Giant Mine Underground Arsenic Trioxide Management Alternatives

Moving Forward: Selecting a Management Alternative

Workshop Summary Report

Prepared for:
Giant Mine Remediation Project
Indian Affairs and Northern Development
NWT Region

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ACRONYMS

DIAND	Department of Indian Affairs and Northern Development (also known as Indian and Northern Affairs Canada – INAC)
ENGO	Environmental Non-Government Organization
GMCA	Giant Mine Community Alliance
GNWT	Government of the Northwest Territories
IPRP	Independent Peer Review Panel
kg	Kilogram
MLA	Member of the Legislative Assembly
MVLWB	Mackenzie Valley Land and Water Board
NT	Northwest Territories
SRK	SRK Consulting
USEPA	United States Environmental Protection Agency
YASRC	Yellowknife Arsenic Soil Remediation Committee

1.0 INTRODUCTION

A workshop on selecting a management alternative for the underground arsenic trioxide dust at the Giant Mine was held in Yellowknife NT on May 26 and 27, 2003. The Giant Mine Remediation Project Team of the Department of Indian Affairs and Northern Development (DIAND) organized the workshop. This was the fifth stakeholder workshop focusing on the management alternatives. The first workshop was held in 1997; the second in June 1999 (focusing specifically on the nature of the arsenic trioxide problem, potential options, and actions that should be considered to appropriately manage the material); the third in July 2001 (to present the Phase I alternatives and research results); and the fourth in January 2003 (focusing on the alternatives for future management of the underground arsenic trioxide dust at the Giant Mine). The May 26-27, 2003 workshop is part of the continuing commitment by DIAND to address the future management of arsenic trioxide dust currently stored underground at Giant Mine. This session brought people together to provide additional public and stakeholder perspectives on moving forward with the selection of a management approach to be submitted by DIAND to the regulatory boards. It built upon the two-day workshop held in January 2003, which presented the findings of the Technical Advisor team and the report of the Independent Peer Review Panel, and on the eighteen public meetings undertaken by DIAND since the January 2003 workshop. The workshop was widely advertised in the local newspaper and on the radio. A range of stakeholders participated in the workshop, including over 20 representatives from:

- *The communities of Yellowknife, N'Dilo, and Dettah*
- *Federal, territorial, and community government agencies*
- *The Legislative Assembly*
- *Health authorities*
- *Environmental non-government organizations (ENGOs)*
- *Industry*
- *Labour organizations (including the Workers Compensation Board)*

The final list of workshop participants is provided in Appendix A.

In addition, the Giant Mine Community Alliance (GMCA) hosted a Public Forum the evening of May 26. A total of 22 participants engaged in a focused and constructive open dialogue.

This report is a summary of the proceedings of the workshop and is organized as follows:

2.0 THE WORKSHOP

2.1 Workshop Purpose and Objectives

2.1.1 Workshop Purpose

The purpose of this workshop was to:

- Provide a forum for further dialogue with participants on the management alternatives;
- Examine, jointly with participants, the issues associated with the implementation of the recommended *in situ* and *ex situ* management alternatives;
- Report back to participants on the work that DIAND and the Technical Advisor have completed in response to the issues raised during the January 2003 workshop and subsequent public meetings; and,
- Gain a sense of the public and stakeholder perspectives on the selection of a management alternative for the underground arsenic trioxide dust at the Giant Mine.

2.1.2 Workshop Objectives

Within the overall workshop purpose, a number of specific objectives were set:

1. To report on what has been heard through the supplementary public information and dialogue process that has been undertaken since the January 2003 workshop.
2. To respond to technical questions raised by participants at the January 2003 workshop and during subsequent public information and dialogue sessions.
3. To discuss and obtain feedback from participants on other issues that need to be considered during the implementation of either the *in situ* or *ex situ* management alternatives.
4. To provide a forum for obtaining comments and additional advice from participants on the public and stakeholder perceptions of the *in situ* and *ex situ* management alternatives recommended by the Technical Advisor and agreed with by the Independent Peer Review Panel.

To achieve the workshop purpose and objectives, a workshop agenda was developed (see Appendix B).

The workshop proceedings were audio and video recorded and placed on the public registry.

2.2. Workshop Process

A number of important factors were considered in designing the workshop to make every effort to find a balance between a range of needs and expectations, to maintain continuity and build on past work, and to provide maximum opportunity for sharing of information and informed discussion.

This required a pragmatic consideration of the factors that often complicate and hold back meaningful discussion of human and environmental risk assessment and management, which include:

- The agenda was designed to bring together a number of initiatives begun at the January 2003 workshop.

- A call for feedback was made at the January 2003 workshop, inviting people to present their views at the May 2003 workshop.
- The IPRP final report was circulated to all participants of the January workshop and the entire IPRP was brought in for the May workshop in order to provide more detail on their review.
- The Technical Advisor attended most of the public meetings and prepared a list of common questions for detailed answering at the May workshop.

The two-day workshop consisted of presentations by Bob Overvold (Regional Director General, DIAND), the Giant Mine Remediation Project Team (DIAND), the Technical Advisor, the Independent Peer Review Panel (IPRP), the Government of the Northwest Territories (GNWT), a Member of the Legislative Assembly (MLA) and the Giant Mine Community Alliance (GMCA). After each presentation, workshop participants were provided with an opportunity to make comments and ask questions. Rita Fabian-Berc, James Rabesca and Violet McKenzie were present to provide simultaneous translation throughout the workshop. Section 4.0 provides a summary of the purpose of each presentation, the key issues raised, questions asked, and the responses provided.

The slides used during each of the presentations are provided in Appendix D.

3.0 THE PROJECT CONTEXT

3.1 Background – What is the Problem?

The Giant Mine, located within the municipal boundaries of the City of Yellowknife, has been producing gold since 1948. In the Giant Mine ore, the gold is associated with an arsenic-bearing mineral, Arsenopyrite, that was roasted to liberate the gold. This roasting process turned the arsenic-rich mineral into an arsenic-rich gas. During the period from 1951 to 1999, operators of the Giant Mine captured the arsenic-rich gases in the form of an arsenic trioxide dust. Approximately 237,000 tons of the dust was then stored underground in mined-out chambers or purpose-built chambers.

Royal Oak Mines Inc. operated the Giant Mine from 1990 to 1999. When Royal Oak Mines Inc. declared bankruptcy the courts conveyed the property to DIAND. In December 1999, DIAND sold the Giant Mine to Miramar Giant Mine Ltd. Liability of the Miramar parent group for environmental conditions of the mine was limited to the assets of Miramar Giant Mine Ltd. Through this transition, the federal government effectively maintained the role of caretaker for the pre-existing environmental liabilities on the property, including the arsenic trioxide dust.

The arsenic trioxide dust is approximately 60% arsenic. Although arsenic is a naturally occurring element, it is known to be toxic to many organisms, including humans, if ingested in sufficient amounts. Currently, the dust is safely contained in the underground chambers. All water coming into the mine and in contact with the arsenic trioxide is collected at the bottom of the mine in the main sump. This water is then pumped to surface where it is chemically treated to remove the arsenic and other contaminants before it is released to the environment. The concern is that, once the pumping system is shut off (and in the absence of other management measures), arsenic could escape the storage areas by dissolving in groundwater. The arsenic-contaminated groundwater would then make its way to Baker Creek and Great Slave Lake, where it would present a hazard to both the environment and human health.

3.2 DIAND's Approach

DIAND, as the agent for the federal government, assumed responsibility for assessing and evaluating management alternatives for the future long-term management of the underground arsenic trioxide dust. In carrying out this responsibility, DIAND is following a phased approach to developing a management plan for the arsenic trioxide dust. Currently, this plan is required to be submitted as an Arsenic Trioxide Management Project Description to the Mackenzie Valley Land and Water Board (MVLWB).

Since 1997, a number of activities and studies have been undertaken by DIAND to better understand the nature of the arsenic trioxide dust problem and to take the necessary actions to address the problem.

In 1999, DIAND held a three-day Technical Workshop with a wide cross-section of stakeholders and technical experts with an interest in the arsenic trioxide dust at Giant Mine. The three-day workshop reviewed the nature of the problem, identified possible management alternatives, proposed preliminary assessment criteria and identified specific actions and next steps to be considered by DIAND.

In 2001, DIAND held a two-day workshop with a wide cross-section of stakeholders interested in the arsenic trioxide dust at Giant Mine. The two-day workshop reviewed the approach being taken by DIAND to address the underground arsenic trioxide dust, presented the work done by the Technical Advisor in terms of examining management alternatives (including the Tier 1 human health and ecological risk assessment), and provided feedback to DIAND and the Technical Advisor on further steps to take in advancing the discussion of management options.

In January of 2003, DIAND held a subsequent two-day workshop, again with a wide cross-section of stakeholders participating, to table the Technical Advisor's report and recommendations on management alternatives. At the same workshop, the results of the Tier 2 ecological and human health risk assessment were made public and the Independent Peer Review Panel (IPRP) presented the conclusions of their review of the Technical Advisor's final report.

