



**SUMMARY REPORT  
WORKSHOP ON MERCURY USE  
IN THE MINING INDUSTRY IN GUYANA  
May 17, 2000  
Ocean View Hotel, Convention Centre  
Georgetown, Guyana**

**By  
Jeff Barnes  
John Harrison  
Jean-Marc Barbera  
Bryan Tisch**

**July 17, 2000**



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## EXECUTIVE SUMMARY

On May 17, 2000, the GENCAPD Mining Project held a multi-stakeholder workshop at the Ocean View Hotel Convention Center in Georgetown Guyana on occupational health and safety aspects of mercury use in placer mining in Guyana. The workshop was opened by the Honourable Samuel Hinds, Acting President, Prime Minister and Minister of Mines and other distinguished guests. The objectives of the workshop were to share information on the occupational health and safety issues surrounding the use of mercury in placer mining. Secondly, the workshop was intended to provide input and guidance for the development of a draft Code of Practice for mercury use in placer mining. Sixty-one representatives of government, the mining industry, and from academia and non-governmental organizations including those representing the Amerindian community attended the workshop. The workshop was organized and sponsored by the Guyana Environmental Capacity Development (GENCAPD Mining Project).

The workshop involved seven presentations by national and international experts in mercury and mercury use in mining. Mr. John Harrison of Health Canada addressed the health effects of mercury exposure. Dr. David Singh of the Institute of Applied Science and Technology (IAST) spoke regarding the present state of mercury research in Guyana. Ms. Rosemarie Benjamin-Noble of the Guyana Geology and Mines Commission (GGMC) reviewed applicable legislation. Mr. Ronald Glasgow of GGMS gave a presentation on placer mining techniques, with particular emphasis on mercury use in amalgamation and gold purification. Mr. Mahendra Samaroo and Ms. Diane McDonald of the GGMC, respectively, gave presentations regarding the retort evaluation program and a simple retort manufactured from readily available materials. Ms. Rhonda Douglas of the Guyana Bureau of National Standards (GBNS), supported by Dr. David Singh of IAST and Chairman of the GBNS, described the standard development process. Mr. Tony Shields Executive Director of the Guyana Gold and Diamond Miners Association (GGDMA), provided the perspective of its membership on mercury use and environmental regulation. After each presentation, a brief question and answer period allowed the participants to gain more detailed information and express their own views.

The workshop was concluded by a facilitated discussion of the potential exposure risks for workers and practical measures for reducing the potential for those exposures. A very animated discussion occurred wherein a high degree of consensus was achieved in respect of important measures to reduce exposure. These included protective measures related to eating, drinking, smoking, and hygiene. As well, the use of protective clothing and gear was discussed. Various techniques for reduction of exposure in the amalgamation and gold purification processes were discussed, including particularly the use of retorts and the avoidance of the use of open fire methods. The safety precautions for gold purification at the Gold Board were also discussed.

It was unanimously agreed that a Code of Practice for mercury use should be developed and that the education program regarding safe use of mercury in mining should be expanded.



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## **SUMMARY REPORT**

### **WORKSHOP ON MERCURY USE IN MINING**

## **1.0 INTRODUCTION**

### **1.1 Introduction**

On May 17, 2000, the GENCAPD Mining Project held a multi-stakeholder workshop at the Ocean View Hotel Convention Center in Georgetown Guyana on occupational health and safety aspects of mercury use in placer mining in Guyana.

### **1.2 GENCAPD Mining Project**

The goal of the GENCAPD (Guyana Environmental Capacity Development) is to strengthen capacities for environmental management in Guyana. The purpose of the project is to strengthen the capacities of key mining sector institutions in Guyana in the area of environmental management. With regard to operational capacity within industry, the project will address both improved productivity and reduced environmental impact. The project will merge these objectives, where possible, to encourage acceptance by Guyanese miners that responsible environmental management is an essential component of profitable and sustainable industry operations. New technologies will be introduced through training and demonstration projects, which will target primarily the small and medium sized mining ventures. These demonstrations will likely form the centrepiece of the project and will incorporate proven Canadian approaches that will maximize mineral recovery in an environmentally responsible manner. The capacity for industry self-monitoring will also be emphasized in demonstration projects.

