SAFETY REPORT

FOR

S.C. ROŞIA MONTANĂ GOLD CORPORATION S.A.

PREPARED BY: S.C. OCON ECORISC S.R.L.

MANAGING DIRECTOR:

UNIV. PROF. PhD ENG. OZUNU ALEXANDRU

OCTOBER 2010
General Coordinator:
Univ. Prof. PhD Eng. Ozunu Alexandru

Theme coordinator:
Eng. Coșara Gheorghe Viorel

Preparation Team:
Geographer PhD Arghiuș Viorel Ilie
Eng. Vana Alexandru Daniel
Drd. (col.) Eng. Roman Emil Grigore
Eng. Kocsis Violeta
Geographer Crișan Augusta Diana
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Information</td>
<td>6</td>
</tr>
<tr>
<td>I. Information on the management system and site organization in view</td>
<td></td>
</tr>
<tr>
<td>of major accident prevention</td>
<td>7</td>
</tr>
<tr>
<td>A. Major accident prevention policy</td>
<td>7</td>
</tr>
<tr>
<td>B. Safety Management System</td>
<td>8</td>
</tr>
<tr>
<td>a) Organization and personnel</td>
<td>9</td>
</tr>
<tr>
<td>b) Identification and evaluation of major hazards</td>
<td>10</td>
</tr>
<tr>
<td>c) Operational Control</td>
<td>11</td>
</tr>
<tr>
<td>d) Modernization Management</td>
<td>12</td>
</tr>
<tr>
<td>e) Planning for emergency situations</td>
<td>13</td>
</tr>
<tr>
<td>f) Performance monitoring</td>
<td>14</td>
</tr>
<tr>
<td>g) Audit, analysis and revision</td>
<td>15</td>
</tr>
<tr>
<td>II. Description of the Project location</td>
<td>16</td>
</tr>
<tr>
<td>A. Site description</td>
<td>16</td>
</tr>
<tr>
<td>1. General presentation</td>
<td>16</td>
</tr>
<tr>
<td>2. Topography</td>
<td>17</td>
</tr>
<tr>
<td>3. Geology</td>
<td>17</td>
</tr>
<tr>
<td>4. Hydrogeology</td>
<td>18</td>
</tr>
<tr>
<td>5. Tectonic structure, seismic activity</td>
<td>19</td>
</tr>
<tr>
<td>6. Groundwater</td>
<td>21</td>
</tr>
<tr>
<td>7. Surface Water</td>
<td>22</td>
</tr>
<tr>
<td>8. Climate</td>
<td>22</td>
</tr>
<tr>
<td>9. Soils</td>
<td>23</td>
</tr>
<tr>
<td>10. Natural risk area</td>
<td>23</td>
</tr>
<tr>
<td>11. Ecosystem</td>
<td>23</td>
</tr>
<tr>
<td>Identification of installations and other activities within the site</td>
<td>23</td>
</tr>
<tr>
<td>posing major hazards</td>
<td></td>
</tr>
<tr>
<td>Description of areas where a major accident may occur</td>
<td>24</td>
</tr>
<tr>
<td>1. Mining areas</td>
<td>24</td>
</tr>
<tr>
<td>2. Process plant</td>
<td>24</td>
</tr>
<tr>
<td>3. Tailings Management Facility</td>
<td>28</td>
</tr>
<tr>
<td>4. Cetate waste and mine drainage dam and pond</td>
<td>29</td>
</tr>
<tr>
<td>5. Explosives storage facility</td>
<td>29</td>
</tr>
<tr>
<td>6. Piping system</td>
<td>29</td>
</tr>
<tr>
<td>7. Waste rock dumps</td>
<td>30</td>
</tr>
<tr>
<td>III. Plant Description</td>
<td>31</td>
</tr>
<tr>
<td>A. Description of activities and main products pertaining to those</td>
<td>31</td>
</tr>
<tr>
<td>parts of the site significant from the point of view of safety,</td>
<td>31</td>
</tr>
<tr>
<td>major accident risk sources and conditions generating such a major</td>
<td>31</td>
</tr>
<tr>
<td>accident, as well description of proposed prevention measures</td>
<td>31</td>
</tr>
<tr>
<td>1. Gold ore mining</td>
<td>31</td>
</tr>
<tr>
<td>2. Ore grinding</td>
<td>31</td>
</tr>
</tbody>
</table>

Prepared by S.C. OCON ECORISC S.R.L. Turda | 1
Safety Report
S.C. Roşia Montană Gold Corporation S.A.

3. Cyanide dissolution and storage 31
4. Cyanide leaching 32
5. Gold and silver recovery 32
6. Tailings detoxification 33
7. Tailings Management Facility 33
8. ARD treatment 33
9. Waste rock stockpiling 34

B. Description of processes, particularly of operation techniques 34
1. Gold ore mining 34
2. Ore grinding 35
3. Cyanide dissolution and storage 35
4. Cyanide leaching 35
5. Gold and silver recovery 36
6. Tailings detoxification 37
7. Tailings Management Facility 38
8. ARD treatment 39
9. Waste rock stockpiling 39

C. Description of hazardous substances 40
1. Inventory of hazardous substances 40
2. Characteristics of the main hazardous substances 47
3. Toxicological and ecotoxicological characteristics of cyanide 49
4. Physical and chemical properties of cyanide under normal conditions of use and predictable accident conditions 52

IV. Identification of Relevant Safety Sections and Sources of Hazard 55
A. Detailed description of potential accident scenarios and their probability of occurrence, circumstances in which they may occur, including a summary of events that may play a role in triggering one of the scenarios, taking into consideration both internal and external causes for the facility. 55
a. Mining Operations Areas 55
b. Site haul routes 56
c. Process Plant 56
d. Pipeline Routes 64
e. TMF 64
f. Cetate ARD Catchment Dam 70
g. Stockpiles 71
h. Explosives storage 71

B. Assessment of the size and seriousness of the consequences of the identified major accidents 71
1. Quantitative risk assessment 71
2. Quantitative Risk Analysis 81
   a. Presentation of the Physical-Mathematical Models Used in Assessing the Consequences of Major Accidents 82
   b. Detailed risk analysis 83
c. Assessment of Cumulated Health and Environmental Risks 105
d. Conclusion 114

C. Description of technical parameters and equipment used for facility safety 115

Prepared by S.C. OCON ECORISC S.R.L. Turda
V. Protection and response measures to limit the consequences of an accident 116
   A. Description of equipment installed on site to limit the consequences of major accidents 116
      1. Tailings Management Facility 116
      2. Wastewater treatment plants 116
      3. Structures for collecting and impounding accidental spills of fluids containing dangerous substances 118
   B. Alert and response 118
      1. Definitions 118
      2. Emergency Organization Chart 121
      3. Declaration of emergency situation and implementation of alert state 138
      4. Information – alarm - notification 139
      5. Action procedures by emergency classes 142
      6. Specific response procedures 143
   C. Description of mobilized resources 148

Summary of elements described under letters A, B, C required to develop the Internal Emergency Plan 151

Annexes

Annex 2.1 Map of Rosia Montana area
Annex 2.2 The location of the safety areas within Roșia Montană Project site
Annex 2.3 Hazard sources identified within the processing plant boundaries
Annex 2.4 Rosia Montana Project location with respect to “Natura 2000” sites
Annex 2.5 Existing situation
Annex 2.6 Side Wide Water Table Contours
Annex 2.7 Site layout plan - end of Year 19 of operation
Annex 3.1 Process Flow Diagram
Annex 3.2 TMF Cross Section
Annex 3.3 Technical safety sheets
Annex 4C1 Simulated HCN emission dispersion at the processing plant total destruction
Annex 4C2 Simulated HCN emission dispersion from the CIL tanks
Annex 4C3 Simulated HCN emission dispersion from the CIL tanks
Annex 4C4 Simulated HCN emission dispersion from the slurry thickener
Annex 4C5 Simulated HCN emission dispersion from the slurry thickener
Annex 4C6 Simulated HCN emission dispersion from the DETOX facility
Annex 4C7 Simulated HCN emission dispersion from the DETOX facility
Annex 4C8 Simulated explosion of the LPG storage tank
Annex 4C9 Simulated fire in the diesel storage tank
Annex 4C10 Simulated diesel fire in the retention tank
Annex 4C11 Simulated diesel explosion in the storage tank
Annex 4C12 Simulated flood due to the Cetate Water Catchment Dam break
Annex 4C13 Simulated explosion in the explosive storage facility
List of Tables