Since the January 2003 workshop, and building on the advice provided by workshop participants, DIAND has:

- Continued to hold public meetings in N'dilo, Dettah, and Yellowknife
- Carried out on-going communications initiatives including the maintenance of the public registry, a poster series in center square mall, the development of information kits, and videos in several languages
- Established the GMCA with interested community members and organizations to act as a liaison between DIAND and the public.

The approach being led by DIAND includes the following future phases and projected timeline:

- Recommendation and request for approval to proceed with Project Description; additional studies for Project Description (2003-2004)
- Completion of a Project Description (2004)
- Environmental assessment and regulatory approvals (2005-06)
- Implementation of the management plan (after 2006)

Summaries of DIAND's presentations at the workshop are provided in Section 4.0.

3.3 The Technical Advisor

The technical work initiated by DIAND since the June 1999 Technical Workshop has been directed by a project Technical Advisor. The Technical Advisor consists of a team of engineering and environmental experts, selected through an international, competitive bidding process. The terms of the Technical Advisor's contract specify that members of the team must provide independent technical advice to DIAND, and therefore must exclude themselves from participation in the implementation phase of the project.

The Technical Advisor includes SRK Consulting Inc., Senes Consultants Ltd., H.G. Engineering, and Lakefield Research Ltd. The Technical Advisor's role is to develop and assess management alternatives for the arsenic trioxide dust and provide senior technical expertise and broad-based advice to DIAND. At the January 2003 workshop, the Technical Advisor presented the results of the Tier 2 ecological and human health risk assessment and the Phase 2 alternatives for the management of the underground arsenic trioxide. During the January workshop, a number of questions were raised with respect to the Phase 2 alternatives and other alternatives suggested by participants. For the May 2003 workshop, the Technical Advisor undertook further studies to respond to these questions and suggestions. The Technical Advisor's responses are discussed in detail in Section 4.0.

3.4 The Independent Peer Review Panel

In order to validate the technical and scientific basis of the work being done by the Technical Advisor, and in part in response to feedback received from participants during the July 2001 workshop, DIAND established an Independent Peer Review Panel (IPRP), consisting of nine experts in many aspects of health and ecological issues, permafrost/ground freezing, engineering, hydrogeology and geology.

The IPRP's role is:

> *To provide DIAND with expert, independent peer review of management alternatives for the arsenic trioxide currently stored underground at the Giant Mine, beginning with a review of the Draft Final Report entitled "Arsenic Trioxide Management Alternatives – Giant Mine December 2002" by SRK Consulting Inc.*

The IPRP's objectives are to provide DIAND with:

1. An independent, technical review of the selection process and subsequent assessment of options considered for the long-term management, removal, secure storage or stabilization of the arsenic trioxide-bearing dust stored underground within the Giant Mine.
2. An assessment of any gaps in the data/information collected that are important in assessing the technical and economic feasibility of a long-term management alternative(s).
3. Recommendations as to what additional information or data should be collected or developed to enhance public consultation and support development of a Project Description.
4. A recommendation as to which management alternatives are most likely to lead to a technically feasible, publicly supported and licensable Project Description, given the current level of technology, information and understanding of public health, occupational, and ecological risk.

To date, the IPRP has fulfilled its role by providing feedback to the Technical Advisor on the report tabled at the January 2003 workshop (the vast majority of which was incorporated into the final report) and by producing a written report detailing their feedback and comments on the report tabled. During the May workshop, the IPRP provided its perspective on the *in-situ* and *ex-*

situ alternatives, as well as initial comments on the additional work undertaken by the Technical Advisor in response to questions and suggestions from the January 2003 workshop. The IPRP participated actively in the question and answer sessions and discussions at the May workshop, and were able to clarify a number of technical issues raised by participants.

A summary of the presentations made by the IPRP at the workshop is provided in Section 4.0.

3.5 Other Related Initiatives

In addition to the DIAND approach to managing the underground arsenic trioxide dust, there are other initiatives underway to address other arsenic related matters at the Giant Mine site and the surrounding area. While these initiatives are proceeding independently of the underground arsenic trioxide dust project, DIAND continues to monitor and participate in these other initiatives. Recent related initiatives include:

- Miramar Giant Mine Ltd – development of a mine site abandonment and restoration plan
- DIAND and Miramar reviewing the abandonment and restoration plan to avoid conflicts with the underground management alternatives selected.
- Yellowknife Arsenic Soil Remediation Committee (YASRC) – establishing soil remediation criteria
- Ongoing arsenic research and risk assessment studies by Royal Military College, Queens University

4.0 SUMMARY OF PRESENTATIONS

4.1 Introduction

During the workshop, presentations were made by a number of individuals from DIAND, the Technical Advisor, and the Independent Peer Review Panel, a member of the legislative assembly (MLA) on behalf of the four Yellowknife MLAs and a representative of Resource Wildlife and Economic Development. Presentations were made on the following subjects:

- Public dialogue and communications
- Review of the recommended alternatives
    - The *in-situ* alternative
    - The *ex-situ* alternative
- Community perspectives
- Technical issues relating to questions raised during the January 2003 workshop
- Community Alliance perspective
- The IPRP's response to issues raised on Day One of the workshop

Each presentation is briefly summarized in this section, along with a summary of the questions and answers from the discussion sessions that followed each presentation. The workshop agenda (Appendix B) identifies all of the presentations made.

4.2 Reporting Back on Public Dialogue and Communications

4.2.1 Summary of the Presentation

After a brief overview of the Giant Mine arsenic trioxide management problem, Mark Liskowich, DIAND, and Bill Mitchell, DIAND, reported on the supplementary public information activities carried out since the January 2003 workshop. The presentation touched on completed and on-going communications initiatives, feedback received from the public on these initiatives, the Federal Contaminated Sites Accelerated Action Fund, and the need to move forward. The presentation concluded with a slide outlining DIAND's next steps, which were to:

- Continue to promote a better understanding of the issues within the communities.
- Recommend a long-term management alternative to Headquarters in Ottawa.
- Develop a Project Description for submission to the Mackenzie Valley Land and Water Board.

4.2.2 Summary of the Discussion

The following summarizes the issues identified and the questions (Q) asked by participants regarding the report back on public dialogue and communications given by DIAND. The corresponding responses (R) are also shown. In some cases statements (S) were made that have also been recorded.

Q – Is there any indication of how much money from the Federal Contaminated Sites Accelerated Action Fund is for the North, particularly for Giant Mine?

R – Headquarters is in the process of establishing a framework to deal with contaminated sites. Although they have received no indication of exactly how much funding the North can expect, it is DIAND's understanding that a large part will be directed to the North.

Q – To clarify, exactly how much money is in the Fund? Is it a two-year budget with $75 million set aside the first year, and $100 million in the second year?

R – DIAND is operating on the assumption of a five-year program, but will ask Headquarters for confirmation.

Q – What is the Giant Mine budget? Where is current funding coming from?

R – Giant Mine has historically been funded through the Financial Management Committee. Last year approximately $6 million was spent on maintenance, care and technical work.

Q – Is there an internal supply of money for Giant Mine?

R – Yes, there is a Plan B option, where funding would be provided from the A-base. At this time however, the Minister has not finalized approval for the continuation of A-base funding. DIAND does expect approval shortly.

Q – What is Bob Overvold's participation level in this meeting?

R – Bob Overvold will be attending the workshop until his morning meeting. He will return again this afternoon (May 26th) and again tomorrow morning (May 27th).

Q – This question relates to funding for the ongoing work at Giant until the implementation of a management plan begins. I am aware that there is a Treasury Board process for accelerated clean up. If implementation will not begin until 2007, then my question is, who has the power to accelerate this project? Here in the NWT, where can we look now for answers?

R – DIAND will remain responsible. DIAND will be working with the Treasury Board this summer and could possibly arrange a community meeting if there is interest.

Q – The Canadian Arctic Contaminants Assessment Report addresses a list of contaminated sites, including a large section specifically on Giant Mine. This was not mentioned in your presentation. Are all of DIAND's commitments being considered? Or just those of the project team?

R – The presentation dealt with commitment issues that refer directly to Giant Mine. All initiatives discussed are specific to Giant Mine.

Q – Was the Giant Mine Remediation Project Team involved in putting together the Canadian Arctic Contaminants Assessment Report? If not, have they seen the report?

R – Members present at the workshop were not personally involved in putting together information for the report, although the Headquarters Contaminated Sites team and the Contaminants Division were involved in producing the report.

Q – What is the process for moving the project forward and deciding on a Project Description? How will the public be involved?

R – The final decision making process is not yet totally clear. The Giant Mine Remediation Project Team will send their recommendation to Bob Overvold and the Senior Management team, which will then work cooperatively with Headquarters. Who will have the final word remains unclear. It is expected that when the Project Description is done, the Deputy Minister will bring the final recommendation forward to the Minister.