It is recognized that for real progress to be made on the environmental front, a meaningful dialogue between industry and government is necessary. Thus, while actions taken to address policy and regulatory issues will focus primarily on government capacity, industry will be involved in this process. In the same way, actions taken to improve industry operations will focus primarily on industry capacity, government will also be involved in the process. In this way, the aim is to build and strengthen a relationship of consensus and mutual trust between industry and government institutions.

The Canada Centre for Mineral and Energy Technology (CANMET) of Natural Resources Canada has been selected by CIDA to execute this project. The three main stakeholders and participating institutions are Environmental Protection Agency (EPA), Guyana Gold and Diamond Miners' Association (GGDMA) and Guyana Geology and Mines Commission (GGMC).

### **1.3 Purpose and Objectives of Workshop**

The objectives of the workshop were to share information on the occupational health and safety issues surrounding the use of mercury in placer mining. Secondly, the workshop was intended to provide input and guidance for the development of a draft Code of Practice for mercury use in placer mining. The agenda for the workshop is provided in Appendix A.

### **1.4 Participants**

Representatives of government, the mining industry, and from academia and non-governmental organizations including those representing the Amerindian community attended the workshop. The attendees and their affiliations are listed in Appendix B.

## **2.0 PRESENTATIONS**

### **2.1 Opening Remarks**

A distinguished panel opened the workshop. The panel comprised the following:

- The Honourable Samuel Hinds, Acting President, Prime Minister, and Minister of Mines;
- His Excellency, the High Commissioner for Canada, Mr. Jacques Crete;
- Mr. Robeson Benn, Chairman of the Board of Directors GGMC;
- Mr. Brian Sucre, Commissioner for GGMC;
- Mr. Patrick Pereira, President Guyana Gold and Diamond Mining Association; and
- Ms. Karen Livan, Manager, Environmental Division (GGMC).

### **2.2 Health Effects of Mercury Exposure in Gold Mining**

#### **2.2.1 Summary of Presentation**

John Harrison of Health Canada gave a presentation on the health effects of mercury exposure in gold mining. The objective of the presentation was to outline the toxicology of the different chemical forms of mercury, with emphasis placed on elemental mercury as this is the form that is used in mining. Mr. Harrison described how mercury can enter the body, how and where it is accumulated, and the rate of elimination from the body. In addition, the acute and chronic exposure scenarios were discussed in terms of their respective symptoms. Other information such as the acute lethal doses and bio-accumulation/bio-magnification of the different chemical forms of mercury was outlined. The neurotoxicity of mercury was identified as a principal potential adverse health effect as a result of chronic exposure. International guidelines for safe levels of mercury in humans and related ranges of health risks were reviewed. The presentation overheads are provided in Appendix C-1.

#### **2.2.2 Summary of Discussion**

- Q. Are there other types of chemicals that can be used instead of mercury? A. Yes, one common alternate is cyanide.
- Q. What are the antidotes for mercury? A. Although not a medical practitioner, apparently the literature states that for patients where the effects are severe, the best antidote is penicillamine. Cysteine is another antidote that is sometimes used for severe exposure.. For less severe cases, BAL (British Anti-Lewiscite) and specifically the oral administration of a thiol resin.

Q. If Amerindians are exposed to mercury, should they be treated with antidotes? Also, should studies be undertaken because of their environmental exposure? A. These are good questions and could be the subject of a further workshop that would focus on environmental and environmental health problems.

Q. A further study to the Tapajos study (discussed during the presentation) indicated that mercury exposure may also occur as a result of natural levels in the environment (i.e., background). A. It is important to have all the baseline environmental data and that it is necessary to review all of the studies of this type to gain a complete picture of the subject.

