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RGC REPORT NO 111001/2

TAILINGS DAM REVIEW BOARD REPORT NO 2 MARLIN PROJECT, GUATEMALA

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1.0 TERMS OF REFERENCE

This Review Report summarizes the observations, conclusions and recommendations of the writer as a consequence of a review of the 'detailed design' level investigations, designs and analyses performed for the tailings dam and appurtenant structures (TSF) being constructed at the Marlin mine, Guatemala. This report is the second of two review reports issued during on-going review of the evolution of the dam design and construction. This report documents the results of reviews performed:

- during a site visit from July 12 to 14, 2004;
- of Detailed Design documentation received periodically since March, 2004 but in substantially final form in October 2004;
- during a review meeting held November 13 and 14, 2004, in Denver, with the dam designers and Marlin mine representatives;
- during on-going discussions and reviews regarding seismic stability analyses; and
- during a site visit from February 21 to 24, 2005.

Finalization of this report was postponed several times by the writer, pending finalization of aspects of the design, and therefore the period between the last report and this report is longer than normally occurs in a review of this nature. During this period there has been regular transmission of project investigation and design information to the writer and responses to the dam design engineers and Marlin mine representatives. This report should be read in conjunction with Report No 1.

Montana Exploradora de Guatemala, S.A. (MEG) is developing an open pit and underground gold mine in northwestern Guatemala. Ore from the mine will be processed at an initial nominal rate of 4,100 tons per day, increasing to 5,000 tons per day after 12 to 18 months, in a conventional mill utilizing cyanide leach and Merrill-Crowe gold recovery. Tailings from the process will be treated with sulfur dioxide to achieve cyanide destruction prior to deposition in a tailings impoundment formed by a 38 m high valley rockfill starter dam and raised progressively during the 10-year mine life to 80 m ultimate height using mine waste rock placed in downstream staged raises.

The starter dam is currently under construction and the schedule anticipates that substantial completion of the construction will be achieved by August 2005 to provide storage of start-up process water in time for commissioning of the milling operations.

Marlin Engineering and Consulting LLC (MEC) have completed site selection, investigation and dam designs to detailed design and construction drawings and specifications issuance stage for most of the facilities, including all facilities currently under construction. The current stage of documentation of these investigations and designs are provided in:

> Marlin Project: Tailings Disposal Facility Design Report. Volumes I to V dated October 2004 and Volume VI attachment 2, dated November 2004.

These documents contain the results of investigations and designs that have been completed to address outstanding issues and deficiencies in the investigations and designs that had been identified by the MEC and MEG, during completion of the feasibility level designs and during the review by the author of these investigations and designs, as reported in Report No 1. They also advance the designs to 'detailed design' stage and include the Technical Specifications and some of the construction drawings. In addition to the above document, a number of memoranda were provided for review, particularly relating to the seismic stability analyses of the dam.

Three of the design documents (Attachments 1, 3 and 4 to Volume VI) have not yet been received and will be reviewed and addressed in a subsequent review. These Attachments address: The Operating Manual, Emergency Procedures Plan and the Closure Plan

Investigations, analyses and designs are on-going to address issues relating to a small number of information and design requirements effecting Stage 2 and 3 designs and for some detailed design elements for Stage 1 typically addressed during construction with field engineering. These relate mainly to elements affected by foundation conditions, construction materials properties and precise field dimensions encountered during construction.

MEG has retained the writer as an independent expert to perform a review of the tailings impoundment proposed for the Marlin mine in compliance with the principles established in the IFC/World Bank guidance and operating principles OP 4.01 Annex D and OP 4.37.

In terms of OP 4.37, a Tailings Dam Review Board is required to review the development of the dam designs, construction and initial dam filling. The writer constitutes the Review Board to satisfy the terms of this OP. While this Board has been constituted as a one man Board, MEG has approved that the Board may consult with independent technical specialists in those areas where the Board considers that such additional technical expertise is required to achieve comprehensive technical review of the key areas of risk and performance of the tailings dam.

During the review of the Detailed Design the writer consulted with Dr. Peter Byrne, a world recognized expert in the field of seismic analyses and response of dams to provide a review opinion and guidance to the dynamic stability evaluation of the Marlin tailings dam. Dr. Byrnes report is attached as Appendix A, and should be read in conjunction with this report.