Q – How will the process be communicated to the public? How can the public influence the decision making processes?

R – The Community Alliance will act as a bridge between DIAND and the communities. They will act to keep the public informed to the best of their ability.

Q – Is this in the Communications Plan?

R – Over the next year, the Project Team fully intends to keep the public informed. Information sessions will continue all the way through to the presumed environmental assessment.

4.3 Review of the Recommended Alternatives

4.3.1 Summary of the Presentation on the Recommended *In-Situ* Alternative

Dr. Jean-Marie Konrad, IPRP, gave a presentation on the *in-situ* alternative recommended by the Technical Advisor. The presentation began with a slide listing the IPRP evaluation criteria, which had been presented previously at the January 2003 workshop (Appendix C). The presentation continued by explaining that the *in-situ* alternative is an arsenic management alternative that freezes the arsenic trioxide in place. Three freezing options were considered in the Technical Advisor's final report: re-establishing natural permafrost, freezing around the chambers and stopes (Alternative B2 – Frozen Shell), and freezing the entire area around and within the chambers and stopes (Alternative B3 – Frozen Block). The risks involved in both the frozen shell and frozen block alternatives were recognized. Based on the implementation issues and risks involved in the three *in-situ* alternatives, the IPRP found the frozen block alternative to be the most feasible. Dr. Konrad's presentation continued by providing many examples of the successful use of artificial freezing in construction and mining projects, including: Boston central artery, Kobe (Japan), McArthur River uranium mine (Northern Saskatchewan), Helsinki Metro (Finland) and large excavations. Next, examples of where frozen blocks exist in nature, namely the massive icy beds (McKay, 1973) and frozen esker (Ham Lake – Izok Lake), were discussed. Dr. Konrad then

presented the IPRP's observations/recommendation on the issues related to the implementation of ground freezing and concluded with a list of issues that would need to be addressed prior to implementation of Ground Freezing.

4.3.2 Summary of the Discussion

Q – In Dr. Konrad's presentation, the IPRP Evaluation Criteria were shown. These are the criteria that will be used to make a recommendation and if they do not reflect public input, then they may not be complete. The criteria should be added to the IPRP report and used to complete a formal assessment of the alternatives. It is unclear how these criteria relate to those in supporting document 18 to the Technical Advisor's report. Would it be possible for a copy of these criteria to be made available? Also, can an explanation on how they were developed and applied be given?

R – The slide listing IPRP evaluation criteria was presented in the January workshop. These criteria were used by the IPRP to evaluate each alternative. This is demonstrated by the Frozen Shell option, which clearly does not meet all the criteria. Proven technology must come into play so we have some justification for believing it will work in the case of Giant Mine. It is also important to use proven technology in determining an option that stakeholders and the public will accept. As the criteria were applied, the frozen block option was shown to be more robust than the frozen shell option, which is why it became a more important option.

R – The Technical Advisor also made use of these criteria. The first three criteria were used to narrow down the alternatives from the 56 options originally considered. Robustness was addressed in supporting document 18 to the report tabled in January, and will be discussed again this afternoon as part of the Technical Advisor's presentation. Monitoring did not have a central role in the Technical Advisor's evaluation because all options would require a similar level of monitoring. The IPRP and the public have shown an interest in the details of the required monitoring. The Technical Advisor agrees that the monitoring will be an important part of the Project Description.

Q – From the IPRP list of criteria, can the word 'potentially' be removed from in front of 'long term solution' and 'economically' from before 'monitoring performance'?

R – Such a list of criteria is to be used as a guideline and a means of improving options. Arguing about wording is valid to some decision-making but in a complex decision-making task like this, it is important to focus on the overall objectives – reducing long term, short term, and worker health and safety risks.

R – The evaluation criteria were solely those of the IPRP. They were presented today to show that they took their job seriously and show that the IPRP had a direction.

S – The primary objective should be to minimize perpetual care requirements, therefore the list of objectives presented is not complete. It is important to note that supporting document 18, based on these objectives, is driving the options that are now on the table.

R – The terminology "minimizing perpetual care" is different, but the idea was taken into consideration when the Technical Advisor evaluated what it calls "long-term risk", and the IPRP assessed the robustness of alternatives.

Q – Baker Creek flows close to one of the mine chambers. Will the freezing option work on this chamber?

R – One chamber is under Baker Creek. For the freezing option to work, you would have to ensure a surface solution, perhaps by using culverts. This issue will be part of the design stage, in which each chamber or stope will have to be addressed as an individual site to be planned separately, according to its unique characteristics, such as its geometry and size.

R – The Technical Advisor has considered that there will have to be some modification to some of the chambers and these added costs have also been factored into cost implementation estimates.

Q – Did the IPRP look at potential flooding during construction, such as occurred at MacArthur River [where serious mine flooding has taken place]?

R – There have been at least two incidents of Baker Creek overflow going into Giant Mine. Therefore, the IPRP recommended a hydrogeological review and improvements to dams in order to avoid problems in the future.

R – It should be noted that the geological environment at MacArthur River is very different from that at Giant Mine. The flooding at MacArthur River was not caused by a failure in the freezing methods being used. Giant Mine is a much less permeable type of rock. Therefore, the predicted flows of water are lower and would be confined to manmade routes in the rock such as drill holes and mine workings.

Q – Is the freezing equipment underground?

R – This is not yet completely clear. The conceptual design has assumed freezing plants at the surface with pipes drilled from below.

Q – Have the costs associated with the IPRP's recommendations been factored into the Technical Advisor's report?

R – Not all of the costs have been incorporated. The cost of a demonstration project has not yet been included, although it would be a cost common to all the alternatives. The timing and duration of a demonstration project would have to be decided before a cost could be assigned. However, the IPRP's recommendations would not likely result in a change in the alternatives recommended by the Technical Advisor and therefore the costs should not vary dramatically.

Q – It was mentioned that it may be possible to circulate cold air to support the freezing process. How can you do this without opening another channel for the infiltration of water?

R – The design indicates a temperature driven system that would be sealed off from its surroundings. It would only open up when the temperature is below a certain level.

Q – Would there be dedicated vents for each chamber?

R – Yes, these vents are located at the top of the chambers.

Q – Was the cost of the cold air circulation system included in SRK's costing analysis?

R –There are a number of ways to keep the ground frozen. One of them is to use thermosyphons. If additional cold air vents were used to encourage freezing and maintain the frozen block, it would result in a lower cost for this option than the use of thermosyphons alone. SRK's cost analysis is for the use of thermosyphons alone.

Q – What are the infrastructure, maintenance and other costs involved in using the thermosyphons?

R – The longest time thermosyphons have been used to date is for approximately 25 years, on the Alaska Pipeline. There are a number of reports written on thermosyphons, and they have found that some maintenance is required over the years. However, when infrared photography is used to monitor the freezing, this maintenance is not onerous. The reports on the thermosyphons from the Alaska Pipeline will be made available to anyone who is interested.

Q – What is the reversibility of the frozen block option if new, better technology for dealing with the problem is developed in the future?

R – It is possible to mine the frozen material, bringing it to the surface to use this new technology. With regards to thawing, tests need to be conducted to see if melting will have any effect on the

nature of the arsenic trioxide dust. At the moment, the dust is thought to freeze in an unrestricted way, which would mean that the material would just settle again if it were thawed. This would not necessarily create a lot of problems, as the material would still be contained.

R – Several of the examples presented by the IPRP involved reversing the freezing process after the construction work was completed. It is a matter of design to ensure that freezing and melting takes place in a proper manner.

R – Freezing has also been used in potash mining in Saskatchewan. The area was later thawed and the IPRP is not aware of any detrimental effects.

Q – Are there specifics available on the coordination of surface and below ground remediation?

R – This recommendation was meant to address the coordination of the reclamation of the surface areas (e.g. the tailings, Baker Creek, etc.) with the *in-situ* management alternative.

R – The Technical Advisor is not required to address surface remediation, only underground arsenic trioxide management.

R – The water license makes clear that the underground arsenic trioxide management should be part of the overall abandonment and restoration plan.

4.3.3 Summary of the Presentation on the Recommended *Ex-Situ* Alternative

Larry Connell, IPRP, gave a presentation on the *ex-situ* alternative recommended by the Technical Advisor. Mr. Connell's presentation began by explaining that the *ex-situ* alternative refers to an alternative in which the arsenic trioxide would be removed from its current underground location, brought to the surface, stabilized by one of several potential process methods and then stored permanently on the surface in a secure landfill. Two *ex-situ* alternatives – cement encapsulation and bitumen encapsulation – were mentioned in the presentation. The IPRP agrees that the cement encapsulation is currently the more feasible of the two options and focused on this alternative in its presentation. Mr. Connell explained that cement encapsulation meant that the arsenic trioxide dust would be mixed with cement, sand, aggregate and water to form a weak concentrate, which would then be stored in a surface landfill and covered with a low permeability cover. Mr. Connell went on to identify what is involved in this alternative, specifically: extraction of the dust from underground, cement encapsulation, placement in a lined and covered surface landfill, long term care of landfill and leachates, and pumping and treatment to remediate dust left behind. Schematic examples of the secure landfill and long-term risks associated with encapsulation were shown.