Table 1.1  Risk Factors
Table 2.1  Stratigraphic units
Table 2.2  Lake Data
Table 3.1  List of hazardous substances present on the site
Table 3.2  List of hazardous substances present on the site which exceed the specific relevant levels according to the Seveso Directive (GD 804/2007)
Table 3.3  Composition of slurry liquid phase
Table 3.4  The average chemical composition estimated for the process water
Table 3.5  Estimated chemical composition of acid water collected in the Cetate drainage pond
Table 3.6  Dissociation constant and approximate concentration of free cyanide
Table 4.1  Risk analysis associated with dam break and release of tailings and water over the crest
Table 4.2  Risk Quantification Matrix
Table 4.3  Qualitative Risk Analysis
Table 4.4  Reference Thresholds
Table 4.5  Maximum cyanide concentrations (mg/l) estimated considering the worst rainfall event followed by a flood in case of increased river flow for the volumes of materials stored in year 17 of operations
Table 4.6  Movement time and maximum cyanide concentrations in case of release of 26,000 m³ of polluted water during 24 hours at a total cyanide concentration in the TMF of 5mg/l, in high flow conditions
Table 4.7  Movement time and maximum cyanide concentrations in case of release of 26,000 m³ of polluted water during 24 hours at a total cyanide concentration in the TMF of 5mg/l, in low flow conditions
Table 4.8  Concentrations of metals in the TMF
Table 4.9  Maximum flood wave height on various flow sections
Table 4.10  Determination of the potential hazard level for the most representative elements for the rapid assessment of industrial risk
Table 4.11  Calculation of the Site Technological Factor (STF)
Table 4.12  Potential Hazard Categories
Table 4.13  SOF Calculation
Table 4.14  SGI Calculation
Table 4.15  DSI Calculation
Table 4.16  DSI Calculation
Table 4.17  Natural Hazard Indicator (NHI)
Table 4.18  NHI Calculation
Table 4.19  Hazard assessment indicators
Table 4.20  Indicators of health and environmental risk assessment
Table 4.21  Indicators of general environment and health vulnerability assessment
Table 4.22  Classification scale of environment and health vulnerability assessment
Table 5.1  Response equipment
Table 5.2  Cabinets with emergency response equipment
Table 5.3  Inventory of typical cabinet equipment
Table 5.4  Inspections on emergency response equipment
List of Figures

Figure 2.1  Rosia Montana Project site location
Figure 2.2  Seismic zonation of Romania based on MSK intensity scale according to SR 11100-1:93 “Seismic zonation. Macro-zonation of Romania”.
Figure 2.3  Zonation of peak site acceleration for earthquakes with 1:100 years return period
Figure 3.1  pH and salinity dependence of the cyan ion hydrolysis
Figure 4.1  Example of tree event presented in NGI Report, 2009
Figure 4.2  The effects of the explosion of the LPG storage tank on people in the area
Figure 4.3  Estimation of cyanide concentrations (mg/l) for an event resulting in the release of tailings over the dam crest followed by discharge into the Mures river system in conditions of increased water flows for the volumes of materials stored after 17 years of operation (the water flow rate estimated to be discharged from the Corna TMF is of 2 m³/sec during 12 hours, which means a total volume of 100,000m³)
Figure 4.4  Cyanide concentrations in case of release of 26,000 m³ of polluted water during 24 hours at a total cyanide concentration in the TMF of 5mg/l, in high flow conditions
Figure 4.5  Cyanide concentrations in case of release of 26,000 m³ of polluted water during 24 hours at a total cyanide concentration in the TMF of 5mg/l, in low flow conditions (Note: The ordinate scale was reduced in order to show the concentrations on the lower courses of the river system)
Figure 4.6  The global scheme of the REHRA approach
Figure 4.7  Probability, risk and vulnerability associated with the operation under review
Figure 5.1  Emergency Organization Chart at S.C. Roşia Montană Gold Corporation S.A.
Figure 5.2.  Notification - alarm diagram at S.C. Roşia Montană Gold Corporation S.A.
General Information

Titleholder of the Study: Roșia Montană – main office – Str. Piața nr. 321A, cod 517615, Alba County Tel: +40 258 806.750, Fax: +40 258 806.749, CUI RO 9762620, Registry of Commerce J 01/443/1999;
Contact Person: Dragos Tănase, Managing Director S.C. Roșia Montană Gold Corporation S.A. Tel: +40 21 223.1351, F: +40 21 223.1408

Activity carried out on site: “Mining of gold and silver ore in the Rosia Montana tenement, Alba County”

The certified author of the document: SC OCON ECORISC SRL, Environmental Evaluator, Registration Certificate with the National Registry of Evaluators of Environmental Protection Studies under no. 105, certified R-EIM–05-38/2008 and R- BM–05-36/2008. Tel./fax.: 0264 315464, mail: oconecorisc@oconecorisc.ro,

Title of Document: Safety Report, S.C. Roșia Montană Gold Corporation S.A. Alba County, for mining project “Mining of gold and silver ore in the Rosia Montana tenement, Alba County”

Legal Basis: The Document was prepared in accordance with the legal requirements of GD No. 804 of 25 July 2007 on the control of major accident hazards involving hazardous substances, amended by GD 79/2009, provided by Art. 2 and 10 and described in Annex no.2 to the above mentioned decision.
I. Information on the management system and site organization in view of major accident prevention

A. Major accident prevention policy

RMGC is a company interested in the development, implementation and improvement of certifiable management systems on environment, health and safety and social responsibility which underlie the Company’s strategy, at the same time being in line with the Romanian laws and EU Directives, as well as international standards. In this sense, the Company will initiate all necessary actions to prevent or minimize the risks to the population, environmental and economic.

Operational safety is a strategic objective of RMGC, the Company aiming to reduce the incidents related to production, facilities, on-site activities and other related activities carried out within and outside the site. In order to achieve this strategic objective, RMGC will prepare and maintain its own safety management system to be imposed also to its partners.

The major accident prevention policy is a commitment of RMGC towards a sustainable development based on the protection of human health, natural environment and prosperous economy. The basis of this policy is the application of technical measures recognized at international level and economically viable to achieve a sound environmental protection throughout its activity.

In this context the main proposed objectives are:
- minimizing the potential environmental risks;
- compliance with the legal acts and regulations;
- training of the personnel with respect to the risks and environmental issues involved by their activity.

Application of this policy is the responsibility of all the Company’s departments under the coordination of the environmental manager who is responsible for the implementation and communication of the policy to the employees. The permanent communication between operational departments is the basis of an efficient implementation while monitoring through periodic safety audits ensures application of likely corrections.

The environmental performance regarding compliance with the rules and regulations are reported to the Company management according to strict rules.

The general policy for the prevention, preparation and responsibility in case of industrial accidents is based on the following principles:
- prevention which involves the construction and operation of the process plant in a manner that ensures any uncontrolled development of abnormal operations, minimisation of potential accident consequences and compliance with the best available safety techniques;
- identification and assessment of major hazards by systematic studies of operability and assessment of specific risk factors, as well as conducting individual and detailed safety analysis for each identified hazardous situation;
- evaluation of safety requirements rated as per “type and scale of potential hazard” and on the basis of the amount of hazardous substances and industrial activities subject to and relevant for accidents.
- priority to protection and saving of human life.

For the application of these principles, RMGC will carry out the following activities:
- provide the necessary resources for the development of the management system in view of carrying out its operations based on the principles of sustainable development;
- permanently communicate with all stakeholders for the application of the best technologies available at international level and economically viable to ensure a sound protection of the environment and population within all activities;
- monitor, update and communicate on a permanent basis the specific list of hazardous substances handled on-site and contacts from the competent authorities which should respond in case of emergencies;
- raise awareness and disseminate within the community the specific issues that can generate emergencies preparing the population for an immediate response.
- immediately warn the population on the risks of pollution and contamination for the adjacent areas and intervene with all available resources and means to protect the population and remove the pollution effects.

B. Safety Management System

The objective of the Company management is to achieve economic-financial performance under optimal conditions for environmental protection, safety and health of employees and population, which aim to ensure prevention and minimisation of accident hazards.

With regard to safety, S.C. Roşia Montană Gold Corporation S.A. management commits to the following:
- **Compliance** with the current safety regulations and development thereof, relevant for the Company operations;
- **Continuous improvement** of the safety performance in order to prevent accidents;
- **Training and awareness** of the Company staff regarding the technical and organisational measures as well as regulations in force relevant for each specific activity;
- **Mitigation or removal of accident hazards**, by defining preventive measures ensuring a permanent safety improvement;
- **Regular analysis** of the safety activity.

S.C. Roşia Montană Gold Corporation S.A. is aware that due to the specific nature of its activities which involve use, handling and storage of toxic and hazardous substances, the proposed project may be the source of a major accident with adverse impact on employees, population, natural and anthropogenic environment, therefore it assumes the responsibility of taking all measures to avoid this hazard.

The particular hazard potential of the activity is generated by the following:
- employment of technologies and facilities which use toxic or hazardous substances (particularly cyanide and heavy metals);
- handling of significant amounts and presence of large stocks of materials consisting of potentially toxic substances;
- location of the tailings management facilities at a rather high distance from the process plant and installation of long pipeline routes for the hydraulic transport of hazardous substances;
- presence of staff working on a daily basis and possibility of human error during operation.

The very high hazard potential of RMGC’s activity justifies the requirement to draw up an **Internal Emergency Plan** based of the provisions of GD 804/2007 (amended by GD 79/2009) and MAI Order 647/2005.

Adoption and proper application of the Internal Emergency Plan is the responsibility of all employees, based on their job descriptions describing the specific duties and tasks. The work and labour safety rules as well as emergency response rules are integral part of this plan.

According to Order MAI No. 712 of 23 June 2005 (amended by OMAI No. 786/2005), training of employees in the emergency situation field for the purpose of acquiring the knowledge and skills required for the prevention and mitigation of impacts of emergency situations or disasters at the workplace or on-site shall be carried out.