Photographs of key elements taken during the site inspections in July 2004, and February 2005, are included in Appendices B and C respectively.

2.0 KEY FINDINGS OF THIS REVIEW

The key findings of this review were:

1. The design for the Starter Dam is in accordance with design criteria and standards of international good engineering practice. These criteria and standards meet the tests

typically applied for dams of this type and site-specific conditions in the leading western world industrialized countries; applicable guidelines and regulatory requirements. The designs for Stage 2 and 3 are adequately advanced to demonstrate the feasibility of the complete dam, though a number of detailed design elements and material specification requirements are still to be finalized, as summarized in the body of this report.

2. The construction is being performed by contractors with adequate resources of equipment and personnel to construct the dam and appurtenant structures to the standards required for them to achieve the design performance and intent. The contractors initially poorly performed the planning, layout and management of the construction activities, and it has been necessary for the MEC to assume additional responsibility in these areas to achieve adequate performance. The writer is satisfied that the current level of construction planning, quality assurance and quality control (QA/QC) is adequate to ensure the dam is built to the specifications of the design.

3. The site supervision, QA/QC and as built documentation, being performed by an experienced and knowledgeable team from MEC, is of excellent quality by any modern tailings dam construction standards. The team has been stretched to address shortcomings in the contractor site management, as well as the level of on-going site investigation and material source identification to meet the aggressive dam construction schedule. Extensive electronic data based construction records are being maintained. It is recommended that, in due course, all critical as built documentation be packaged in formats that will survive technical progress and obsolescence (such as producing paper copies) and stored in a secure long term facility, ensuring its availability, post mine closure, for long-term monitoring, maintenance and remediation.

4. Construction progress has not achieved schedule requirements to date and earthfill placement is being accelerated by implementing a two-shift construction schedule. Achievement of the schedule is crucial to the timely capture of water for ore processing start-up in August. The QA/QC resources to cope with the accelerated fill placement schedule are being appropriately increased. The writer cautions that due diligence must be maintained during the accelerated construction - to ensure that the required quality of fill placement not be compromised by schedule requirements.

5. The location and management of construction material is proving to be a challenge. Sources of an excellent low permeability core material have been identified and considerable work has been done to expose and define this resource. The suitable core materials occur in relatively small pockets scattered within the impoundment basin and adjacent slopes. The recovery of the core material from these deposits are being carefully managed to optimize resource utilization. Special care will be required during resource recovery to ensure that quality is consistent and within specification. Increased site supervision of material recovery, blending and conditioning at the borrow location may be required.

6. The rock to be recovered from the shell rock quarry area had not been adequately exposed to make a definitive assessment of the rock quality. Exposures available for inspection would likely yield run-of-pit rockfill with excessive fines and low rock strength (R2 and lower). It is anticipated that drilling and blasting, beyond the limit of ripping currently being performed, would yield rockfill of better quality. It is noted that the rockfill may be of marginal quality, which may be acceptable for the Starter Dam

construction, but would require re-assessment of the Stage 2 and 3 requirements. Stage 2 and 3 rockfill is due to be provided from the Open Pit waste rock stripping, and better quality rockfill is anticipated.

7. The filter and drain rock materials are being provided from a separate quarry in a aggregate plant established for this purpose. The aggregate plant appeared to be in excellent condition and well suited to producing the products required. The drain rock being produced is adequate and suitable. The filter material requires careful screening to achieve the grading envelope specified in the design. The filter being produced at the time of inspection appeared to satisfy specifications and to be adequate. Inspection of the stockpiles at the aggregate plant and at stockpile locations in the dam area indicated a high propensity to segregate. Given the broad even grading design of the filter and drain rock it is crucial that such segregation be prevented from happening during handling and placement. Special handling and inspection procedures are required for diligence in achieving an un-segregated filter.

8. The seismic analyses indicate the dam to be stable but predict displacements of approximately 1 m vertically and 2 m horizontally in the Phase 3 crest zone during the maximum design earthquake (1 in 10,000 year event). The design parameters are considered conservative but the displacements realistic for these parameters. Control of piping as a consequence of deformation induced cracking of the core becomes particularly important. To allow for such displacements, and the long-term performance requirements, post closure, it is recommended that filter and drain zones be increased in width in the upper portions (upper part of Phase 2 and Phase 3) of the dam to widths of 3 to 5 m (see recommendations Appendix A). MEG and MEC have indicated that this revision to the design will be made.