## **2.3 Present State of Mercury Research in Guyana**

### **2.3.1 Summary of Presentation**

Dr. David Singh gave a presentation on research being undertaken by the Institute of Applied Science and Technology (IAST). During 1997, in collaboration with the Environmental Studies Unit at the University of Guyana, a survey of contamination in Mazaruni River, and Paruima and Bartica was conducted. A survey of mercury levels and mining practice was conducted in the Mazaruni area. The research was funded by the EU and UNDP.

In 2000, IAST (principal) are working at identifying the sources of contamination in the human and aquatic environments in the Mazaruni basin in a project funded by the World Wildlife Fund (WWF). Initial results of this study indicate a correlation between mercury in humans with the environment. Also, there is an association between human exposure, gold mining and the level of awareness of mercury hazards.

Dr. Singh's presentation is provided in Appendix C-2.

### **2.3.2 Summary of Discussion**

Q. How many people were sampled? A. About 50 each in the two areas.

Q. Is there a correlation between mercury levels and geo-sampling(?), both in Guyana and around the world? A. Atmospheric levels of mercury also arise from land clearing and wood burning which complicates the issue. The distribution of mercury throughout Guyana has not been well documented, however, there has been some work completed in the Mahdia region.

Q. Miners need to be part of the research. They seem to have been omitted in past studies. A. The needs to be some initial answers to convince miners that there is indeed a problem. Once they are on board, the research program can move forward.

Q. Has there been any consideration of food-chain levels of mercury, for example, in the marine environment and the consumption of food? A. There is not much data as yet, but this needs to be pursued. There has been some diet work but this is difficult to do and correlate.

## **2.4 Review of Existing Legislation Regarding Mercury Use and Storage in Guyana**

### **2.4.1 Summary of Presentation**

Ms. Rosemarie Benjamin-Noble reviewed the applicable existing legislation regarding mercury use and storage in Guyana. The presentation provided the legal context for any future regulation of mercury in mining and also for the proposed Code of Practice for mercury use in mining. The legislation reviewed included the *Mining Act* and a proposal for upgrading the regulations with respect to mercury. This included the provision that the use of retorts be made mandatory for the containment of fumes and harmful emissions.

Ms. Benjamin-Noble also reviewed relevant aspects of the *Occupation Safety and Health Act*. Ms. Benjamin-Noble's paper is provided in Appendix C-3.

### **2.4.2 Summary of Discussion**

Q. (series of comments from the same person) How can Pork-knockers be responsible for controlling the use of mercury when there are no managers at these operations? School children are sold mercury at drug stores. How can you store tailings, there is too much of it to store? Present regulations indicate that tailings should be stored in drums, however, there aren't enough drums in Guyana to store it all! You can't eliminate mercury, but you can minimize it. Mercury should only be used in the jig box. The possibility of jail terms are frightening, should only be applied to those who abuse the law, and may actually deter miners from selling their gold to the Gold Board. Punters are illegally re-working the black sands of other operators, and generally do not exercise control over mercury usage. The managers are responsible for the storage of mercury not the workers. Someone should be trained in the use of antidotes.

Q. What mechanism will be used to ensure safe storage and disposal of mercury? A. Theoretically, this should be achieved through routine inspection by GGMC inspectors.

## **2.5 Mercury Use in Placer Mining**

### **2.5.1 Summary of Presentation**

Mr. Ronald Glasgow gave a presentation on placer mining techniques with emphasis on the use of mercury, particularly in amalgamation and retorts. The presentation reviewed sluice box technology, including their use as jigs; described jig boxes and the amalgamation process; and outlined the use and type of retorts being used.

Mr. Glasgow's paper is provided in Appendix C-4.