In the relation with business partners (suppliers of goods and / or services, subcontractors etc.), RMGC shall define and pass on the rules and specific safety measures and set specific tasks and responsibilities deriving from the warning and emergency response plan which the partners must adhere to.
The Safety Management System (SMS) is the part of the general management system which includes the organizational structure, responsibilities, practices, procedures, processes and resources to define and implement the major accident prevention policy.

The safety management covers the following aspects: organization and personnel, identification and assessment of major hazards, management for modernization, adoption and implementation of predictable emergency identification procedures, performance monitoring, operational control.

a) Organization and personnel

S.C. Roșia Montană Gold Corporation S.A. understands the importance of using sufficient and adequate resources and direct involvement of the management at all hierarchical levels in order to successfully achieve the safety goals.

In this context, the Company management certifies and communicates the roles and responsibilities, provides the necessary means and ensures that all employees are aware of their responsibilities with respect to safety.

The management permanently develops and updates the Company’s organizational structure, list of duties (job description) for each safety related position and list of relevant responsibilities for these positions and also any likely organisational tool (committee, work group etc.) which will participate at the implementation and maintaining of the safety systems.

In order to limit and remove the emergency situation impacts S.C. Roșia Montană Gold Corporation S.A created and equips its own emergency services and structures, based on the performance criteria issued by the General Inspectorate for Emergency Situations. The authorization of these structures will be conducted based on the Methodological Rules issued by the General Inspectorate for Emergency Situations and approved by the Ministry of Administration and Internal Affairs.

The intervention structure for emergency situations is incorporated in the RMGC organizational structure and the duties are defined in the Company Operational Rules and Internal Rules.

The site emergency structure will consist of:
- Emergency Cell
- Private Department for Emergency Situations

The specific duties of the personnel involved in the emergency management and response which are also specified in the organisational structure will be detailed in Chapter V.

Qualification and education

The qualification level of the staff is proved by the documents submitted upon employment. The experience in the activity field is proved by records in the Labour Record Book.

The training of personnel in the emergency situation field is conducted according to OMAI 712/2005 as follows:
- upon employment through general introductory training;
- before the actual commencement of activity by training at the workplace;
- regularly, once a month, as per the training schedule;
- in case of changes or commissioning of facilities;
- in case of special works other than the normal work and which involves special hazards.

The staff is trained by the workplace supervisor, based on a training schedule along the following directions:
- Professional;
- Labour Health and Safety;
- Fire defense;
- Environmental protection;
- Quality of products.
The production activity is carried out as per the “Operational Rules” of the facilities. There are operating procedures regulating the conduct of the personnel assigned to various work sectors. Obligations to comply with the technology, labour safety and health instructions, fire defense and environmental protection and product quality are defined.

The spills, discharges, leakages of hazardous substances that may lead to major accidents are avoided by compliance with all relevant provisions. In case of emergencies, the provisions of the Operating Procedures, Emergency Preparedness and Spill Contingency Plan or Internal Emergency Plan will be complied with.

The operational staff is trained on a monthly basis, while the technical staff on a 6 month basis. The responsibility of staff training lies with the management. Operating, labour safety and health and fire safety instructions are displayed at work places. The supervisors of work places must permanently check the compliance with all specifications, i.e.: compliance with the technological process, observance of labour safety and health and fire defense rules and rules for detection of potential failures. The supervisors of work places, facilities or departments will take all necessary measures to remove the faults or failures occurred.

The supervisors of work places will test the subordinated personnel with respect to the knowledge acquired during training. The personnel is tested on a regular basis by simulation of accidental pollution or other emergency situations and practical exercises will be conducted to test the response.

b) Identification and evaluation of major hazards

Identification and evaluation of major hazards involves detection of potential hazards generated by both operations and particularly by the characteristics of the substances stored on site. The characteristics of the products deposited on site as hazardous substances are defined in the technical safety sheets which contain relevant data regarding the safety of the products. The safety sheets are explained to the employees during training sessions before they come into any contact with the hazardous substances.

Under certain conditions, storage, use and handling of large amounts of hazardous substances may lead to major risk situations requiring alarming of the personnel. The major accident hazard is determined by the co-existence of several risk factors presented in Table 1.1.

Table 1.1. Risk Factors

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Potential Risk Factor</th>
</tr>
</thead>
</table>
| Chemical| - storage and handling of toxic and potential hazardous substances;  
           - current or accidental emissions or spills of toxic or hazardous substances |
| Explosion| - accidental development of mixtures of gases and air above the explosion limits;  
             - recipients and installations under pressure. |
| Fire    | - storage of flammable substances (activated carbon, packaging etc.);  
           - use of flammable substances (LPG, petrol);  
           - electric grids. |

The potential for natural calamities should also be taken into consideration: seismic activity, landslides, severe meteorological events, as well as terrorist attacks or air attacks.

In order to identify and evaluate the accident hazards within the site, qualitative methods (matrix method) and quantitative methods specific fire and explosion related accidents are used. In this respect, for the purposes of this report the consequence-based method with simulation of accidental scenarios considered relevant was used. The resulting evaluations will be presented in the following sections.

While RMGC's operation is complex, the use of cyanide is the key aspect of the safety management, therefore its design is based mainly on the proper cyanide management.
Cyanide has been used safely and efficiently in the gold metal industry for many years, however it is a very hazardous substance which should be used with special care, by employing procedures and principles which should ensure its effective, economic and safe use with no impact on the environment. The ecological cyanide management means responsible use of cyanide so that it does not affect the environment or workers, by rigorous control of its transport, storage, handling, emergency procedure, personal hygiene of the workers and monitoring of the working environment. It is also required to employ well trained personnel properly equipped who should understand the effect of cyanide on humans and natural environment, as well as treatment methods to be used in case of cyanide exposures.

The basic principles used to control the environmental impact of cyanide are as follows:
- use of minimal cyanide amounts required for gold recovery and maximisation of recycling;
- cyanide disposal with minimum environmental impact;
- monitoring of all operations, cyanide discharges and environment to detect any cyanide spills and respond to minimise its effects.

Contribution of external factors was taken into account for risk identification and assessment, as follows:
- historical and current contamination of the environment in the area where the process facilities will be installed;
- abnormal climatic conditions (precipitations, temperature, seismic activity, wind, landslides, floods);
- road networks, adjacent engineering constructions;
- adjacent industrial and public activities.

In the process of identification and assessment of major hazards, risk and environmental impact assessment studies, process and environmental monitoring (mainly water balance) are and will be used, as well as the results of investigations conducted as a result of potential incidents and accidents. A clear link between the identified risk and measures taken will be ensured through a hierarchical approach aiming to prevent major accidents or ultimately minimisation of impacts by employing safety practices in all work places.

c) Operational Control

The S.C. Roşia Montană Gold Corporation S.A. operational control will provide input data for the measures to be taken in case of deviation from normal operating parameters.

The operational control of the Company will consist of two main components i.e. process monitoring and environmental monitoring.

Process monitoring consists in the measurement, permanent control and recording of the process technical parameters in accordance with the operating instructions and specific procedures in order to achieve the proper technical parameters as well as to maintain the operational safety. The monitoring results ensure the early detection of potential failures or abnormal operation of installations and equipment, underlying the decisions regarding implementation of remediation measures, partial or total closure of activity or even initiation of alarming and response procedures.

“Working instructions” will be posted at each work place which will include all normal operating parameters of the respective installation or machinery. The staff servicing the different work phases is trained and tested on a regular basis. The working instructions include the actions to be taken in case of failures or flaws.

The installations operation is monitored by means of measuring and control devices and by the operational staff. Each work place within the site has a defined area under supervision. In case of an event triggering an emergency situation, the operational staff will alarm the site for the initiation of response procedures.

The maintenance of installations will be conducted based on a plan defined for this purpose.

Environmental monitoring includes continuous or periodic analysis of water and air quality within the site and verifications against the environmental standards. The monitoring results ensure the
early detection of potential failures or abnormal operation of installations and equipment, underlying the decisions regarding implementation of remediation measures, initiation of chemical alarming and response procedures. In case of failures resulting in major accidents a continuous monitoring of the affected areas is conducted until the total remediation of the impacts.

The analysis will be conducted in the Company's own laboratory and periodically (for control / calibration) in certified laboratories.

d) Modernization Management

Modernization management within S.C. Roșia Montană Gold Corporation S.A. takes into consideration the planning and control of all changes within the management, staff, installations, technological processes and operating parameters, materials and raw materials, measurement and control equipment as well as safety equipment, operating rules and working instructions, software and where applicable changes due to external circumstances capable of affecting the major accident risk control. The permanent, temporary or urgent changes are considered.

Identification, communication and modernization management are the responsibility of each concerned person.

The principles applied for the modernization management system consist in:
- identification and definition of the proposed changes maintaining and documenting in detail the changes involving a significant modification;
- assigning responsibilities for initiation and authorization of changes (depending on the specific nature and area affected by the proposed change);
- assessment and prioritization of environmental and safety implications of the proposed changes (possibly in cooperation with external experts);
- definition and documenting of the control measures of the proposed change impacts on the environment and safety;
- approval, allocation of resources and then implementation with verifications after implementation.

The change initiation process will involve all the Company staff; documenting will be conducted by the S.C. Roșia Montană Gold Corporation S.A. technical specialist staff possibly in cooperation with external experts. Approval and allocation of resources are duties of the executive management, the actual execution is (normally) carried out by external specialist companies while implementation (including information, training of executive staff and monitoring) is the responsibility of the manager of the operational sector where the change occurs.