9. The grouting for the grout curtain has evolved in method and quality since the July inspection by the author. The author is satisfied that the grouting has, and is, being performed to the standards required to achieve the design objective of a continuous curtain to the designed depth of a permeability generally less than $1x10^{-6}$ cm/sec. The grouting record indicates that there is the potential for some limited zones with permeabilities moderately greater than $1x10^{-6}$ cm/sec below the installed curtain. Previous sensitivity analyses of seepage potential have indicated that any potential seepage through a 'window' below the curtain is relatively low. It is recommended that the grouting data be reviewed and an estimate be made of the potential for such windows; followed by a re-run of the seepage analyses to more accurately bracket the potential seepage. Should future water quality be such that such seepage becomes a concern, consideration may be given to accelerating the discharge of tailings from the dam crest to produce a low permeability upstream blanket. The effectiveness of such a blanket could be modeled during the seepage analyses, and would serve to demonstrate the effectiveness of this mitigation measure, should it ever be required.

10. The design for the main waste rock pile in the upper portion of the tailings impoundment is still in preparation and the writer looks forward to reviewing this on completion. The stability of the waste pile that has been placed to the east of the adit portal is influenced by the drainage across it (from an upslope gulley and adit drainage), the weak shear strength of the waste rock from the mill site excavations that have been placed in it, and the steep terrain underlying the waste rock pile. While this pile has been stable to date, during dry season conditions, there is concern that during the wet season the wetting up of the toe, increased drainage into the pile

and wetting-up of the dry weak waste rock in the pile will reduce the stability for both the current pile and its future development. This would place a risk on both men and vehicles working on the pile, or in the valley below the pile where foundation preparation for the main waste rock dump will occur. It is recommended that a stability evaluation be performed as a matter of priority, with the objective of being able to perform any mitigation measures that may be concluded from the study prior to the onset of the next wet season.

3.0 REVIEW ACTIVITIES

3.1 Site Visit July 12 to 14, 2004

Prior to making the site visit a 'Draft Tailings Disposal Facility Design Report' prepared by MEC was received and reviewed.

11th July 2004 – traveled from Vancouver to Guatemala City
12th July 2004 – traveled to the project site from Guatemala City to site by helicopter. In the company Mr. Dorey of MEC, made a site inspection as follows:

- Visited and viewed foundation excavations for core trench on right abutment (Photo B-4) and inspected exposed rock.
- Inspected equipment and viewed procedures for drilling and grouting of grout curtain on right abutment (Photos B-1, 2, and 3)
- Inspected diversion intake and pipe and foundation zone for coffer dam (Photo B-5)
- Inspect potential core material exposed in excavations in potential borrow areas
- Visited and viewed on site soils laboratory
- Visited and viewed the waste rock pile at the exploration adit entrance (Photos B-6 and 7) and inspected some available core from the underground exploration.
- Met MEC site QA/QC staff and discussed grouting procedures and grouting results obtained.

Returned to Guatemala City.

13th and 14th July 2004 - reviewed draft tailings dam design documentation in the offices of MEG in Guatemala City and discussed reviewed materials with Mr. Dorey of MEC and Mr. Miller of MEG. Comments on the designs were provided. The author requested and received permission for Dr. Peter Byrne, specialist in dynamic stability of dams to be consulted with regard to the dynamic stability analyses of the dam that had been performed.
15th July 2004 – traveled from Guatemala City to Vancouver

On returning to Vancouver Dr. Peter Byrne was consulted and provided with the relevant sections of the draft Design Report relating to dynamic stability analyses. Dr Byrne made recommendations for additional analyses and alternative analyses methods.

3.2 Meeting of November 13 and 14, 2004

Prior to the meeting of November 13 and 14, 2004, the author received a preliminary copy of the Marlin Project: Tailings Disposal Facility Design Report. Volume I, Main Report dated October 14, 2004. This Design Report was reviewed and the design discussed with Mr. Dorey and staff of MEC and Mr. Miller and Mr. King of MEG at a meeting in Denver on November 13 and 14, 2004. Comments on the design elements were provided at the meeting. These comments have been addressed by MEC and MEG in the final design documents.

Dynamic stability analyses methods and alternative analyses were on-going during this period with a number of analyses submittals and reviews by Dr Byrne.