### **2.5.2 Summary of Discussion**

Q. (comment) Using an open wood fire for cooking and volatilization of mercury is a bad idea. GGMC should inspect Brazilian dredging operations, which are losing 80 % of their mercury due to its use in sluice boxes, pits and as a result of amalgamation techniques. A. GGMC is a young department and has difficulty reaching all areas. The commenter was thanked for his information.

Q. The amount of gold mentioned in the 90's was 800,000 ounces. Does this include Omai? A. No, it is a summary without Omai for the decade.

## **2.6 Retorts and Retort Evaluation Program**

### **2.6.1 Summary of Presentations**

Two presentations were made. Mr. Mahendra Samaroo outlined a proposed evaluation program for retorts. His presentation addressed some of the properties of mercury, the basic principles of retorts, and some examples of retort designs. Mr. Samaroo reviewed what should be evaluated when considering the performance of retorts including cost, ease of use and transportation, and compatibility with worker knowledge and technology. The results of testing of two retorts, the CETEM and the Lopes retorts were reviewed, indicating recovery efficiencies on the order of 95%. The attributes of a successful retort were described.

Ms. Diane McDonald presented a retort comprised of available materials and of simple construction that is being proposed by the GGMC for small scale miners. The retorts were shown to the audience and their manufacture and operation was described.

The presentations are provided in Appendix C-5.

## **2.6.2 Summary of Discussion**

- Q. What safety systems have been installed at the Gold Board? A. I am not aware of the Gold Board's operation and cannot answer.
- Q. What is the best material for seals on retorts? A. I am not certain, however Mr. Lopes uses an automobile gasket. A participant stated that some use mud or muffler exhaust repair kits.
- Q. Are plastic containers with a lid good for carrying and storing mercury? A. It is important to keep the mercury under water, in order to prevent volatilization.
- Q. How do you minimize gold loss through the retort system, as you indicated potential losses of 2-20%? A. The crucible must be heated slowly, and not overfilled.
- Q. Our company uses a variety of retorts. You showed Mr. Clarkson's retort. The addition of a water jacket results in more efficient capture (condensation) of mercury vapor. He has pointed this out to Mr. Clarkson. Different sizes of receptacles can be used to suit the scale of operation. A. Mr. Clarkson's retort has undergone some modification, related to the crucible. It would be appreciated if further input and the provision of a retort(s) for inclusion in the retort evaluation program were supplied.
- Q. What is the cost of an effective retort? Can they be made in Guyana? A. Currently, retorts are not commercially available in Guyana. This is what GGMC has as its goal; to get a simple, effective retort for small scale mining.
- Q. The retort technology must be established before proceeding with a Code of Practice, which should include the proper use of a retort. A. The Lopes retort costs only \$9,000 and apparently achieves approximately 90% recovery.

## **2.7 Standards Development Process in Guyana**

### **2.7.1 Summary of Presentation**

Ms. Rhonda Douglas gave a presentation on the standards development process in Guyana. Ms. Douglas is with the Guyana Bureau of National Standards (GBNS). The role of GBNS was described, and a Code of Practice was defined. The process for the formulation of standards was outlined. The need for transparency in this multi-stakeholder process was emphasized.

Ms. Douglas' presentation is provided in Appendix C-5. Appendix D provides the Draft Code of Safety for Mercury that is under development by the Guyana Bureau of National Standards.

## **2.7.2 Summary of Discussion**

Q. Which agency, the GBNS or GGMC, takes the lead in the development of a Code of Practice? A. GGMC would take the lead. The GBNS has a transparent process to arrive at a Code of Practice.

Discussion: It was stated that the GNBS is encroaching into the jurisdiction of GGMC. If GNBS develops this code, there might be duplication. The question was asked as to whom would enforce the Code of Practice. A. GGMC would enforce this Code of Practice.

The facilitator concluded that it appeared that there were three options for the development of a Code of Practice: 1) under regulation by GGMC; 2) under the GBNS; or 3) jointly with a GGMC regulation citing the national standard. The facilitator suggested that the matter of who should develop the Code of Practice and how it should be enforced could be deferred for further discussion between the relevant parties.