The operational safety and effectiveness are taken into consideration in the early design stages to ensure that the changes are designed, implemented and tested accordingly and to avoid major accident risks and mitigate the effects of such accidents, based on a detailed risk assessment.

Evaluation of environmental and safety impacts of the proposed changes is reflected in impact assessment studies prepared by specialist companies according to the legal regulations where due to the nature of the site, the section dedicated to risks must be very well developed (depending on the anticipated hazard). The measures regarding the modernization management are related to the removal of uncertain situations occurring during activities and preparation at the management level of the phases preceding the required changes. Following assessment, decisions on the likely design changes, continuation of works and agreements with suppliers and subcontractors are adopted.

Changes which may occur and change the S.C. Roșia Montană Gold Corporation S.A. processes are of the following type:
- Legislative;
- Contractual with contractors and subcontractors;
- Physical changes at installations, processes, process flow due to implementation of investments or cancelling of some activities;
- Occurrence of natural and/or anthropogenic hazards.

The modernization management principles described above are applied also to the changes occurring during the design and construction of installations, processes or storage facilities. Thus, for
new investment projects techniques will be implemented which will minimise the environmental impact and associated risks.

Any significant change implemented within the Company involves the review and if applicable the modification of the Safety Management as well as notification of the competent authorities.

e) Planning for emergency situations

All emergency situation plans are integrated in a consistent and coherent management system of major accident risks. The objectives are specific, measurable and can be effectively achieved. The need to regularly update (whenever necessary) is also addressed, considering the following:
- advance of technical knowledge;
- experience gained from potential incidents and accidents occurred on or off site;
- lessons learned during the implementation of emergency plans;
- significant changes;
- human behaviour as response to emergency situations.

A regular inspection of the resources, equipment and emergency response system is conducted to ensure they are at any time operational.

Resources will be allocated for the restoration and environmental reconstruction of areas affected by a potential major accident.

The development, maintenance and improvement of the safety management system will be ensured by clearly defining the responsibilities (who has to do, when and with what results) and regular verifications of their fulfilment at all execution and decision making levels.

The emergency situation plans will address the systematic identification of any major accident consequences formulated in writing and containing:
- description of the emergency situation preparation;
- provision of the records regarding the application of the necessary measures at the right time;
- potential emergencies that may occur in all accident scenarios;
- description of the coordination and communication during an emergency response action;
- agreements with other companies or institutions for the provision of resources for emergency responses if the own response systems are insufficient;
- description of internal and external resources which may be mobilized to limit the effects of a major accident on people and environment;
- provision of sufficient personnel within a reasonable period of time to lead and act according to the Internal Emergency Plan;
- provision of intervention equipment, according to its purpose, available at all times and in perfect operational condition;
- provision of resources required for monitoring and sample collection in case of a major accident;
- description of the mobilisation of medical emergency services in case of a major accident

The emergency situation plans will be checked regularly through exercises organised by the Company and exercises organised in common with response teams from the County Inspectorate for Emergency Situations, based on a commonly agreed schedule.

f) Performance monitoring

Procedures for identification, inspection and testing of installations, processes, machinery, constructions and key measurement devices are established for performance monitoring and also for evaluation of the compliance with the training requirements, work procedures and practices relevant for major accident prevention.

The decisions on any aspect of the facility, equipment etc. and procedure or activity to be monitored, monitoring frequency and level of detail are based also on risk considerations and are taken by the executive management of the Company.
An active monitoring will be conducted in relation to the major risk control activity, including:
- regular inspection of installations, equipment, tools and control systems which are relevant for the permanent and effective operational control in relation to major accident prevention;
- regular and direct monitoring of the labor and staff behavior to assess the compliance with the safety procedures and rules relevant to major accident prevention;
- periodic examination of operational and environmental monitoring records to verify the compliance with safety standards;
- verification by managers of the quality of monitoring activity carried out by the subordinated personnel.

A reactive monitoring of the performance will also be conducted that will provide the opportunity to learn from mistakes and lead to safety improvement. In this respect, the following aspects will be recorded, notified, reported and used in the safety improvement process:
- potential major accidents;
- any relevant incidents and cases of disease;
- any significant events leading to environmental damage;
- other incidents (including individual behavior with environmental damage potential and particularly those with major accident potential);
- weaknesses and omissions in the risk control system significant for major risk prevention;

In the evaluation and valorization of the reactive monitoring results the occurrence site, nature and cause of the event, potential impacts, their severity and associated costs will be taken into account and the conclusions will consider the performance evolution (improvement or worsening) and define the required remediation measures.

Monitoring of safety culture implemented by the Company is an important part of the safety performance monitoring. It consists in the evaluation of the employees’ conduct at all hierarchical levels with respect to the control, communication, cooperation as well as capacities of the personnel involved in the safety management.

Investigation of the failures identified by active and reactive monitoring of the safety performance consist in:
- preliminary evaluation for immediate risk identification and prompt action (to be conducted by the work place supervisors with subsequent reporting to the superior hierarchical level);
- determination of direct causes and related management issues (to be conducted by the executive department leaders and reported to the management);
- Company management decision on the detailing of investigations, the detail level and nature thereof (based mainly on potential considerations than on the actual result), as well as fulfilment responsibilities.

The investigation of failures will take into consideration all relevant aspects including the human factor and the results will be compiled in a written report submitted to the executive management who decides on the remediation action required to improve the safety management.

**g) Audit, analysis and revision**

The purpose of the audit is to establish whether the organisation, processes and procedures conducted in accordance with the provisions of the prevention policy and SMS comply with the legal regulations and internal regulations of the Company. The audit results are used to define the improvement method of the SMS components and implementation of the improvements.

An effective safety management involves also a periodical evaluation of the major accident prevention policy. This evaluation involves internal permanent monitoring (also by operational control and environmental monitoring) and periodic evaluations conducted by independent auditors (also through the competent State Inspection Authorities).
The responsibility for the overall audit program lies with the executive management and the management will nominate an internal coordinator for each audit within the program. The Management System audits are carried out internally as primary and secondary audits, and also from the outside by third parties in view of ensuring the Management System effectiveness. The results are discussed with the management staff and members of the Executive Committee and the actions generated by the audits are permanently monitored.

The audit will be conducted by independent certified auditors with proven experience and capacity and the Company will make available all necessary material and human resources for the audits, taken into account the expertise, operational independence and technical support requirements. The audit results will be reported in writing and the report will include the procedures, standards and references used, the work methodology, investigations and measurements conducted, conclusions and recommendations.

Any external audit will be subjected to the analysis of the Company’s technical staff who will provide considerations on the accuracy of the resulting audit conclusions and then to an independent verification (by competent institutions) to confirm the reliability of the audit.

Finally, the audit results are used in the revision process of the major accident prevention and policy and strategy and risk control.
II. Description of the Project location

A. Site description

1. General presentation

Rosia Montana is a commune located in the central western part of the Alba County, approximately 80 kilometers (km) northwest of the regional capital of Alba Iulia, and 85 km north-northeast of the City of Deva and borders the Campeni town and Bistra locality on the north, the Abrud town on the south–west, the Bistra, Lupsa and Bucium communes on the east and south–east and the Sohodol commune on the west. The component localities of the commune are as follows: Bâlmoșești, Blidești, Bunta, Cărpiniș, Coasta Henții, Corna, Curățura, Dârboia, Gura Roșiei, Iacobesti, Ignătești, Soal, Țarina, Vârtop and Roșia Montana. Annex 2.1 includes a map of the Rosia Montana area.

The future Rosia Montana Project site location is illustrated in Figure 2.1.

Figure: 2.1. Rosia Montana Project site location

The Project area lies in a region known as the Golden Quadrilateral in the Apuseni and Metaliferi Mountains of Transylvania.

This Golden Quadrilateral has been the most important gold-producing region of Europe for over 2000 years. The existing mine ("Rosiamin") is a small-scale open pit mine owned and operated by the state-owned company C.N.C.A.F. "MinVest" S.A. ("MinVest").

The Rosia Montana Project is owned and managed by Roșia Montana Gold Corporation (RMGC).
An Exploitation Concession License was granted to Minvest (the titleholder) and RMGC (as an affiliated company) in December 1998 and the license came into force in June 1999. In October 2000, the license was transferred from Minvest to RMGC, with Minvest as an affiliated titleholder. As such, Minvest is entitled to continue its current small-scale RoșiaMin mining operations at Roșia Montană, while RMGC conducts exploration and early project development activities, until such time as RMGC makes a production decision in relation to the Roșia Montană Project, Minvest remains responsible for all current mining operations at RoșiaMin, including all current environmental issues, as well as issues related to the anticipated closure of the RoșiaMin operation.

2. Topography
The topography of the area is determined by the variety of geological formations. The volcanic chains impress through the following massifs: Cârnic, Cetate, Orlea, Curmătura, with heights between 1000 m and 1300 m. Elevations below 1000m are most frequent in the area, while the lowest elevations vary between 550m and 580m in the Rosia Montana Valley. The sedimentary deposits generated a hilly setting with shallow slopes and occasionally steep particularly in the vicinity of springs and streams. The watershed generated a relief composed of small hills and ridges that separate deep valleys.