3.3 Site Visit February 21 to 24, 2005

A revised and final design report 'Marlin Project: Tailings Disposal Facility Design Report. Volume I dated January 2005, Volumes II to V dated October 2004 and Volume VI attachment 2, dated November 2004 were received and reviewed prior to the site visit of February 21 to 24. The final report from Dr Byrne, which records his observations and recommendations, was also received and this report is attached as Appendix A.

20th February 2005 – traveled from Vancouver to Guatemala City
21st February 2005 – traveled to the project site from Guatemala City to site by helicopter. In the company Mr. Dorey of MEC, made a site inspections on the 21st and 22nd as follows:

- Inspected the excavations and foundations for core trench to the main dam (Photo C-1), including the right abutment foundation rock prior to dental concreting (Photos C-2 and C-3), the left abutment foundation rock and trenching for the low level outlet pipe (Photos C-4 and 5).
- Inspected on-going grouting equipment and procedures (Photos C-6 and 7).
- Inspected the foundation stripping and foundation for the main drain, the main drain materials and construction methods (C-8, 9 and 10).
- Visited the quarry being developed as a source for the crushing plant preparing material for the filter and drain as well as the aggregate plant installed to process the materials, and the products (Photos C-11 and 12). The quarry on the left flank of the impoundment being developed for the shell rock for the starter dam was also inspected.
- Inspected the excavation to bedrock for the monitoring weir (Photo C-13), and the foundation excavations for the pumpback system.
- Visited and viewed the stripping, foundation preparation and initial materials placement for the saddle dam on the right flank off the impoundment (Photo C-14).
- Inspected the waste rock pile formed at the adit entrance for underground exploration (Photo C-15), including the drainage from the backslope and valley and from the adit that is directed in culverts across the pile and discharges onto the face of the pile.
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On the 22 and 23rd, met with:

- MEC staff responsible for QA/QC and reviewed the grouting and check hole permeability test records and results, and
- MEG mine planner, Mr. Baptista, who is responsible for the geological block model and open pit planning and obtained plots of pit wall exposures of highly, marginal and non-acid generating rock types, as well as a tentative waste production schedule.

On the 23rd, prepared the key findings of this review and presented and discussed these with Mr. Dorey and MEC staff, and returned by plane to Guatemala City.

24th February, met with and discussed key findings with Mr. Miller of MEG and travelled from Guatemala City to Vancouver.

4.0 DESIGN REVIEW

This section provides the observations and conclusions of the author resulting from both a review of the design documents as well as the site inspections and discussions with MEC and MEG. The section titles and subject matter covered follow the same structure as the design report.

4.1 Project Description

This section includes description of the site-specific data applicable to the facility design including, climate, geology, hydrology and seismicity. This review has addressed particularly:

- The high precipitation resulting from hurricanes that occur in the area. Since local data is sparse, conservative values have been adopted from other areas subjected to similar conditions and we consider the resulting values conservative and appropriate.
- The high potential seismicity. The basis for seismicity and design acceleration determination was reviewed and found to conservative and appropriate.

This section also provides a description of the mine, mill and milling processes. It is noted that cyanide destruction using the SO_2/air process considerably reduces the toxicity potential of the tailings. Further, the initial TSF capacity is such that the facility will operate as a zero discharge facility for two years. During this period the water quality of the tailings can be determined with certainty and provision is made for the construction and operation of a water treatment plant should the water quality be found to require treatment to achieve discharge quality.

The open pit and underground waste rock will be placed in the waste rock facility (WRF), dump or pile, in the headwaters of the TSF (see Photo C-15). This ensures that any contaminated seepage from the WRF will drain to the tailings impoundment where it will be monitored and treated by the same system as the tailings discharge. However the stability of the WRF must be such to ensure that failure into the TSF will not occur under either static or dynamic loadings.

At the time of this review a revised WRF design was in preparation. It is understood that the revised design provides for a base drain and for construction to be made in lifts 'from the bottom up'. This is considered appropriate and we look forward to receipt of this report for review. It was further understood that the construction of the main drain and the establishment of first 'platform' below the toe of the current pile is due to commence as soon as an access road can be developed to the required location.