## **2.8 Perspective of the Mining Industry**

### **2.8.1 Summary of Presentation**

Mr. Tony Shields, Executive Director of the GGDMA provided his perspectives on the subject of mercury use in the mining industry. Mr. Shields noted the importance of gaining information on the subject prior to enacting regulations. He said that there is a mistaken idea that miners are anti-environmental. He re-counted how in the minutes of a 1994 GGDMA meeting, it was noted that industry should self-regulate and that an environmental sub-committee be formed. A \$1.5M (Guy) environmental fund was established. In its press release at that time, the association stated that its aims were to minimize environmental impact, generate education on environmental issues and retain independent groups to do environmental assessment reviews.

Mr. Shields indicated that initially he was suspicious of GENCAPD. Now he appreciates that GENCAPD has been very helpful. He noted that GENCAPD has complied with all of its aims so far.

Mr. Shields indicated that (in his opinion) there is no mercury problem in Guyana and noted that the Prime Minister shared this view. He indicated that the illegal use of mercury in sluice boxes was the practice of Brazilians that are operating in Guyana. Mr. Shields also indicated that any mercury contamination in Guyana can at least partially be attributed to contamination of river systems originating in Venezuela.



Mr. Shields sees mercury as an occupational hazard. Industry is aware that pollution and sedimentation can be controlled. He noted that there is no one with the agenda to close down mining in Guyana. Thus, he concluded, that all parties should get going with dealing with the issue of safe mercury use. He wants to see immediate action.

He suggested that GGMC could support purchase of 40-50 retorts in Mahdia, for example. He noted that \$200,000 bond was initially required in order to mine in the Mahdia area. Why not use some of this money to subsidize the cost of providing retorts?

The GGDMA wants immediate action and calls for mandatory use of retorts. He observed that the mine owners are generally not the ones that actually use mercury, but that they would be anxious to use retorts in their operations, as they would recover their investment quickly through the recovery of mercury.