3. Geology
The undisturbed surficial geology in the Project area consists predominately of alluvium, colluvium, and rock outcrop. The unconsolidated deposits may be up to 12 meters thick along the valley bottoms and 3 to 10 meters thick on the valley slopes. These unconsolidated materials within the Project area consist dominantly of Quaternary alluvial deposits along the valley floors and colluvial soils along the valley slopes. The alluvial deposits contain a variety of sediment types ranging from silty clay to limited interbeds of sand, gravel and cobbles in a fine-grain matrix, mostly limited within the stream channels.

The material generally classified as colluvium is a mixture of true colluvium (a mass of soil and rock fragments derived from mass wasting and down-slope movement) and deep soil residuum derived from in-place weathering of the bedrock resulting in soil or un lithified silty clay. The colluvial and residual soils on the valley slopes are up to 10 meters thick. The predominant soil types in these deposits are fine grained clayey and cohesive in nature.

The colluvial deposits dominate the surficial exposure of the Corna Valley. There are also deposits of mine waste rock generated from historic mining activities. The surficial geology in the Rosia Valley is similar to Corna Valley. However, the surficial materials are more disturbed and variable because of the existing mining activities, increased habitation and greater variability in bedrock geology.

Rock outcropping, particularly marl and/or sandstone occurs along the ridges of both valleys. In addition, at higher elevations along the ridges, volcanic andesite occurs. Volcanic rock outcropping occurs more often in the Rosia Valley.

Bedrock in the Project area, outside of the mine area and beneath the key ancillary Project facilities, largely consists of Cretaceous sedimentary deposits that are predominantly black shale with interbedded sandstone with some conglomerate which are interpreted as a flysch rock sequence. Bodies of volcanic rocks and phreatomagmatic breccias from the late Tertiary (Neogene) period intruded and overlay the sedimentary units in the Project area. Mineralisation is strongly associated with phreatomagmatic breccias pipes and dactite intrusives.

The main unmineralised rock types within the Project area are described below. Black shales - this Cretaceous-aged sedimentary sequence, also described as flysch or argillaceous marl schist, typically consists of interbedded shale and fine to medium grain sandstone. Interbeds of fine conglomerates also occur. The rock is characterised by calcite veins and cement within the sandstone, variable bedding orientation, and occasional weak and/or brecciated or gouged zones. This unit comprises the bedrock typical of much of the Project area outside of the mine area and forms the foundation of the proposed TMF, SCS and Cetate Water Catchment Dam embankments.
Vent breccia - in the form of microconglomerates and tuffaceous grits, described as medium grain volcanioclastics (i.e., sedimentary rock composed mainly of particles of volcanic origin) from the late Tertiary period (Neogene). The vent breccias are generally massive. This breccia may be mineralised in some areas of Rosia Valley and may contain many minerals. Some vent breccia is present in the upper portion of the Corna Valley were it borders the ore body.

Andesitic agglomerate - this rock type has been mapped in several locations near the head of the Corna Valley and on the ridge between the Corna and Salistei Valleys, but lies outside the planned TMF. Andesite outcrops occur on the eastern and northern ridges bordering the upper portion of Rosia Valley. (The term agglomerate characterises a chaotic assembly of coarse pyroclastic materials).

While not considered a primary rock type, there are local blocks of limestone outliers (olistolites) that were observed just upstream of the TMF embankment centerline and near the right abutment. Based on drilling and site-specific mapping, the limestone blocks are not considered to be rooted and no karst formation is expected.

Mineralisation in the Rosia Valley is hosted in dacite that has been intruded into the vent breccia, vent breccia, and other phreatomagmatic breccias. Other mineralised sedimentary rocks are present, however on relatively limited areas.

Investigation of the geology of the Corna Valley found that the bedrock on the east and west slopes and in the flood plain near the proposed TMF Dam, consist mainly of Cretaceous cleavable schistose shale interbedded with fine gritstone (coarse sandstone) with calcareous cement. The shale and more often the gritstones contain narrow fractures and cleavage surfaces, with millimetre and sub-millimetre openings, most of them cemented with calcite. The shale unit dips 30 to 55 degrees in a southerly direction.

The Rosia Valley contains most of the altered and mineralised volcanic sequences that host the ore body. These include dacite and volcanic breccias of various types. The upper bedrock in the vicinity of the future Cetate pond is predominantly residual with colluvial soils and two and seven meters in thickness.

The alluvium within the valley consists mainly of clayey-silt/silty-clay either as a main constituent or as a matrix within a coarser fraction including gravel and some cobbles and boulders. Bedrock in the Project area largely consists of black shale with interbedded sandstone. The core of the excavated rocks was identified as sandstone interbedded with black shale gradually turning into black shale with interbedded sandstone. The shallow bedrock is highly weathered and fractured within the upper four to eight meters and becomes more competent with depth.

4. Hydrogeology

The primary stratigraphic units and their typical hydrogeologic properties are summarised in Table 2.1.

Table 2.1. Stratigraphic units

<table>
<thead>
<tr>
<th>Stratigraphic Unit</th>
<th>Assignment</th>
<th>Hydrological Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alluvium (Minor and major streambed)</td>
<td>Deposits of silty clay and sandy clay with significant and variable distribution zones of gravel and cobbles. Includes layers of gravel and clean sand located in the minor streambed. They have a width of 10-80 m and thickness of up to 12m.</td>
<td>Clean sand and gravel layers act as local aquifers. The mean hydraulic conductivity is relatively high in the range of 2x10^{-6} to 3x10^{-4} m/s</td>
</tr>
<tr>
<td>Colluvium (with soil) (on valley hillsides)</td>
<td>First silty sand and silty clay with small amounts of sand and gravel with thickness of 3 to 10.5m.</td>
<td>Low water storage capacity Hydraulic conductivity approximately 1x10^{-8} m/s</td>
</tr>
</tbody>
</table>
### Upper bedrock (marl)
- Highly weathered and fractured interbedded shale, sandstone, breccia and gouge in the upper 40 meters. Located under the alluvium and colluvium
- Generally water bearing only through fracture network and has only low regional capacity. It may be moderately water bearing through the bedding planes. The hydraulic conductivity values in the range of $1 \times 10^{-7}$ to $1 \times 10^{-6}$ m/s

### Lower bedrock (marl)
- Interbedding of marl, gritstone with minor intervals of silty clay and breccia increasingly competent with depth
- Low capacity. Hydraulic conductivity in the range of $6 \times 10^{-9}$ and $1 \times 10^{-7}$ m/s

### Dacite and Andesite
- Generally competent bedrock.
- Low capacity. No piezometers were installed in this rock type. Hydraulic conductivity <$1 \times 10^{-7}$ m/s

### Volcanic breccias and black breccia
- Typical soft rocks
- Limited flow may occur through fractures or naturally formed zones of enhanced permeability. Low hydraulic conductivity <$1 \times 10^{-7}$ m/s

### Alluvium
- is present in the valley bottom in the water channel extension area. These surface deposits of alluvium in the stream valleys are up to a maximum of 12 meters thick, and may act as local aquifers with locally high hydraulic conductivity. The hydraulic conductivity of the alluvial deposits was estimated to be relatively high, up to $1 \times 10^{-7}$ cm/s.

### Colluvium
- is generally present in the valleys, except where there are bedrock outcrops or where alluvium is the predominant surface material (e.g., within the valley bottoms/streams). The colluvium observed at the site is a combination of formal colluvium (i.e., soil and rock deposited by water action and/or downslope mass creep) and bedrock residuum or soil (i.e., bedrock completely weathered to a soil or un lithified residuum). The colluvium range in thickness from 3 to 10.5 m. The colluvium is the preferred material within the footprint of the TMF as determined by hydraulic testing, because of its low permeability on the order of $1 \times 10^{-7}$ cm/s. This low permeability is the result of the clayey fine-grain content of the material. This fine-grained character is inherited from the black shale, which is the dominant bedrock beneath much of the site.

### Black shale
- is present on most of the site. Interbedded, cemented sandstone and conglomerate layers occur in the shale, but are laterally and vertically discontinuous and are not considered significant water-bearing units, except in the upper weathered zones. Hydraulic conductivity values of the shale unit were estimated to be between $6 \times 10^{-7}$ cm/s and $4 \times 10^{-4}$ cm/s. The hydraulic conductivity generally decreases with depth with values measured less than $1 \times 10^{-5}$ cm/s deeper than approximately 25 meters below ground surface at Cetate and the SCS and 40 meters below ground surface at the TMF.

- The bedrock near the Cetate and Cârnic Pits is drained (to an elevation of about 714 meters) because of existing underground workings. In the current mining tenement area, the historical underground workings significantly altered the natural underground conditions. However, these rock types (dacite, andesite, breccia) are described as being of low permeability, and hence, have a low potential for groundwater supply.

- The shale bedrock present beneath the TMF and SCS has been characterised and designated as upper and lower bedrock. These intervals were characterised based on differences in measured hydraulic conductivity, as well as rock quality designation (RQD) and core recovery. The hydraulic conductivities estimated from water pressure tests and relative RQDs and core recovery for each of the units are as follows:
  - Weathered bedrock - $5 \times 10^{-5}$ to $2 \times 10^{-4}$ cm/s,
  - Upper bedrock - $2 \times 10^{-5}$ to $1 \times 10^{-4}$ cm/s,
  - Lower bedrock - $3 \times 10^{-5}$ to $3 \times 10^{-4}$ cm/s.