During the site visit it was noted that the waste rock pile that has been developed immediately east of the adit to the underground is located in a steep side valley (see Photo C-15). It was observed that:

- The current pile is located within a small valley or with a 'tight' toe, adding to its stability. However, this side valley is of limited size and the pile has utilized most of the available capacity before it overtops the 'ridge' that constrains it on its west side. Thereafter the pile will develop over steep unconstrained valley slope on this west side.
- It was also noted that the drainage from upstream is conducted over the pile in a culvert. The discharge end of this culvert appeared to have been buried at the time of the inspection. The adit drainage is drained over the pile in a pipe which

discharges beyond the dump crest but flows back into and under the pile. We understand that this pipe discharge is due to be located further west outside the tributary valley hosting the pile.

- During the inspection it was noted that material excavated from the plant site was being placed on this pile. This material is of variable strength and much of it of lower strength than the underground waste rock.

In view of the steep terrain over which the pile is being advanced, the potential for weak materials from the mill excavation, and the water being introduced into the pile, it is recommended that the stability conditions of this pile be re-evaluated with the objective of implementing any stabilization measures that may be appropriate prior to the onset of the wet season when working below the pile would involve increased risk. MEG is aware of the issues surrounding the current dump conditions and indicated to the reviewer that procedures for alleviating the potential stability and water management issues of the dump were being developed.

4.2 TSF and its Design Criteria

This section describes the basis for site, type and major component selection. We have reviewed the available materials and are in agreement that the investigation was appropriately broad in scope and area considered, and with the selected location and options. The basis for elimination of liners, diversions and other sites are defensible. The selection of a rockfill dam with a low permeability core is appropriate for the seismic and water balance conditions applying at the site. We concur that the dam centerline location has been optimized to suite the local topography, geological conditions, and operating requirements.

We have reviewed the design criteria, including those for seismicity, stability, storm events, control of solids and seepage releases and discharge controls. These are consistent with best international practice for facilities of this nature. We are of the opinion that these criteria meet World Bank/IFC, MAC (Mining Association of Canada) Environmental Policy and Tailings Guidelines.

Operating design criteria are considered appropriate and adequate.

This review has considered the facility closure characteristics and design preparation. We are satisfied that MEC and MEG have applied ‘design for closure’ principles for both the development and operation of the tailings facility.

4.3 TSF Site Selection and Investigation

The location of the dam centerline has been modified to take advantage of the local topography. We concur that the dam centerline location has been optimized.

The dam site and the impoundment basin, has been adequately investigated with drilling, sampling and testing to define the geotechnical and geohydrological conditions pertinent to the design, construction and operation of the tailings impoundment.

The excavation for the dam foundations, as well as the extensive testing performed with the construction of the grout curtain has not identified any substantial unexpected features or conditions.

Since the issuing of Report No 1 by this Board, geohydrological conditions have been investigated with additional drillholes in the right flank of the impoundment. We are satisfied that extent and quality of this investigation is sufficient to characterize the ash deposits forming the right flank ridge, and that permeabilities have been demonstrated to be adequately low to control seepage to the east. Seepage to the west is controlled by the groundwater height which is higher than the future elevation of tailings in the TSF.

4.4 TSF Site conditions

The geology, rock and soil properties of the dam site have been adequately characterized, as has been demonstrated now by the findings during excavation and foundation preparation.

4.5 Tailings Basin Hydrogeology

With the completion of the 2004 drillhole investigation program, and the grouting and testing program for the grout curtain, the hydrogeological conditions have been adequately investigated and characterized for design and seepage assessment purposes.

The permeability of bedrock is highest in the upper weathered zone. The potential for seepage in this zone is controlled by the grout curtain under the core of the Main Dam and the location of the low permeability east Saddle Dam (Photo C-14). Any seepage bypassing the grout curtain is expected to emerge in the stream channel immediately downstream from the grout curtain and be collected in a seepage collection pond. This pond is located on bedrock. In addition a monitoring weir close to the ultimate seepage collection pond is located on competent bedrock (see Photo C-13).

4.6 Foundation Construction and Tailings Characteristics

The geology, geotechnical and rock conditions of the site have been adequately characterized for foundation design and construction purposes, as has been demonstrated by experience during the earthworks and foundation preparation that has been completed. We have reviewed the investigation methods, laboratory testing and material properties summaries that have been prepared and are in agreement with these.

The borrow material for the low permeability core is found in shallow (2 to 5 m depth) deposits about the basin of the impoundment. These deposits are of limited extent requiring careful control of excavation in the borrow pits. Material placed in the east Saddle berm appears well suited to its purpose. MEC is alerted to the need for diligent control of excavation of this borrow at the source.