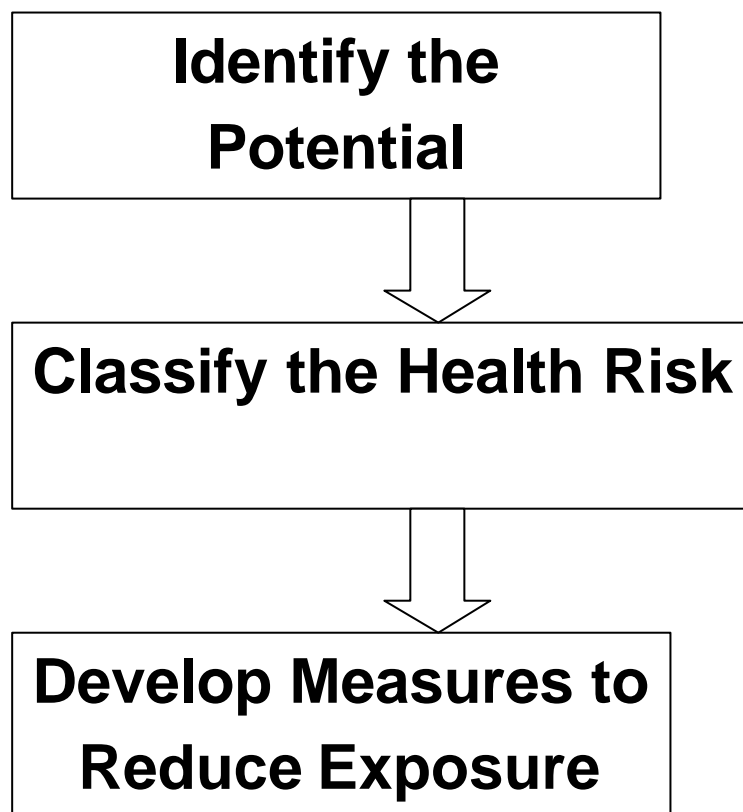
### **2.8.2 Summary of Discussion**

A representative of the Precious Metals Association indicated that he supports the efforts of GGMC (including activities such as this workshop). However, he queried as to why the GBNS was involved. Mr. Shields was asked if he had broached the subject of mercury levels in rivers originating in Venezuela with Venezuelan officials during his recent trip to Venezuela. Mr. Shields indicated that he hadn't, but felt that this would be attributed to illegal miners who are difficult to control. He observed that a large mining company was processing for small miners using cyanide and charging a 30% fee (cooperative approach). Mr. Shields also stated his opinion that permits for the use of cyanide for gold recovery should not be made available to small-scale miners.

### **3.0 FACILITATED DISCUSSION**

#### **3.1 Framework for Discussion**

Mr. Barnes described that the objective of the group discussion was to identify and characterize the exposure risks for workers, and practical measures for reducing the potential for those exposures. This would provide the basis for the development of a draft Code of Practice for mercury use in placer mining. The following framework was adopted for the discussion.



It was recommended that the discussion identify measures to reduce exposure for the following exposure points:

- Common Activities
  - Eating
  - Drinking
  - Clothing
  - Smoking
  - Personal Hygiene
- Specific Mining Activities
  - Use of Retorts
  - Amalgamation
  - Re-mining Previously Mined Areas.

The participants agreed to follow the proposed framework. Mr. Barnes presentation notes are provided in Appendix C-6.

## **3.2 Discussion**

The following represents a summary of the key points of discussion and points of consensus. Additionally, some recommendations were made.

### Eating and Drinking

Many miners burn amalgam in the kitchen. For example saltfish is sometimes stored above the stove which was also used to burn off mercury, and would therefore be directly exposed to mercury vapour. Some miners burn mercury over a fire that is also being used for cooking food.

Water for cooking is often the same source as that used for washing black sands. It was recommended that black sand washing be done in a separate area downstream. A reservoir should be used to wash the black sands.

No cooking utensils or buckets should be used in the processing of gold or mercury. Water is sometimes carried in the same bucket as used for amalgamation.

### Other Issues

A high percentage of miners smoke. Most miners wash buckets in streams or ponds. Miners mix mercury in buckets with their bare hands. Some people actually supplement food with mercury. Mercury is sometimes stored with foodstuffs. It was recommended that they be stored away from these areas and in a locked strong box.

Mercury workshops should be held in Mahdia, for example, where miners are concentrated.

#### Clothes

Workers use the same handkerchief to squeeze mercury as to wipe their face. Small-scale miners typically don't wear much clothing; it's too hot for coveralls. It was suggested that clothes could be worn only during retorting or exposure to mercury as a minimum.

If there are too many conditions on miners, it may be impractical and hard to implement. We need to consider all aspects; some of these conditions will apply to medium scale, some to small scale. Clothing, while important, may not be practical or reasonable in all conditions. Education of miners is a major point of the exercise. GGMC recognizes that an education program is necessary.

#### Personal Hygiene

Wash and store "street" clothes separately from "working" clothes. Bathing should be frequent.

### SPECIFIC MINING ACTIVITIES

#### Amalgamation

Codes of practice should only address one way (the right way) to use mercury properly.

A filter cloth should only be used for amalgamation. The same cloth is repeatedly cleaned and dried between uses.

The legality of using sluice boxes as a jig was debated. The practice is very common. Some argued that losses to the environment were substantial. Others argued that there was little or negligible loss. It was suggested that sluice boxes as jigs is not a problem with land dredges. It was also stated that a fully sealed jig box should be required.

Natural processes (i.e., rain) will leach spills and losses into the environment. Of particular concern are sources of drinking water.