5. **Tectonic structure, seismic activity**
Taken into consideration the earthquake magnitudes occurring over long periods of time and seismic engineering studies, calculation methods were developed to be used in the antiseismic design of constructions and seismic zonation maps. Seismic zonation consists in delineation of areas exposed to earthquakes at national or regional level based on historical, geological and geophysical information. The zonation takes into consideration the sale of earth movements correlated with the geographical representation determined based on seismic parameters: magnitude, acceleration, velocity or displacement.

Seismic zonation of Romania on the MSK scale (SR 11100-1:93) which reflects the probable seismic intensities on the territory of Romania in case of an earthquake indicates that the Rosia Montana area is located in an area characterized by probable seismic intensity 6, the lowest level of seismic intensity over the national territory (Figure 2.2).

Figure 2.2. Seismic zonation of Romania based on MSK intensity scale according to SR 11100-1:93 “Seismic zonation. Macro-zonation of Romania”.

For antiseismic design of constructions special maps are available such as the map presented in Code P.100-1/2006 which shows the zonation of Romania based on horizontal peak ground acceleration (see Figure 2.3.).
Figure 2.3. Zonation of horizontal peak ground acceleration of the site for earthquakes with a return period of 100 years.

It should be noticed that Rosia Montana is located in an area with a peak ground acceleration of 0.08, the lowest level in Romania. For Rosia Montana, the magnitude of a presumptive earthquake effects is low, the movement being entirely felt, causing panic, however the damages to the non-structural construction elements are insignificant.

6. Groundwater

Due to the geological structure consisting in fissured rocks, the Rosia Montana area is poor in groundwater flows. Active springs occur at the interface between sedimentary rocks and massive, compact rocks, but they dry out in summer. Groundwater appears as captive water tables emerging in delluvial deposits, following accumulation of storm waters.

The main groundwater supply within the mining tenement is stormwater. The site is in a climatic region classified as continental temperate with strong topographic influences. Winters are cold with snowfalls during four to six months of the year. On average, 76 percent of the precipitation occurs as rain and 24 percent as snow. Snowfall occurs during the winter months and does not contribute to runoff until April and May. Rainfall peaks occur in the summer months of June and July. The average precipitation for the period 1965 to 2003 was approximately 700 to 780 mm (National Institute of Meteorology and Hydrology (INMH), 2002).

Surface water discharge takes place mainly through the spring flow and baseflows of watercourses within the two main watersheds. Rivers accumulate groundwater as a result of low permeability geological units and convergent groundwater flows. The average flowrates for Rosia, Corna and Saliste Valley between 2001-2003 were of 0.16, 0.07 and 0.16 m³/s, measured using permanent weirs.

An extended underground working network acts as a drain for the upper portion of Rosia. This drain flows into the 714 adit and Rosia Valley approximately 500m upstream of the Cetate Water Catchment Dam. These underground mine workings will hydraulically connect all of the proposed mine pits with the possible exception of the Jig pit.

Prepared by S.C. OCON ECORISC S.R.L. Turda
High flow wells are not located on the mining site or in close vicinity.

7. Surface Water

**Permanent watercourses** include the Rosia and Corna rivers.

Rosia river originates in Taul Tarina, Taul Mare and Taul Brazi and crosses the villages of Rosia Montana, Balmosesti, Ignatesi, Iacobesti and then flows into the Abrud River, at Gura Rosiei. The river collects ARD, which gives it a reddish-yellow colour, due to the iron oxides of the volcanic rocks it washes. The maximum river flow rate is 300l/min.

Corna river originates in Taul Corna and flows into the Abrud river upstream of the town of Abrud.

Saliste river flows between Rosia and Corna rivers and it is also a tributary of Abrud river. A tailings management facility is constructed in the Saliste Valley.

Apart from the permanent watercourses, there are a number of semi-permanent streams, manifest only during massive rainfall or snowmelt. They have flood potential with maximum flow in spring.

Around 1910 in the Rosia Montana area there were some 120 artificial lakes constructed for the hydraulic operation of the stamp mills used to crush the gold ore before flotation. Currently, there are five important lakes: Tăul Mare, Țarina, Brazi, Anghel and Corna. They are located at elevations ranging from 950 m (Țarina) and 1,000 m (Tăul Mare). The morpho photometric data for the lakes are summarized in **Table 2.2** below:

<table>
<thead>
<tr>
<th>Lake Name</th>
<th>Altitude m</th>
<th>Dam Height, m</th>
<th>Maximum Depth, m</th>
<th>Average Depth, m</th>
<th>Area m²</th>
<th>Volume m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tăul Mare</td>
<td>1000</td>
<td>25</td>
<td>10.0</td>
<td>4.9</td>
<td>32120</td>
<td>160600</td>
</tr>
<tr>
<td>Țarina</td>
<td>950</td>
<td>10</td>
<td>4.5</td>
<td>2.6</td>
<td>10480</td>
<td>27300</td>
</tr>
<tr>
<td>Corna</td>
<td>961</td>
<td>3.6</td>
<td>1.8</td>
<td>1.8</td>
<td>8830</td>
<td>15930</td>
</tr>
<tr>
<td>Brazi</td>
<td>950</td>
<td>10</td>
<td>5.5</td>
<td>3.0</td>
<td>7800</td>
<td>22000</td>
</tr>
<tr>
<td>Anghel</td>
<td>987</td>
<td>4.5</td>
<td>2.0</td>
<td></td>
<td>4250</td>
<td>8500</td>
</tr>
</tbody>
</table>

The lakes are supplied with water from precipitations and slope run-off with the exception of Tăul Mare located on Rosia River in the upper watershed.

8. Climate

The Rosia Montana locality is located in a mountainous region with continental temperate climate. The main climate elements are:

- Total overall radiation is around 65 kcal/cm², the locality being exposed to sun throughout the day;
- the average multi-annual temperature is 6°C, with seasonal variations; Winter averages are -5.5°C, and summer averages 16-17 °C. The temperature evolution is under foehn influence, therefore spring comes early and autumn extends into winter. The number of summer days is approximately 50, tropical ones 15-20.
- the first frosts occur around October 1st, and the thaw in May 1st.
- average multi-annual precipitation is approximately 1,200 mm/m² and its influence on the other climate elements is extremely important; The large rainfall amounts occur in springtime, under the foehn effect;
- the snow cover measures 35 -40 cm, while snowdrifts may be up to 1.5 m deep, representing the main water supply for the rivers, particularly in spring time; snowpack is sizeable and lasts for a long time (about 120 days).
- **The dominant winds are westerly, with strong foehn circulation that melts the snow and raises the river levels.**
9. Soils
The overburden soil is relatively diverse in terms of type and sub-type, due to the numerous
soil characteristics (thickness, parent material, grading of deposits, texture class and skeleton content) in associations with the site characteristics (relief, slope gradient and subjacent rock).

In the region eight units of soil types and subtypes and 19 units of associations of soil
types and soil subtypes were delineated in the region, consisting of: typical soils or bruni lithic
eu-mesobasic soil; typical acid brown soils and lithic acid brown soils, typical regosols and typical
colluvisols and typical lithosols.

The total agricultural area available in Rosia Montana amounts to 2,306 hectares. Of this area,
280 ha are arable, 1,088 ha are pastures and the balance of 937 ha are hay lands.

Abrid has a total agricultural land area of 1920 hectares. Of this area, there are190ha of
arable land, 964 ha of pastures and 766 ha of hay lands.

10. Natural risk area
Due to the geological conditions, morphology, impact of exogenous factors and mainly due to
anthropogenic impacts, there is a high probability of natural phenomena occurrence, such as
landslides, rockfall etc.

Rock erosion, particularly sedimentary rocks, led to the deposition of eroded materials on the
shallow slopes creating delluvial deposits prone to landslides. Landslides are the result of external
factors and formation of a clay bed supporting the slide. Presence of lakes may accelerate the
landslides and generate suffosion. Landslides can be easily noticed on the upper courses of Rosia and
Corna rivers.

No accelerated soil erosions were noticed in the region, with the exception of erosions
occurring along narrow valleys tributary to larger valleys. However, geological erosion occurs in
regosol areas associated with other soil types.

Rockfalls and detritus may be noticed in the road area connecting Gura Rosiei and Corna and
also in the area of waste rock dump, deposits rutted by floods and valleys under development. During
heavy rainfalls the coarse and fine material is transported to the slope bottom extending the affected
area. This occurrence is visible at Cetate, Carnic, Orlea and Jig hills.

There is also probability for flood occurrence from the Abrid river and its tributaries Corna and
Rosia. In general, floods occur during heavy rainfall periods or due to downpours. The largest
floods occur in the Gura Rosiei - Daroaia area where (at the confluence) the Rosia stream flow brings
its contribution.

Temporary flooding occurs along the Corna stream (with damage on the hayfields and
household gardens near the floodplain).

11. Ecosystem
Monitoring shows that the area is dominated by significantly affected ecosystems long-term
damaged by human activities. As a result, the overall quality of terrestrial and aquatic ecosystems is
poor and there are very few areas with higher ecological value.

Surveillance identified no rare or endangered plant species. Some species of mammals,
amphibians, reptiles and birds are afforded vulnerable status or are of conservation concern. However,
the majority of wildlife species are considered common and widespread.