The identification of adequate and economic sources of other construction materials has proven to be somewhat of a challenge. Initial difficulties in securing a suitable source of filter material resulted in the requirement for this to be initially imported from a commercial source. A quarry has now been located in the Rio Quivichil valley downstream from the dam site. This was being developed during the period of the site inspection and R3 or better rock was being processed at an aggregate plant brought in for this purpose. Inspection of the plant indicated it to be in good condition and effective in producing the required products. It was observed that the filter material particles were rather ‘platy’ and highly susceptible to segregation (see Photo’s C-11 and C-12). The filter material meets grading specifications and is considered suitable. To prevent the segregation observed in Photo C-11 it will be

necessary to control segregation by adopting special placing methods and blending and mixing procedures in the field. MEC is alerted to this requirement.

The quarry for the shell rock was being developed during the site visit. Material had been removed only in the weathered bedrock that could be ripped. Observed exposures were of low strength rock (R1 and R2) and had very high fines contents. The suitability of rock at greater depth, likely requiring blasting, remained to be established. This rock may be marginal for Phase 1 dam construction. For Phases 2 and 3 the shell rock will be obtained from the open pit mining operations where drill core has established the presence of higher strength rocks (R3) that are expected to be suitable for dam construction.

Two additional samples of tailings material have been produced, representative of from the first and second half of mine life. Physical and geochemical testing of these tailings have been completed.

While the physical testing has a number of anomalous results, and the sample set is small, we are in agreement with the parameters selected by MEC for representative permeability and consolidated density, for use in TSF design. There is uncertainty as to what the 'correct' values will be, once full-scale production and actual field conditions of segregation and layering are established in the tailings pond. However the design of the impoundment, for the first two years of operation, is not highly sensitive to these properties, and it is recommended that they be checked during the first year of production. Should they prove to be substantially different from the values assumed the designs for later Phases of the dam can be amended appropriately.

Additional geochemical testing of the new tailings samples and supernatant provide a much improved indication of tailings effluent quality. These chemical analyses must be considered as 'indicator' tests only since actual field concentrations could be found to vary substantially from such small pilot scale samples. Natural degradation of some constituents will occur in the pond on a scale not reflected in laboratory testing. Solutions are gypsum saturated with low concentrations of a number of metals and ammonia at elevated concentrations.

The static testing for acid generating potential of the tailings indicate that they will not be acid generating. While kinetic testing has been performed and test results do not indicate significant propensity for neutral leaching.

We have reviewed the testing results and conclude that for this stage of evaluation the concentrations assumed for contaminant concentration estimation in the tailings pond and discharge waters are appropriate.

4.7 TSF Design

This section provides a detailed description of the TSF layout, elements of the design and its operation. It describes the sequence of construction, material sources and performance capabilities (such as flood storage capacity). We have reviewed these and are of the opinion that the facility has been thoroughly thought through. The design represents a practical, workable, economic system for tailings solids storage and mine and mill process water management. The Design Report provides a clear and rational description of all the major elements of this design, the way they are intended to function and design basis. All design assumptions and values are provided.

Numerous design measures and details have been discussed between the reviewer, MEC and MEG personnel at the July, November and February meetings. All questions, issues raised, and recommendations provided have been addressed satisfactorily, excepting only those which apply to later Phases of design and can be addressed later, or require additional information, such as shell rockfill properties from the quarry being developed, or production tailings effluent water quality.

We are in agreement with the basis for, and design of:

- Main Embankment
- Saddle Berm
- Embankment Internal Drains
- Grout Curtain
- Seepage Collection pond
- East Ridge Abutment Wells
- TSF Decant System
- Return Water System
- Tailings Delivery System
- Operation and monitoring to the extent explained (Operating Manual not yet available for review)
- TSF Embankment Monitoring
- TSF Closure to the extent explained (Closure Plan not yet available for review)

4.8 TSF Design Analysis

This section describes the various analyses performed to evaluate performance or design elements of the TSF. Considerable review effort was applied to the evaluation of these analyses. Questions raised during the July and November 2004, and February 2005 meetings have all been satisfactorily responded to.