Approximately 20% of mercury is lost with black sand tailings and water bodies, sometimes directly, otherwise indirectly.

The facilitator suggested that the use of sluice boxes as jigs be deferred as an issue for consideration by the Technical Committee that will review the draft Code of Practice.

20% of mercury is contained in tailings and we must find a way to deal with these, i.e., some method of storage and disposal. It was suggested that sluice box tailings be separated from amalgamation tailings (black sands).

### Retorts

There was clear endorsement by all that retorts should be used without exception. It was suggested that the technology needs to be evaluated and optimized.

The question of gold loss during recovery was raised. It was asked if mercury could be regenerated, and what happens to water used to condense mercury in retorts?

Mercury can be regenerated. One method uses nitric acid, a second was electrolysis and another uses sodium carbonate. It was suggested that larger mining companies to see what they do with used mercury. There needs to be a mechanism to deal with used mercury. Appropriate disposal methods where applicable should be investigated. Elemental mercury is very insoluble in water.

Is it practical to use respirators? There is a need to educate miners on the use and benefits of these and other safety equipment.

It was asked what systems have been put in place at the Gold Board to protect chronic exposure of workers. It was indicated that there are mechanisms in place to deal with mercury releases from the Gold Board. A mercury scrubber has been installed. Consultation with IAST is underway with respect to the disposal of scrubber sludge. Blood and urine tests are conducted on employees. Mercury respirators are mandatory for staff burning gold. There is a fume hood used for this purpose. The board has purchased a mercury vapour tester to monitor air in and around the laboratory.

Blood and urine levels were found to be lower than safety limits. There has been a significant decrease in the mercury content of the gold brought forward by the miners, based on the experience of the representative's four years at the Board.

It was suggested that it might be good to make Gold Board data available. These data are apparently available.

It was suggested that the same standards for mining should be applied to the Gold Board, i.e., smelting. How much mercury is left in the gold that the miners bring in? This would be a concern to the jewelers. It was suggested that jewelry workers should wear respirators.

It was reported that one study indicated that mercury levels in urine and blood of workers was significantly higher in jewelers than in a control population.

The Gold Board indicated that gold coming from the miners contains approximately 0.4-0.6 % mercury. The gold from the gold board is approximately 0.1-0.2%.

It was suggested that miners involved in amalgamation should undergo periodic biological monitoring. There was general support for this notion.

Miners who observe retorting at the Gold Board are not provided with protection. Does this expose them to risk? It was suggested that miners should endeavor to reduce mercury levels in gold brought to the Gold Board, as they will be paid more if they do this. A code of practice should address this issue.

In the closing remarks by Ms. Livan, three points were emphasized:

- A Code of Practice should be developed;
- An education program should be expanded; and
- Appropriate regulation should be implemented.

## **APPENDICES**





**APPENDIX A**

**WORKSHOP AGENDA**



## **APPENDIX B**

### **LIST OF PARTICIPANTS AND SPEAKER CONTACT LIST**



**APPENDIX C**

**PRESENTATIONS AND PAPERS**



## **APPENDIX C-1**

### **Health Effects of Mercury Exposure in Gold Mining**

**Mr. John Harrison, Health Canada**





**APPENDIX C-2**

**State of Mercury Research in Guyana**

**Dr. David Singh**



## **APPENDIX C-3**

### **Review of Existing Legislation Regarding Mercury Use and Storage in Guyana**

**Ms. Rosemarie Benjamin-Noble**



**APPENDIX C-4**

**Mercury Use in Placer Mining**

**Mr. Ronald Glasgow**



**APPENDIX C-5**

**Retorts and Retort Evaluation Program**

**Mr. Mahendra Samaroo**





## **APPENDIX C-6**

### **Development of Draft Code of Practice for Mercury Use in Placer Mining – Group Discussion**

**Mr. Jeffrey Barnes**



## **APPENDIX D**

### **DRAFT CODE OF SAFETY FOR MERCURY**