The presentation concluded with a slide on the pros and cons related to cement encapsulation:

- Pros:
  - Majority of the dust is no longer underground
  - Material is stored on surface where condition of cement stabilized material is more visible.
- Cons:
  - Not all of the dust can be removed from the underground vaults.
  - Difficulty in selection and approval of suitable site.
  - Surface landfill; what are the long-term maintenance requirements.

4.3.4 Summary of the Discussion

Q – Where would the materials for the layers [covering the landfill] come from?

R – That engineering research has not yet been done so detailed information is not available. Further research needs to be done, although it is probable that some material will come from around Giant Mine and the rest will have to be hauled in.

Q – Why are you suggesting Southern technology for a Northern climate, where snow is more of a concern than rain?

R – The landfill lining and covering method is a proven technology for northern as well as southern climates. In addition to snow, Yellowknife has wet periods in the spring and fall.

Q – Does the issue of the treatment of sludge have to be addressed no matter what option is chosen?

R – Yes. The treatment of sludge is a component of all alternatives.

Q – The Technical Advisor suggests that approximately 2% of dust will not be collected. What mining methods were considered in making this estimate?

R – This 2% is a cautious estimate after all mining methods, including restoping, are used. This 2% will be recollected through water treatment and pumping and was used to estimate the costs associated with these activities. However, the 2% figure is an estimate and a sensitive number due to the economics of the issue. It is extremely difficult to be precisely sure how much dust will not be collected.

R – The 2% is an estimate, but it is as good a number as can be put on the table at this point.

Q – What is the stability of the cement encapsulation mix? Will it leach? Will there be chemical reactions?

R – The design of the cement encapsulation option is extremely important. The Technical Advisor studied leachability and found that cement does not stop water solubility of the arsenic, but it does decrease the chance of water coming into contact with the arsenic trioxide. However, the chance of water contact is not eliminated. For example, the cement could crack and water could get in. Therefore, the landfill holding the cement mixture must be able to cope with any water that may get into the cement and flow out containing arsenic trioxide.

Q – What is the lifespan of such a landfill?

R – The lifespan of such a landfill is unknown, as they have only been built in the last 20 years. The material will fail at some stage and it would need care and maintenance. An engineering system will have to be put in place to deal with leaching and water treatment. The lifespan of the liners may be 50-100 years, but they will eventually need repairs and a system must be put in place to address this for a long time.

Q – In the frozen block alternative, would any of the remaining 2% be outside the frozen zone?

R – Yes, but there would be less outside the frozen zone because of the large area that would be frozen. In the Technical Advisor's calculation, however, it was assumed that the 2% would remain. Therefore, as soon as the block is frozen, a water treatment system would be put in place.

R – The IPRP considers that the 2% assumption is likely correct when the frozen block is maintained at a temperature of 0^{0}C. However, if the IPRP's recommendation to freeze the block to –2'C is taken into account, the extent of the surrounding zone frozen to at least 0^{0}C expands, and the amount of arsenic that would be outside the 0^{0}C zone decreases to below the 2% estimate.

Q – Is there too much uncertainty to apply different predictions of remaining arsenic trioxide to each alternative? 2% is still a lot when dealing with such a large amount of arsenic trioxide.

R – Too much uncertainty exists to give a different number estimate to different alternatives. Yet removing 98% is substantial, especially when the remaining 2% can be retrieved and removed through water treatment. The amount of arsenic trioxide leaching into the water would, in the short term, be the same as it is now. Therefore, the assumption is for 20 years of intensive water treatment to address the remaining 2% of the arsenic trioxide.

Q – Which alternative, ex-situ or in-situ, is more sustainable?

R – Both options are sustainable, otherwise they would not be on the table for further discussion. In both cases the arsenic trioxide would be secured and in both cases new solutions could be applied in the future, as they emerge.

4.3.5 Summary of the Presentation on Methods for Extracting the Arsenic Trioxide Dust

C. O. (Chuck) Brawner, IPRP, gave a presentation on the proposed method for extracting the arsenic trioxide dust from Giant Mine, should the recommended *ex-situ* option be the one carried forward. Mr. Brawner began by stating the objectives for arsenic trioxide dust extraction, which were to: recover a minimal of 98% of the dust, use safe proven mining technology, minimize costs, optimize the product, reduce uncertainty of the outcome and achieve an acceptable overall schedule. The presentation continued by identifying the assumptions and constraints that are involved with arsenic trioxide dust extraction. Mr. Brawner outlined the numerous complex conditions for mine design and arsenic trioxide dust extraction. A proposed extraction method was then presented, along with the difficulties involved. Mr. Brawner then reinforced the following concerns that he felt required consideration if the arsenic trioxide dust was to be extracted:

- The proposed program [of arsenic trioxide dust extraction] is unique – there will be a definite learning curve.
- Exact measurements of the stopes are unknown.
- Moisture profile of the dust is unknown – must be determined by geotechnical drilling.
- Do not know how much arsenic dust will be left around the stopes to later leach into groundwater.
- The extraction process will be slow: 10-20 years.
- All openings that intersect the stopes must be cleaned of dust. Vent curtains and bulkheads may be required.
- Winter mining is not recommended.
- The cemented gravel roof may require rock bolts and shotcrete to provide stability.
- The mass mining area must be well ventilated.
- Where wet dust is mined and trucked, the roadway must be stabilized.
- There will be exposure to arsenic dust during mass mining – employee health must be protected. Protective clothing and filter masks are mandatory – mining efficiency will be reduced.

The presentation concluded with a slide on the risks involved in dust extraction. The major risks identified by Mr. Brawner include:

- Potential instability of walls of the stopes.
- Some arsenic dust will not be removed.
- There are many factors that cannot be quantified accurately so that errors in cost estimates are potentially high.
- The time of total dust extraction is estimated to be long: 10-20 years unless several mining units are used.
- During mass mining of the lower stope area, miners must be protected from the arsenic dust. Even with protective clothing and filter masks, health issues are a concern.

4.3.6 Summary of the Discussion

Q – Should there be concern over the hydrostatic qualities of the arsenic trioxide dust?

R – The dust tends to be water repellent, but it is possible to add surfactants, similar to those found in detergents, to solve the problem.

Q – Has any other recent testing been done [to determine the characteristics of the arsenic trioxide dust]?

R – No. The Technical Advisor relied on information from others who have dealt with the arsenic trioxide dust in the past. There is some indication that the dust may have picked up some moisture over the years, reducing the potential for water repellence. In the case where the dust is water repellent, it is possible to deal with this problem by adding surfactants. Additional geotechnical work will be required to determine the state of the dust and the degree to which it repels water.

Q – Is there a criteria to compare worker health and safety from previous mining at Giant Mine?

R – No, as the historical information is unavailable. The Workers Compensation Board should have this information.

Q – What are the Workers Compensation Board's criteria for worker health and safety in an arsenic trioxide area?

R – The only procedures currently in place are those related to exposure to chemicals put in place at Con Mine, not to mining the arsenic trioxide. Procedures would need to be put in place to deal with the health and safety of workers in a high arsenic trioxide environment.

R – There are limits to exposure and protective clothing will definitely be required.

Q – Has borehole mining ever been used to remove contaminated materials elsewhere? If so, what have been the results?

R – Borehole mining has been applied to a wide range of materials, but the IPRP has found no examples of its use on contaminated sites.

R - A preliminary test could be done to see if it works, but the IPRP believes that the materials and processes used at other sites are compatible with the conditions at Giant Mine. However, much more needs to be done to deal with this issue.

R – Approximately 15 years ago, the arsenic conditions in eight stopes were investigated. This investigation used conventional mining practices as well as a modified airlift method to sample the arsenic. Very strict health and safety protocols were used, including protective gear. The investigation could be revisited as a source of information since it was successful and strictly supervised. This investigation brought up some dry samples, but also some completely saturated

samples. Therefore, there is some knowledge of the character of the arsenic trioxide dust, although more work would be required in the design phase to flesh out this knowledge.

Q –Other toxins are also in the stopes. Where the cumulative effects considered?

R – No, the cumulative effects were not considered. While it is important to worry about these other toxins, right now, the major concern is the arsenic trioxide. There may be some information available on the cumulative toxicology in humans, but arsenic trioxide is bad enough on its own. The protective work suits that would be required are heavy, self-contained, and require a breathing apparatus. The maximum work time for an individual wearing such a suit would be approximately two hours. Therefore two shifts would have to be operating at all times, and additional personnel would be required to help workers put on and take off their protective equipment. This is a big process and there is a lot that needs to be considered.