B. Identification of installations and other activities within the site posing major hazards

The criteria used to identify the areas within the site which may be relevant in terms of safety
was the amount of hazardous substance which may be present. The use of this criteria involves setting
a threshold value (threshold amount) for each category of present hazardous substance. The Guide for
the preparation and verification of safety reports published within the „Twinning Project
RO/2002/IB/EN/02 Implementation of the VOC’s, LCP and Seveso II Directives” recommends the
use of 5% of the relevant amount specified in column 2 (lower level) of Annex 1 to the Seveso
Directive (column 2 of Annex 1 to GD 804/2007) - which stipulates measures regarding prevention of
major accidents where hazardous substances are involved, as well as limitation of their impact on
human health and environment in order to ensure a high level of protection in a coherent and efficient manner).

The inventory of hazardous substances based on which the site installations posing potential major accident hazards is described in Chapter III of this Report (Table 3.1 and 3.2). While the tailings deposited in the Corna TMF and water stored in the Cetate water catchment pond and dam are not considered hazardous materials as per GD 1408/2008 and therefore are not hazardous substances under GD 804/2007, having in view that these facilities will store extremely high amounts of tailings and contaminated water respectively, with hazardous substance content (even if in very low concentrations) and Corna TMF is rated under Category A as per Directive 2006/21 on the mining waste management, by applying the principle of precaution, these facilities were considered under the incidence of the Seveso Directive.

Based on the technical documentation and information provided by the Beneficiary, the site sections relevant for safety purposes which may constitute critical areas in terms of major accident hazards are identified (see Annex 2.2 Safety sections) as follows:

1. Mining areas
2. Process plant
3. Tailings Management Facility
4. Cetate waste and mine drainage dam and pond
5. Explosives storage facility

Furthermore, the areas associated with following facilities are also considered:

6. Piping system
7. Waste rock dumps

C. Description of areas where a major accident may occur

The previous presentations shows that a series of areas within the site are critical areas (hazard areas) identified as safety sections relevant for the probability of a potential major accident occurrence. The hazard areas are further described.

1. Mining areas
   Following detailed geotechnical investigation the following base parameters have been adopted for the design of the four open pits (Cârnic, Cetate, Jig and Orlea) which will extend to depths between 220 and 260 below the current ground level:
   - Ramp width of 27 m, including berms and ditches;
   - Ramp gradient of 8% with occasional use of 10%, where prudent;
   - Bench height of 10 m; and,
   - Inter-ramp slope angles planned not to exceed 42° overall; lower angles may apply within vent breccias.

2. Process plant
   Annex 2.3 describes the location of the hazard sources identified within the process plant site.
   The process plant will be located on the side of a ridge between the Salistei Valley and the Roșia Montană Valley. This location was chosen for its proximity to the Cârnic and Cetate pits, which provide the majority of the proven and probable reserves, as well as its proximity to the TMF to be situated in the Corna Valley. The process plant will be winterised to enable continuous operation throughout the year.
   The general flow sheet for ore processing includes the following main phases:
   - Single stage crushing of Run of Mine (ROM) ore by means of a gyratory crusher;
   - Stockpiling of crushed ore;
   - Reclaim of crushed ore and wet grinding using a semi-autogenous grinding (SAG) mill followed by two ball mills in parallel;
   - Cyanide leaching, commencing in the grinding circuit, from which a classified fine product passes to the CIL tanks to undergo agitation and continued cyanide leach;
- Adsorption of extracted gold and silver onto activated carbon within the CIL tanks followed by separation of the loaded carbon and elution of the gold and silver from the activated carbon in pressure vessels;
- Electro-winning to recover gold and silver stripped from the activated carbon, as a precious metals sludge, and smelting of this sludge to produce gold and silver (doré) ingots;
- Thickening of the tailings;
- Detoxification of residual cyanide in the tailings, before the tailings leave the process plant containment zone;
- Placing of treated tailings into the TMF;
- Water reclamation from the TMF for recycling and re-use;
- Abstraction of fresh water from the Arieş River.

The section below briefly describes the identified hazard sources.

a) Sodium cyanide storage
The sodium cyanide mixing tank is cylindrical vertical open at top with flat bottom placed directly on the ground. The tank has a diameter of 5m, height of 5.57m and total volume of 87 m³. The 20% cyanide solution tank is vertical covered at top with flat bottom; the tank is 6m in diameter, 7m high and has a capacity of 216 m³. The two tanks are located in a building designed and constructed for this purpose within a retention basin with a capacity of 110% of the storage tank capacity, equipped with sump and immersion pump to collect and return potential accidental spillages to the process circuit.

b) Hydrochloric acid storage
The 32% hydrochloric acid solution is stored in 20 m³ corrosion resistant tank surrounded by a containment berm with capacity to hold 22 m³.

c) Carbon in Leach (CIL) Circuit
The leaching circuit consist of two parallel trains each of seven tanks (leaching tanks) equipped with agitators and oxygen spargers. Each leaching tank has a diameter of 18.7m, height of 19m and a nominal volume of 5000 m³.

d) Tailings thickener
The tailings thickener has a diameter of 42 m and volume of some 3700 m³ surrounded by a containment berm (together with the supply container and the two DETOX tanks) with capacity to hold 110% of its volume.

e) DETOX Plant
The cyanide detoxification facility will consist of two tanks operating in parallel. Each tank has a nominal diameter of 13m, height of 14.5 m and capacity of 1688 m³.

f) Pregnant solution storage area
Through elution of the gold and silver from the activated carbon in pressure vessels, a pregnant solution is obtained with 3% cyanide and 2% NaOH content which is stored in specially designed tanks with capacity of 280 m³ (4 tanks) 180 m³ (one). They are surrounded by a containment berm equipped with sump and immersion pump.

g) Reagent facility (DETOX)
The reagent facility within the DETOX plant includes the following main equipment:
- The sodium metabisulphite storage tank with a 4m diameter, 4.48m height and volume of 46.2 m³. The prepared solution contains some 20% metabisulphite and has a relative
density of 1.48 and pH of 4. The consumption is of some 60 m³/h and the reagent is supplies in 1000 kg bags.
- The copper sulphate mix tank has a diameter of 3.5m, height of 3.3 m and capacity of 31,5 m³. The prepared solution contains some 15% copper sulphate with a relative density of 2.28 and pH of 4. The consumption is of some 60 m³/h and the reagent is supplies in 1000 kg bags.
- The flocculant preparation tank (Ciba Magnafloc 5250) has a diameter of 4.5m, height of 4.3m and capacity of 68 m³. The prepared solution contains some 0.25% flocculant with a relative density of 1 and pH of 7. The consumption is of some 75 m³/h and the reagent is supplies in 1000 kg bags.

h) Reagent Storage and Handling
The technological processes within the Project will require supply and storage of the following chemical substances:
- Flocculant;
- Sodium metabisulphite;
- Copper sulphate;
- Smelting fluxes;
- Activated carbon; and,
- Carbon dioxide.

All the chemical substances and reagents will be stored in their original packaging and in the minimum amounts required for the process. The storage and handling areas will be designed and constructed in accordance with the regulations and standards in force in order to prevent and minimise the risks and taken the incompatibilities into account.

i) Sodium Hydroxide Storage
Sodium hydroxide will be stored in a 40 m³ stainless steel storage tank located within a special building together with a dissolution vessel for solid NaOH (supplied in 1000 kg bags) with 3m diameter, 3.26m height and 20 m³ capacity, both tanks will be surrounded by a containment berm with a capacity of minimum 44 m³. The NaPH solution is prepared at a concentration of 20% and has a density of some 1.2 and pH of 12.

j) Lime storage/preparation
Lime will be supplied in granulated form and stored in 860t hopper to be further ground in the SAG mill at a rate of some 12t/h; the ground lime is stored in a 600 t hopper.

k) Wet ore grinding
The grinding circuit will consist of a single SAG mill followed by two ball mills, operating in parallel.

The SAG mill discharge is screened via a trommel to remove coarse particles; the SAG mill discharge will be classified with a trommel, from which the undersize will be directed into a cyclone feed pump box.

The ball mills discharge over trommel screens designed to scalp out remnant balls and unground material. The scalped ball mill discharges into a concrete bunker while the undersize is mixed with the SAG cyclone discharge material and transferred to the CIL process.

l) Desorption and gold recovery
The desorption/gold recovery facilities are located in a special building (which also includes the gold room) located between the cyanide storage and hydrochloric acid storage. They consist of two elution columns two parallel elution columns where a hot cyanide-caustic solution will be used to strip the precious metals from the carbon, heat exchangers with thermal oil, reactivation kiln (using LPG as fuel), electrowinning cells with a volume of each cell of 32 m³ and a total volume of 303 m³ (the power is supplied via a 4500A), a gold-silver sludge filter press, mercury retort (where mercury is
volatilised and extracted via a suction pump), induction furnace where the gold and silver doré is obtained – unintelligible sentence. The mercury vapours are discharged to the bottom of the condensing recipient, and the water vapours as well as the mercury vapours are retained in a cooling condensate/water installation, which performs the fog elimination. Condensed mercury will be captured in the charge tank and stored.