4.8.1 Hydrologic Containment and Seepage through TSF Embankment

We have reviewed the basis and conclusions of the seepage modeling performed for both the basin-wide seepage modeling (MODFLOW modeling) and the seepage through the TSF embankment modeling (SEEP-W modeling). We are in agreement with the approach, parameters used, calibration (where applicable) and results.

The seepage estimates indicate low seepage values which, combined with the tailings effluent water quality anticipated, are not expected to result in environmental impacts to the downstream environment.

4.8.2 Stability

Considerable review was made of both the static and dynamic stability of the Main Dam. Since the stability is most critical during large seismic induced accelerations, these analyses control dam slope angles.

We are in agreement with the investigation and test work performed to determine the dam construction material strengths and deformation parameters as well as the seismic induced ground motion at the dam site.

Dr. Peter Byrne, specialist in dynamic stability analyses of dams, was the prime reviewer of the dynamic stability. Between July 2004 and February 2005 there were a number of reviews of interim analyses resulting in recommendations for alternative or additional analyses. MEC has responded to these questions and suggestions appropriately and a final conclusion has been reached as summarized in the Executive Summary section of the review report prepared by Dr. Peter Byrne.

"The expected movements for the design earthquake are quite large, but provided appropriate design features are incorporated in the dam, the risk of dam failure and the release of tailings, is minimal in the event of the design earthquake.

These features involve:

1. Provision of freeboard to accommodate at least 1 m of crest settlement;
2. Wide filters and transition zones to resist horizontal movements and possible tension cracks in the core. The filters should be at least 3 m and preferably 5 m wide and comprise of concrete sand with essentially no fines. The movements and accelerations are expected to be largest in the crest area, and particular attention should be paid to filter criteria in the top 20 m of the dam."

MEC has indicated that the filters and transition zones will be increased in width in Phases 2 and 3 of the dam, and this is considered appropriate.

4.8.4 Water balance

A detailed water and load balance has been developed to determine water release quantities and assess qualities. As for the previous analyses, these have been extensively reviewed. We are in agreement with the methodology and the factors and parameters used for the various inputs to the model. There is uncertainty with regard to many of the parameters, ranging from mine dewatering flows and qualities to precipitation variations (wet and dry years) and uncertainties regarding mill startup schedule. The water balance model has been used to demonstrate the sensitivity to some of these variables and can be used to manage the water accumulation strategy for the impoundment.

The model has demonstrated the ability to store the first two years of tailings and process affected water, and the rate and duration of discharge in subsequent years is estimated. Load balance calculations, based on conservative behaviour of effluent constituents, have been used to explore potential contaminant concentrations in release waters in the absence of water treatment. It is intended that the release of water from the impoundment will be regulated to match stream flow in the receiving environment (Quivichil and Rio Cuilco), such that concentrations in the receiving water is below levels of concern. It is understood that MEG are currently in discussions with Guatemala regulatory authorities to establish suitable downstream water quality objectives and discharge criteria. MEG have committed to achieving international standards of water quality in the downstream receiving streams.

MEG strategy for release management is to determine pond water qualities during the first year to establish if water treatment will be required. If required it would be installed and operational by the time discharge commences.

4.9 Construction Schedule

The design schedule indicates an earthworks placement schedule starting January 3rd and completion of work by June 30th, 2005. However, due to the projected delay in the delivery of materials on the critical path, at the time of February visit, the earthfill placement was projected to be delayed by about 6 weeks, and arrangements had been made for the contractor to go to double shifting for earthworks placement. The placement schedule is ambitious and the consequences of not achieving the completion schedule for water impoundment in the early wet season are substantial, in that lack of water in storage may limit mill commissioning and operation. Under such an ambitious schedule additional and diligent site supervision and quality control is essential to maintain the quality of dam construction. Particular care will be required for vulnerable elements such as the fairly narrow and segregation prone filter zone. MEC is aware of this concern and has made arrangements for additional staff to provide the site supervision required.

5.0 NEXT REVIEW MEETING

It is appropriate that the next site visit be made when the earthworks are nearing completion. The last week of May 2005, appears to be appropriate.

By that time it is anticipated that the reports for the design of the WRF and Attachments 1, 3 and 4 to Volume VI of the Design Report may be available for review.

The key findings from this review have been summarized in Section 2.0 of this report.

We would welcome the opportunity of answering any questions you may have wit respect to this report.

Yours truly

Dr. A. MacG. Robertson. P. Eng.
President – Robertson GeoConsultants Inc.