4.4 Community Perspectives

4.4.1 Summary of the Presentation from Local MLAs

Bill Braden, MLA Great Slave, gave a presentation (including a formal signed written position) on the MLA position on behalf of Sandy Lee, MLA Range Lake; Brendan Bell, MLA Yellowknife South; and Charles Dent, MLA Frame Lake. The presentation touched on the history of the Giant Mine and the arsenic trioxide issue, the review and consultation process undertaken by DIAND to date on this issue, the MLA's position on management alternatives for the arsenic trioxide dust, and the need for on-going care and commitment to the issue.

With respect to the review and consultation process to date, Mr. Braden's presentation indicated that "the panel has done a very satisfactory job in process", that "the efforts of the Community Alliance, while they got off to a rocky start, are back on track", and that the MLAs recognize that "concerned citizens, and other credible experts, will have ample opportunity to further challenge findings and decisions as the process continues". With respect to the management alternatives, the presentation indicated that the MLAs "reject any surface treatment/management option for the arsenic" and "are, with the information presented to date, relatively confident in the underground freezing option".

The MLAs concluded, "our city, and the federal government, must acknowledge that we have a perpetual management issue" and requested that DIAND "impress on Canada that we are continuing to rely on its commitments to see this problem through to an effective resolution".

4.4.2 Summary of the Discussion

Q – Your presentation referred to a "Panel" which made presentations to the MLAs. Who did the use of "Your Panel" refer to? The IPRP?

R – When speaking of "The Panel," I was referring to officials with the Giant Mine Remediation Project who met with the MLAs, not the IPRP. Sending a clear, strong message to Ottawa is a valid point to consider, especially in dealing with the federal government, as issues tend to have a short life. We have seen issues come up and then disappear again. We wanted to take the initiative in this public hearing to send the message that this is a critical issue to the community and the message that this is not an optional project needs to be sent to Ottawa.

Q – Did you read the IPRP report? Given the IPRP's view concerning pilot projects, would the MLAs want a pilot project to be carried out?

R – If it is a prudent and reasonable step, then yes. The question is to what extent do MLAs want to be involved. We still favor the "do not disturb", *in-situ* option. If a pilot project shows that this is not the best option, then we are willing to have some flexibility to rethink this alternative.

R – The IPRP recommendation for verification testing was not intended to be a condition for accepting a management option. Rather, the testing was considered to be a prudent aspect of developing and implementing the design of the chosen option.

4.4.3 Summary of the Presentation from the GNWT

Emery Paquin, Director of Environmental Protection - RWED, presented a submission from the GNWT. Mr. Paquin's presentation focused on the importance of minimizing the risk of arsenic release in the long term, stating that the long-term eco-system and human health risks are considered by the GNWT to be the highest ranking decision-making criteria. Taking that as the key consideration, and otherwise relying only on the analysis carried out by the Technical Advisor, leads the GNWT to conclude that alternative C – Deep Disposal could be rated higher than or equal to Alternative B3 – Frozen Block. Therefore, the GNWT recommends that DIAND conduct another year of studies to obtain further information on the deep disposal alternative and the need to have more community input on the outcomes of a comparison of the frozen block and deep disposal alternatives prior to making a final recommendation to DIAND senior management. The presentation concluded with the following summary:

- The final management alternative must effectively isolate the arsenic from people and the environment, be feasible to implement, minimize short or long term environmental and worker risks, and not require maintenance in perpetuity.
- "Cement encapsulation" or other "*ex-situ*" alternatives should not be brought forward as a preferred management method.
- Based upon the available information, the "deep disposal" and "frozen block" alternatives represent the two best identified alternatives.
- Further study into the "deep disposal" alternative and specifically groundwater movement and interactions and worker safety, need to be undertaken over the next 12 months before a recommendation is submitted to INAC senior management.

4.4.4 Summary of the Discussion

Q – The GNWT does not support the cement encapsulation ex-situ alternative, but what about other ex-situ options like scorodite and deep disposal? Would the GNWT reconsider their position?

R – The GNWT looked specifically at SRK's options. If deep disposal would isolate the arsenic effectively, then scorodite transformation would likely not be required.

Q – Who is responsible for the surface clean-up at Giant Mine?

R – This issue has not yet been decided. Negotiations are taking place, but they are in their early phases.

4.5 Reporting Back On Technical Issues

4.5.1 Summary of the Presentation

Daryl Hockley, leader of the Technical Advisor team, reported back to participants on the additional research and analysis undertaken in response to questions raised during the January 2003 workshop and subsequent meetings in Ndilo, Dettah and Yellowknife. Mr. Hockley's responses were grouped into the following three categories:

1. Questions about alternatives B3 (Frozen Block) and G1 (Cement Encapsulation)
2. Questions about Risk

3. Suggestions for new or revised alternatives

Questions About Alternatives B3 (Frozen Block) & G1 (Cement Encapsulation)
In this section, Mr. Hockley answered three questions that were asked during the January workshop and subsequent meetings in Ndilo, Dettah and Yellowknife. The first question was in regard to the monitoring of animals and fish. Mr. Hockley made it clear that monitoring is part of all alternatives and the design of monitoring is considered to be part of the development of the Project Description. The second question asked about the possibility of earthquakes and cave-ins of the chambers. Mr. Hockley gave a detailed answer using various diagrams and concluded that for *in-situ* alternatives you would need to backfill pits and stopes to prevent collapse and for *ex-situ* alternatives a very cautious approach to the extraction of arsenic trioxide dust would be required. The third question was whether the ground freezing alternatives would still work after global warming. Mr. Hockley used a visual display to conclude that ground freezing would still work in the event of global warming although it might slightly increase the cost of freezing, as the use of thermosyphons would be increased. Climate changes would need to be considered in the design of the project.

Questions About Risk
In this section, Mr. Hockley answered three questions that were asked during the January workshop. The first question whether the risks of government neglect were taken into consideration in assessing "long-term risks". After comparing the definitions of "high", "moderate", "low", and "very low" risks, Mr. Hockley concluded that a low long-term risk of arsenic trioxide release meant that maintenance must be completely absent for decades or centuries before the rate of arsenic release would reach Health Canada's provisional daily tolerable intake. The second question was in regard to worker health and safety risks. After a detailed report on the risks involved, Mr. Hockley concluded that worker health and safety risks are moderate (moderate meaning significant physical safety risks and significant health risks from exposure to arsenic trioxide and other toxins) for all alternatives that require the removal of the arsenic trioxide. The last question in this section concerned overall risks and whether the long-term risks of arsenic trioxide release should be considered more important than worker health and safety risks. In response, Mr. Hockley concluded that the risks to worker health and safety would be immediate and significant, whereas risks to public health would only become significant in the hypothetical case of decades or centuries of complete neglect of the property and complete absence of environmental or public health monitoring. Therefore the Technical Advisor team stands by its earlier approach of giving worker health and safety risk equal emphasis as long-term risks. Mr. Hockley also stated that the IPRP agreed with the importance of worker health and safety risks, as acknowledged in the IPRP's report.

Suggestions For New or Revised Alternatives
The first question in this group was why the deep disposal alternative had been rejected. The answer reviewed the reasons for its original ranking and case histories of deep disposal elsewhere, and identified that the common problem in these cases is the requirement for intensive groundwater characterization and that the investigation requires many years or decades to complete. The conclusion reached about the deep disposal alternative was that it could not compete with ground freezing as an *in-situ* alternative. It could compete with cement encapsulation as an *ex-situ* alternative, but the permitting process would require many more years of study. The second question asked about using mix and match alternatives to reduce long-term risk. Mr. Hockley reviewed SRK's findings and concluded that:

- While alternatives that mix and match portions of Alternative G1 with other alternatives do lower long-term risks, the long-term risks associated with Alternative G1 are already low.
- Mix and match combinations that increase the handling of the dust may cause worker health and safety risks to increase.
- Mix and match methods would significantly increase costs.

Another question was whether or not some of the dust could be re-processed to recover gold. After comparing the reprocessing costs and the value of the potentially recoverable gold, the Technical Advisor concluded that the partial re-processing of the highest value stopes would not pay for itself, but could reduce the overall cost of the remediation project.

The final question answered was whether it was possible to start with seepage control, then try out other alternatives before eventually implementing the best option. The Technical Advisor identified a number of positive and negative points associated with this option before concluding that it would be preferable to have agreement and support on one preferred method, but that implementation of the preferred method could involve several steps. For these reasons, the frozen block and cement encapsulation remain the Technical Advisor's preferred alternatives. Both could be implemented in a series of steps that would allow pilot testing.

During the next part of his presentation, Mr. Hockley reviewed the two preferred alternatives – frozen block and cement encapsulation – and gave detailed explanations of the steps involved in each alternative, applications elsewhere, site specific investigation, conclusions regarding risk, and conclusions regarding cost.

4.5.2 Summary of the Discussion

Q – What are the IPRP's thoughts on the discussion of long term risks provided by Technical Advisor today?

R – This is the first time the IPRP has seen this information. They will discuss it overnight and give a preliminary response tomorrow [see Section 4.7 of this report]. They will then follow up with a formal, written analysis.

Q – Where does the Workers Compensation Board sit with regard to short term and long term worker health and safety risks? Do they share the Technical Advisor's outlook?

R – The accident statistics presented by the Technical Advisor are an average. The actual rate could be lower, depending on the training provided and methods put in place. There would be a cost associated with such training, etc., but the cost need not be that high. The statistics presented make the risk of accident seem greater than it could be if strict procedures and processes were put in place.

R – It is possible to put in place procedures to minimize risk. Using cautious procedures, contact with arsenic trioxide can be minimized. It is possible to sufficiently reduce worker health and safety risks.

R – Participants should remember that the arsenic trioxide is a carcinogenic substance in a highly available form. Any contact at all with the arsenic trioxide represents a risk, even if strict procedures are in place.

S – Kevin O'Reilly received the Technical Memo associated with the Technical Advisor's presentation on the Friday prior to the workshop. Today's presentation includes further new information. It would be preferable to receive this information well in advance so that it can be understood.

R – Part of the purpose of this workshop was for the Technical Advisor to report back in public on the further work that has been done in response to questions raised at the January 2003 workshop. The Technical Memo was an internal memo from the Technical Advisor to DIAND and was provided to some workshop attendees on a courtesy basis.

Q – The dollar figures on page 5 of the Technical Memo do not match the numbers shown in today's presentation. Why are the numbers lower in the presentation?

R – There is a difference of $30 million out of $550 million because the numbers were rounded for the presentation.

Q – In the second paragraph on page 2 of the Technical Memo, there is mention of a need to establish a separate chamber pumping system for deep disposal. Why is pumping needed? Is there interchange with ground water?

R – In the deep disposal alternative, the arsenic trioxide is mixed with water to form a slurry, which will flow by gravity down to the deep disposal chambers. Pumping refers to the areas where arsenic trioxide is not removed and the contaminated water needs to be pumped out. It is necessary in all of the alternatives.

Q – In regard to autoclaves, it was mentioned that you would have to pay to use the autoclave at Con Mine. However, if Con Mine does close in the next few years, will DIAND not own it? Can you therefore offset the cost of building an autoclave?

R – The total cost of the alternative includes building an autoclave or purchasing the use of an autoclave. There are several ways that the autoclave at Con could be used, but it is not the whole solution.

Q – Can arsenic trioxide be absorbed through the skin? Has there been any follow up testing to the work done by Health Canada? What other toxicology data is relevant?

R – Yes, arsenic trioxide can be absorbed through the skin. However, toxicology information emphasizes workers' exposure through air pathways.

R – Discussions are currently taking place with regard to follow up bio-monitoring. The IPRP would like to see these studies carried out to see if new information becomes available as a result.

R – New data has become available from Bangladesh with respect to arsenic trioxide in drinking water. As a result, the USEPA threshold for arsenic in drinking water has been lowered.

S – Much of the information available is related to chronic exposure to arsenic trioxide. The participant's interest is in acute exposure.

Q – Will the IPRP provide something in writing on the presentations by the GNWT and the Technical Advisor?

R – They will give a brief oral report back tomorrow, with a written document to follow.

R – DIAND is committed to having the IPRP provide on-going review of new materials, including those presented today and the Project Description.

4.6 Community Alliance Perspectives

4.6.1 Summary of the Presentation

Steve Petersen, GMCA, reported back on the public forum that was held on the evening of May 26th 2003. Mr. Petersen's presentation touched on the role and mandate of the group and the initial results of the questionnaire that had been distributed to the community in April 2003. The presentation concluded with key points and questions raised during the forum, including:

- The need for an integrated vision from DIAND for 10, 20, 30 years in the future.
- The need to engage younger people in the process, as they will be responsible for carrying the project through to completion.
- The extent of consultation with local First Nations communities, including the Métis.
- The resources available to the GMCA.

Walt Humphries, GMCA, provided additional comments about the excellent work done to date by the IPRP. He indicated that experienced miners and prospectors seem to support the *in-situ*

alternative and that, in his opinion, cement encapsulation was not a viable option. Mr. Humphries also emphasized that site monitoring and ongoing cleanup activities must continue to meet the requirements of ENGOs while a solution for the underground arsenic trioxide problem is being developed. He concluded that, as the process of developing an alternative continues, an overall vision for the future of the Giant Mine is needed that brings together the underground and surface clean-up, the salvaging of buildings and equipment, and potential uses for the site. DIAND must continue to keep the public informed by publicizing initiatives related to the clean-up of the Giant Mine site.

Lynda Comerford, GMCA, also commented on the role of the GMCA. In particular, she described the GMCA as a communications bridge between the Giant Mine Remediation Team and the public, to ensure that questions and issues are raised and that a comfort level exists with the situation and the potential remediation activities. Ms. Comerford would like to see a long term plan for addressing the Giant Mine site, but stated that the role of the GMCA is not to advocate for a particular outcome, but rather to ensure that the chosen solution is clearly understood by the public.

4.6.2 Summary of the Discussion

S – During the public forum the previous evening, Dr. Chris Paci committed to ask the National Chief of the Dene Nation about the Nation's position on title to the Giant Mine site. This has been done. The title issues are not clear. However, the property rights are clear, as is DIAND's responsibility and obligation to clean up the site. The Dene Nation would like to see a good job done in cleaning up the site and will take part in the process in support of this outcome.

Q – What does the Community Alliance see as the next steps for moving forward?

R – The Community Alliance is not a proactive group, but a monitoring group. They want to ensure that a commitment to the clean up of the arsenic trioxide at Giant Mine is made, and that action takes place now. The Community Alliance also feels that DIAND needs to publicly state this commitment.

R – The Community Alliance acts as a bridge between DIAND and the public. Their role is to get answers to the questions of members of the public. The Community Alliance will move forward with whatever alternative is recommended as long as they are kept informed as to why this solution was chosen.

R – All of the available information regarding the alternatives is extremely technical. It is important to keep it simple, and use as many mediums as possible to get the issue out to the public. In the last six months, people have shown increased interest and understanding of the issues because the communication lines have been opened up. By keeping the communication lines open, public trust will increase.

Q – What does DIAND see as the next steps for moving forward?

R – DIAND agrees with the Community Alliance that dealing with technical information is a challenge and that increased communication between DIAND and the Community Alliance is necessary. The Giant Mine Team is also moving up a steep learning curve. The Community Alliance is working well and has been very productive – for example, the questionnaire was a successful initiative. DIAND would like to see the collaboration between the Giant Mine Team and the Community Alliance as a model for the management of other contaminated sites.

R – DIAND also believes that it is important to have a vision. They want to work with the Community Alliance and the public to create such a vision. The vision should encompass the remediation of the entire site.

R – The IPRP agrees that enough study and research has been done to make a decision about which alternative to move forward with.

4.7 IPRP Report Back on Day One Issues and Concerns

4.7.1 Summary of the Presentations

Fred Matich, Chair of the IPRP, introduced the IPRP report back by indicating that the panel had reflected overnight on the presentations made during Day One of the workshop and, specifically, on the deep disposal option. The Panel was willing to make some preliminary statements in response to issues raised during Day One (in particular those voiced by the GNWT), and committed itself to providing a written response at a later date.

The IPRP chose to focus its comments on two alternatives, the frozen block and deep disposal, as it heard during Day One that there was little support for the cement encapsulation option. The Panel's preliminary response focused primarily on risk issues, although other issues were also considered.

Steve Hrudey, IPRP, introduced the subject of risk by providing an overall perspective on risk management, which identified five key elements of risk:

1. The nature of the hazard (in this case, the toxicity of the arsenic trioxide dust)
2. The probability that an incident will occur
3. The harmful consequences of an incident occurring
4. The timeframe associated with the probability of occurrence
5. What matters most to those who would be affected

All five dimensions must be considered if a clear understanding of the overall risk is to be achieved. It should also be made clear that the level of risk for any option will be different for different potential incidents. For example, the risk associated with a significant release of arsenic trioxide (as defined in the human and ecological health risk assessment carried out by the Technical Advisor) is not the same as the risk associated with a full-scale disaster. From a risk analysis perspective, the IPRP does not believe the deep disposal alternative has been subject to the same level as the frozen block alternative.

The remainder of the IPRP's presentation focused on three issues:

- The worker health and safety issues associated with the deep disposal option (presented by Chuck Brawner).
- The risk of long-term release associated with the deep disposal option (presented by Ken Raven).
- The risk of long-term release associated with the frozen block option (presented by Dr. Jean-Marie Konrad).

Worker Health and Safety Issues – Deep Disposal Option
Chuck Brawner, IPRP, indicated that the worker health and safety risks associated with the deep disposal option had been underestimated by the Technical Advisor. The IPRP felt that the option should have received a "moderate-high" rating on this risk factor, rather than a "moderate" rating. Mr. Brawner explained that excavating the deep caverns in which to store the dust and moving the dust into those caverns would increase the number of miners involved in the operation and, therefore, the risk to worker health and safety.

Risk of Long-Term Release – Deep Disposal Option
Ken Raven, IPRP, discussed the risk of a long-term release of arsenic trioxide associated with the deep disposal option. The IPRP felt that the "very low" long-term risk assigned to the option by the Technical Advisor is too optimistic, as it is not based on a hydrogeological study of the

Giant Mine itself. Mr. Raven indicated that some releases from the deep disposal option should be expected because of:

- Bedrock permeability.
- Pathways that connect the chambers to the surface (for example, unknown exploration holes and natural fractures in the rock, which could be increased by the blasting necessary to create the underground disposal chambers).
- Great Slave Lake being a regional discharge location, which means that water will flow upwards into the lake from some depth.

The IPRP feels that, if the deep disposal option were pursued, it would require a thorough groundwater study of the Giant Mine. This would be a major undertaking, requiring three to five years to complete.

Mr. Raven also indicated that, in other deep disposal programs, a multiple-barrier approach is being used. The multiple barrier approach recognizes the difficulty of achieving a complete understanding of the flow of water at the deep disposal level, and therefore involves using "engineered barriers" (containers, liners, etc.) to contain the substance, as well as the natural barrier of the rock itself. The deep disposal alternative for the arsenic trioxide dust at Giant Mine does not currently include an engineered barrier, which would affect the results of the risk and cost analysis for this option.

Risk of Long-Term Release – Frozen Block Option
Dr. Jean-Marie Konrad compared the frozen shell and frozen block options in terms of long-term release risks. He indicated that, with the frozen shell option, it would be difficult to completely seal around all of the arsenic trioxide dust as there was no way to tell whether the seal was complete. Furthermore, the presence of water in the dust might make it more difficult to obtain a complete seal. If the seal around the arsenic trioxide were not complete, the risk of release would increase. Dr. Konrad then indicated that the frozen block option was considered more robust than the frozen shell option because:

- Freezing from underneath, as well as from the sides, eliminates the possibility of "windows" in the frozen block.
- The frozen block option takes advantage of the wet dust to create even more ice.
- Supplementing the active freezing method with cold air pipes from the surface gives added protection from thawing.
- The option is flexible and can be monitored. If there is a concern about thawing, the freezing mechanism can be reactivated to refreeze the blocks.
- Very little energy is required to maintain the frozen blocks once they are frozen solid. This reduces the long-term cost of the option and the extent of the long-term maintenance required.

Dr. Konrad also spoke to the idea of a pilot project. He indicated that the IPRP considers a pilot project to be a prudent engineering practice that would be used to calibrate machinery, develop temperature change models, etc., as well as to investigate alternatives such as staged freezing (from the bottom up). However, the IPRP feels that the pilot project should be undertaken as part of the implementation phase, not as a prerequisite to choosing an option.

4.7.2 Summary of the Discussion

The question and answer session following the IPRP's report back on Day One issues and concerns flowed directly into an open forum session, where all participants, as well as members of the IPRP, the Technical Advisor, and the Giant Mine Remediation Project Team, had the opportunity to ask and/or respond to questions of clarification and information.

S – The deep disposal option would make it difficult to retrieve the arsenic trioxide if, 50 years from now, new technology existed to manage the problem in a different way. Remining the frozen blocks is an easier option. Ease of access and removal is also a consideration if a catastrophic event were to occur, such as an earthquake or flooding.

S – The GNWT is pleased to hear that the IPRP considers that deep disposal did not receive the same scrutiny as the frozen block alternative. The GNWT still requires additional information in order to accept the frozen block as the only in-situ alternative. The GNWT is also pleased to hear the consideration of sequencing, which could be explored during the additional 12-month study period being suggested by the GNWT.

S – The GNWT requests that DIAND provide a written response to its presentation on Day One of the workshop [see Section 4.4.3].

S – The GNWT does not want the debate over the deep disposal alternative to become a prolonged research project, as the technical advisor has suggested would occur. The GNWT's intent is to ensure that a thorough comparative analysis of the two preferred alternatives be completed and provided for further public input so that the best possible informed decision can be made on a long-term management alternative.

S – There are many examples of mines with lower accident rates than those used in the assumptions underlying the assessment of worker health and safety risks. Appropriate procedures could be put in place to minimize or eliminate accidents if the arsenic trioxide were to be removed from its current location.

R – In response to this comment Dr. Laurie Chan of the IPRP noted that, in addition to the worker health and safety risk from mining activities, it was necessary to take into consideration the health risks arising from the arsenic trioxide dust. It is hard to imagine a more dangerous substance than the arsenic trioxide dust because of its toxicity and the size of the particles involved, which would be easy to inhale.

Q – Where are the horizontal freezing pipes located in regards to the bulkheads and drifts?

R – This is a design question. It would not be necessary to drill through bulkheads or chambers, and the safest location for each freezing pipe will be used. The freezing pipes can fan out from any point.

Q – How can you thaw the frozen block?

R – The frozen block can be thawed using the same design but with warm water and warm temperatures instead of cold water and cold temperatures. Other options are also possible. For example a heat source can be used, as was done in Japan, or the frozen block could be mined.

Q – Would thawing involve adding warm water to the frozen arsenic trioxide?

R – No. The pipes used for freezing would be filled with warm water, which would radiate heat, thawing the block. Warm water would not be poured onto the frozen blocks from the top.

Q – Water expands when it freezes. Could the freezing cause fractures or otherwise affect the stability of the chambers?

R – The design would have to ensure that the arsenic trioxide dust froze in a way that did not create high pressure that could cause the chambers to erupt. This can be ensured if the project is designed and built properly. For example, the block must be frozen all the way through. It is important to remember that we are dealing with rock and that it will not collapse easily, but the question does need to be considered in the design process.

Q – Do the thermosyphons and other parts of the freezing system increase the likelihood of a fracture?

R – No. However, even if a fracture occurs, the water will fill up the cracks and be frozen, sealing in the arsenic trioxide. The freezing process is very uniform. It does not miss sections.

S – The mitigation of worker health and safety risks is very important. Other mines using similar techniques should be studied. Whatever option is chosen, the most modern technology and techniques should be used.

S – The amount of time required to mine out the arsenic trioxide [in the ex-situ alternative] should be reduced. For example, four borehole drills should be used rather than one to reduce the time required. However, this will result in an increase in cost.

R – Some options are safer than others and some hazards, such as old stopes, can be avoided. However, there are still objective hazards such as the toxicity of the arsenic trioxide. The question is whether the risks of extraction are higher than the risks of leaving the arsenic in place. The extraction risks will always be higher in comparison.

R – The schedules used to determine the length of time required for the *ex-situ* method were not dependent on the drilling rate but on the rate that the arsenic trioxide could be processed once extracted. Therefore, increasing the number of drills would not reduce the overall time required.

Q – Has the 2003 Budget been set?

R – DIAND is waiting for clarification from Head Office.

Q – Why is there such a rush to go to Ottawa now to get funding for an event that will not take place until 2007? Where is Giant Mine on the regional priority list for the clean up of contaminated sites in comparison to other sites, such as Colomac?

R – DIAND wants to go to Ottawa in the fall in order to get approval to proceed with developing a detailed Project Description, which will take approximately one year. Approval will also indicate the beginning of a commitment to implementation and funding. The Giant Mine figures prominently as a contaminated site in the North. In terms of risk, a catastrophe at Giant Mine would be worse then at Colomac, and no one would argue that. Furthermore, the remediation of Colomac is more advanced and will require funding in the years prior to the years Giant Mine will require funding. Given this, DIAND sees no conflict in funding between the two projects.

Q – Is the accelerated clean-up funding limited just to the clean-up of contaminated sites?

R – Yes. It is expected that most of the funding for developing the Project Description will come from the accelerated clean-up fund this year. However, the fund is focused on clean-up activities, not on carrying out endless studies.

Q – Is converting the arsenic trioxide to scorodite, mixing the scorodite with cement, and using the mixture to backfill into the current workings of the mine an option?

R – This mix and match alternative was considered and then discarded because it increases short term and worker health and safety risks. It does very little in terms of minimizing long-term risks. This alternative also significantly increases costs. As a result of these factors, it was concluded that there was no additional benefit in using a mix and match option. Other mix and match alternatives were also considered, and of all alternatives considered, the ones found to be the most logical are the frozen block and cement encapsulation options that remain on the table today.

R – Some studies show that scorodite requires a low pH environment to be stable. Mixing the scorodite with cement could raised the pH and therefore reduce the scorodite's stability. Chemically reducing conditions can also be a problem. For example in Red Lake, Ontario, scorodite was released into a lake. It was discovered that the arsenic levels in the lake were increasing because the naturally low-oxygen conditions at the bottom of the lake were causing the scorodite to be unstable and release arsenic. It is possible that the conditions within the Giant Mine would also be low in oxygen, increasing the risk that the scorodite might become unstable and release the arsenic.

Q – What about the conversion of arsenic trioxide to scorodite?

R – Scorodite is a relatively stable form of ferric arsenate that is formed when the arsenic trioxide is heated to a high temperature in an autoclave. However, it is possible that not all of the arsenic trioxide will be transformed into scorodite – some of it could be transformed into less stable forms, which would be more soluble.

5.0 KEY WORKSHOP FINDINGS

The general themes resulting from the open forum echoed what was heard throughout the two-day workshop. The major themes were as follows.

Preferences Among the Alternatives

- There seems to be general support for *in-situ* management and apparently no support for ex-situ management.
- The freezing option is the most widely preferred *in-situ* management alternative although the GNWT requested further consideration of deep disposal in order to make a comparison with freezing.
- Some attendees were not prepared to express a preference.

Ways to Move Forward

- A decision about the arsenic trioxide needs to be made in order to allow remediation planning for the rest of the site to move forward and to take advantage of the current momentum.
- Worker health and safety, technological feasibility and environmental and human health are seen as the most important factors in choosing an alternative. Some stakeholders do not regard cost as a key consideration.
- The IPRP supports the Technical Advisor's position that there is enough information to select a preferred alternative.
- It may not be possible to reach complete consensus on the option to pursue but community input will continue to inform the decision-making process.

APPENDIX A: LIST OF PARTICIPANTS

The following table contains the names and affiliations (where available) of the workshop participants.

Name	Affiliation
Adrian Paradis	Mackenzie Valley Land & Water Board
Andre Corriveau	Health and Social Services, GNWT
Bill Coedy	Contaminated Sites Office, DIAND NWT Region
Bill Mitchell	Giant Mine Remediation Team, DIAND
Bob Leech	Independent Peer Review Panel
Brendan Bell	Legislative Assembly
Bruce Halbert	SENES Consultants
Chris O'Brien	Private Citizen
Chris Paci	Dene Nation
Chuck Brawner	Independent Peer Review Panel
Craig Nowakowski	Stanton Territorial Health Board
Daryl Hockley	SRK Consulting Inc.
Dave Tyson	Department of Fisheries & Oceans Canada
Don Riendeau	CJCD
Dr. Laurie Chan	Independent Peer Review Panel
Dr. Steve Hrudey	Independent Peer Review Panel
Ed Collins	Environment Canada
Emery Paquin	Resources, Wildlife and Economic Development, GNWT
Ingrid Nielsen	Giant Mine Remediation Team, DIAND
James Rabesca	Translator
Jean-Marie Konrad	Independent Peer Review Panel
Jennie Rausch	University of Alberta Student
Julie Plourde	L'Aquilon
Ken Raven	Independent Peer Review Panel
Kevin O'Reilly	Private Citizen
Kris Johnson	North Slave Metis Alliance
Larry Connell	Independent Peer Review Panel
Lionel Marcinkowski	Resources, Wildlife and economic Development, GNWT
Lynda Comerford	Yellowknife Chamber of Commerce
M. A. J. Fred Matlich	Independent Peer Review Panel
Mark Davy	Municipal and Community Affairs, GNWT
Mark Liskowich	Giant Mine Remediation Team, DIAND
Michel Noel	SRK Consulting
Peter Bengts	Workers' Compensation Board
Peter Stenne	Canadian Dewatering Ltd.
Rita Fabien-Berc	Translator
Ron Connell	Miramar Giant Mines Ltd.
Sarah Baines	Mackenzie Valley Land & Water Board
Stephen Schultz	SRK Consulting
Steve Petersen	Canadian Auto Workers Union
Sylvester Wong	Workers' Compensation Board
Walt Humphries	NWT Mining Heritage Society

APPENDIX B: WORKSHOP AGENDA

Giant Mine Arsenic Trioxide Moving Forward: Selecting A Management Alternative

May 26 & 27, 2003

Northern United Place, Yellowknife

WORKING AGENDA

Day 1 – May 26, 2003

8:00 – 9:00 a.m.	**Workshop Registration**	
9:00 – 9:30 a.m.	**1.0 Workshop Introduction** • Welcome • Introduction of Participants • Review of Reference Binder • Review of Purpose & Objectives • Review of Working Agenda	Facilitators
9:30 – 10:00 a.m.	**2.0 Reporting Back on Public Dialogue and Communications** The Giant Mine Remediation Project Team will present a brief report back to participants on the supplementary public information and dialogue activities carried out since the January 2003 workshop, including what was heard from the public during those meetings and activities. ***Questions and Discussion***	Bill Mitchell & Mark Liskowich (DIAND)
10:00 a.m. – 12:00 p.m. **(including coffee break)**	**3.0 Review of the Recommended Alternatives** ***3.A. The In-Situ Alternative*** A representative of the Independent Peer Review Panel (IPRP) will briefly review the *in-situ* alternative recommended by the Technical Advisor and associated implementation issues. ***Questions and Discussion***	Dr. Jean-Marie Konrad & Fred Matich (IPRP)
12:00 – 1:15 p.m.	**Lunch Break (not provided)**	
1:15 – 2:30p.m.	***3.B. The Ex-Situ Alternative*** A representative of the Independent Peer Review Panel (IPRP) will briefly review the *ex-situ* alternative recommended by the Technical Advisor and associated implementation issues. ***Questions and Discussion***	Larry Connell & Chuck Brawner (IPRP)

2:30 – 3:15 p.m.	**4.0 Community Perspectives** Several groups and organizations will provide brief presentations regarding the recommended management alternatives and issues associated with their implementation.	Bill Braden, (MLA) Emery Paquin, (GNWT)
3:15 – 3:30 p.m.	**Coffee Break**	
3:30 – 4:45 p.m.	**9.0 Reporting Back on Technical Issues** The Technical Advisor will present a brief report back to participants on the additional research/analysis undertaken in response to questions raised during the January 2003 workshop and subsequent community dialogue sessions. ***Questions and Discussion***	Daryl Hockley (Technical Advisor, SRK Consulting)
4:45 p.m.	**Wrap-Up Day 1**	

Evening Session – May 26, 2003

The Community Alliance will host an evening session on the management alternatives for the arsenic trioxide dust at the Giant Mine at Northern United Place. All workshop participants are cordially invited to attend. The Community Alliance will also make a presentation at the workshop on Day 2.

Giant Mine Arsenic Trioxide Moving Forward: Selecting a Management Alternative

May 27, 2003

Northern United Place, Yellowknife

REVISED WORKING AGENDA

DAY 2 – MAY 27, 2003

9:00 – 9:15 a.m.	**Introduction to Day 2** • Key observations from Day 1 • Review of revised Day 2 agenda	Facilitator
9:15 – 9:45 a.m.	**Community Alliance Perspectives** The Community Alliance will report back on the previous evening's session and on the initial results of the questionnaire distributed to community members in April	Steve Pedersen (Community Alliance)
	Questions and Discussion	
9:45 – 10:30 a.m.	**IPRP Preliminary Response To the GNWT Position and Information Provided During the Technical Advisor's Presentation With Respect to the Deep Disposal Alternative** The IPRP will provide a brief oral report back to questions raised during the previous evenings session. A formal written response will follow.	Dr. Steve Rudy, Ken Raven, Dr. Jean-Marie Konrad (IPRP)
	Questions and Discussion	
10:30 – 11:45 a.m. **(including coffee break)**	***Open Forum: Further Discussion of Technical Issues and Public Perspectives on the Selection of an Option*** An opportunity for all participants, as well as members of the IPRP, the Technical Advisor, and the Giant Mine Remediation Project Team, to ask was well as respond to questions of clarification and information.	Facilitators
11:45 a.m. – 12:00 p.m.	**Wrap-Up Day 2**	Facilitators

APPENDIX C: IPRP EVALUATION CRITERIA

IPRP Evaluation Criteria

- Must be technically viable.
- Must be proven technology (used successfully elsewhere).
- Evaluation data must be available and adequate.
- Must be robust – potentially long-term solution.
- Must be capable of acceptable implementation (including environmental acceptability).
- Must be able to economically monitor performance.

APPENDIX D: WORKSHOP PRESENTATIONS

This appendix contains the presentations made at the May 2003 workshop. The majority of the presentations were made in PowerPoint. However, some were made using overhead slides (which were scanned for reproduction here) or handout materials. Unless otherwise noted, presentations were made by the Technical Advisor, the IPRP, and the Giant Mine Remediation Team. The following is a complete list of the presentations contained in this appendix:

- Arsenic Management Options – Giant Mine (Presentation by Yellowknife MLAs)
- Basics of Freezing Diagram
- Dust Extraction Methods
- Frozen Block Option Diagram
- Frozen Block Pilot Project Diagram
- Frozen Shell Option Diagram
- Introduction by the GM Project Team
- IPRP Opening Remarks
- Responses to Technical Questions
- The Cement Stabilization Option
- The Freezing Option
- The Management of Arsenic Stored Underground at Giant Mine (Presentation by the GNWT)