Off-gases from the induction furnaces will be drawn through a scrubber to capture any precious metal or other dusts emitted from the furnace by washing with 0.5% NaOH diluted solution. There is also a general ventilation system which captures the gases from electro-winning, carbon regeneration system and other sources and provides their wet washing in scrubber.

m) Process Water Tank
The process water tank has a capacity of some 12,000 m³, diameter of 40m and height of 10m and is located in the drinking water treatment area together with the raw water tank in a retention basin provided with drainage channels towards the plant site stormwater and spill contingency pond.

n) ARD treatment plant
The wastewater treatment plant is designed specifically to reduce the dissolved metals concentrations and reach the regulatory quality parameters.

Following the neutralization and oxidation/precipitation phases, the solution will be discharged by gravity to a settling tank with a capacity of some 2000 m³, diameter of 28 m designed for an average flow rate of 505 m³/h of treated water at a pH of 8.5.

o) Air Compressor Room
It will be equipped with 4 compressors (three duty and one standby) discharging at a pressure of 950 kPa and flow rate of 6000 Nm³/h. It is located within an acoustic chamber of antivibration stand.

p) Oxygen Plant
The oxygen plant supplies 90% oxygen at a maximum rate of 250 kg/h and 400 kPag pressure. It is located within a metal building and the buffer tank is located outside.

q) 110kV Transformer Substation
It has a capacity of 10 MVA and it is equipped with protection and safety systems as per the regulatory standards.
r) Fuel Storage
The plant site fuel storage facility will include one above-ground storage tank (~ 800,000 litres) for diesel fuel and one above ground storage tank (~ 20,000 litres) for gasoline surrounded by a containment berm.

s) Process circuits
The management of water in the process plant is designed to maximise recycling of process water and to minimise process water effluent beyond the plant boundary with an aim to minimise demand for fresh water. Water will be required for:
- Reagent mixing;
- Gland seal water of process pumps;
- The elution circuit;
- Electro-winning; and,
- Drinking and fire water.

The transport circuits for the process solutions and suspensions required for consist in pipes and fittings of various size, manufactured from corrosion-proof materials. The transport will be conducted both by gravity and pumping.

3. Tailings Management Facility
A Tailings Management Facility (TMF) has been designed for the deposition and storage of tailings; several locations were analysed and eventually the Corna Valley located south and close to the process plant was selected.

The TMF consists of the following main components:
- main rock fill embankment dam to retain the detoxified tailings;
- Coffer dam and runoff diversion channels;
- Basin for the detoxified tailings located behind the dam;
- A treated tailings delivery and water reclaim system;
- A secondary containment system, seepage collection and recycling systems and in the later Project stage a treatment system to manage any seepage water located downstream of the dam;
- A comprehensive geotechnical monitoring system; and,
- Service roads.

The TMF dam construction will comprise two main phases: construction of Tailings Facility Management (TMF) starter dam and construction of the main embankment dam, respectively. A low permeability Starter Dam will be constructed after the first Project year to a crest elevation of 733m which corresponds to a height of about 78 m above ground level. After construction of the starter dam, the main tailings dam will be developed in stages over the operating life of the mine using a modified-centrelines method of construction; the initial rate of rise of the embankment will be 20 m in the first year, reducing to about 5 m in the final year. The final height of the embankment will be approximately 185 m.

The main TMF dam will be constructed in several stages, the first stage being the construction of the starter dam. As noted previously, the central low permeability zone will act as a water retention structure for the initial construction of the starter dam. Subsequently, the dam will be raised based on storage requirements, while at all times respecting the pervious dam concept to ensure dam safety and minimise environmental risk.

Minor seepage through the main dam is expected, is normal for any dam, and is a design feature that contributes to progressive dewatering of tailings within and behind the dam structure, which results in increases in stability with time. Seepage through the dam will be collected directly in the secondary containment system (SCS), located at the final downstream toe of the embankment (Exhibit 2.19). The SCS will consist of a 10 to 15 m deep sump excavated into weathered rock in conjunction with a zoned rockfill dam and pumping system to pump water over the TMF embankment and back into the tailings impoundment.
The secondary containment dam will be approximately 10 m high and will be a zoned rockfill dam, similar to the starter dam.

The seismic design inputs used for the SCS are identical to those used for the TMF. For static loading conditions, the main tailings embankment will be designed with a minimum factor of 1.5. A minimum factor of 1.1 will be used for consideration of seismic loading.

In order to minimise the volume of water entering the TMF, diversion channels will be constructed to collect and route clean runoff water before it drains to the TMF and discharge it downstream of the SCS (Exhibits 2.4, 2.5, 2.6 and 2.7).

4. Cetate waste and mine drainage dam and pond

Based on Romanian standards and risk rating categories, the Cetate dam is classified as Class II of Importance and Category B, respectively. The height of the embankment will be approximately 31 m measured from the crest to the initial ground level and the total Cetate catchment area is 4.9 km². The maximum normal operating level of the pond is 600,000 m³ including 25,000 m³ deposited sediment.

The base flow in the Roşia stream will be maintained primarily by constructing a diversion canal that will collect and divert water not impacted by the new mining operations around the Cetate dam and discharge it into Roşia Creek. Initially, the 3.9 km diversion canal will drain an area of about 7.5 km², which has not been impacted by recent mining. This represents about 70% of the Cetate pond catchment. Hence, initially the base flows of the Roşia Stream downstream of the Cetate dam will only be affected to a minor extent by the construction of the dam.

5. Explosives storage facility

The explosive storage location should take into account the distance to the open pits where rock blasting will take place and it should not be affected by the seismic waves generated during blasting operations.

The existing data shows that the explosive storage facility is located in area with no constructions, except for the access road. The closest structure to the explosive storage is the TMF dam at approximately 1200m (the storage is located in the north-western part of the TMF dam).

According to the Romanian legislation the explosives may be stored solely in special designated areas and constructed based on properly documented designs and authorised by the Territorial Labour Inspectorate.

Explosive agents and detonators will be stored in two separate, secure magazines (for ammonium nitrate and dynamite). Thus, the ammonium nitrate will be stored in an above ground facility while dynamite and other initiation means in an underground facility located approximately 110 m NE of the ammonium nitrate storage; the two storage facilities are connected through an underground gallery. Each storage facility will be provided with the actual storage space and a working space where a certain amount of explosive is stored for easier handling. Therefore, the explosive storage facilities will accommodate 80 t of ammonium nitrate and 5 t of dynamite, while the working facilities will store 20 t of ammonium nitrate and 1 t of dynamite.

The two facilities are partially connected through the underground facility adit which restarts from one of the safety area boundaries of the above-ground facility.

Dynamite will be stored in the facility in its original packaging. The ammonium nitrate will be stored in bulk, in bags and of granular, porous type to retain the diesel added to manufacture the ANFO explosive.

6. Piping system

*Tailings Delivery Pipeline*

The 5.2 km-long pipeline will be 800-900 mm in diameter and will generally follow the mine roads leading to the TMF. Suitable containment will be provided to control any occurrences of spillage.
Reclalm water pipeline
The estimated initial pipeline length will be 5.1 km. The pipeline length will gradually reduce as the tailings impoundment fills and the decant pond moves closer to the plant.

The Secondary Containment Pond pipeline to the TMF will be 1200 m long and will be used to collect and reclaim the seepage from the TMF at a rate of some 114 m³/h. The WAD cyanide concentration of the reclaim water will be below 5mg/l.

Cetate Wastewater Pipeline
This 300-mm pipeline will be buried along the access road to the plant, parallel with the fresh water supply pipeline and will have a length of 1805 m.

7. Waste rock dumps
The pit design includes approximately 262 million tonnes of waste rock. Quarried rock and pre-stripped waste rock will be utilised as appropriate for construction of the Corna Valley TMF embankments and other impoundments. If not required for construction, waste rock will be hauled to the Cetate and/or Cirnic stockpiles. Starting in Year 10, the Cirnic pit will be backfilled with mine waste from the late pushbacks of the Cetate, Orlea, and Jig pits.
III. Plant Description

A. Description of activities and main products pertaining to those parts of the site significant from the point of view of safety, major accident risk sources and conditions generating such a major accident, as well description of proposed prevention measures

The Project activity is highly complex and covers a large area. Annex 3.1 presents the Process Flow Diagram and describes the main operations with emphasis on the operations significant with respect to the site safety.

1. Gold ore mining
Both geological and morphological conditions and equipment to be acquired through the investment project have been considered in the choice of the method used for open pit mining; The following have been considered:
- geological – technical characteristics of the deposit;
- predominant vertical distribution of the mineable mineral resources over a relatively extended area;
- in order to ensure economic efficiency given the relatively low average grades of the gold-silver mineralisation, a large production capacity must be achieved by employing cost-effective and highly effective mining methods;
- provision of mining equipment according to the investment plan consisting of highly effective machines, specific to open pit mining (excavators, bulldozers, haul trucks, loaders, drill rigs etc.);
- availability in the Roşia Montană area of technical personnel specialised in mining (mine engineers, mine supervisors, mine igniter, miners etc.).

The Roşia Montană deposit is interpreted to be a maar-diatreme complex formed by the intrusion of sub-volcanic bodies in a sequence of cretaceous sedimentary rocks.

The Roşia Montană gold and silver deposit will be mined by conventional open pit with 10m high benches, method that complies with the geological and technical conditions.

2. Ore grinding
After the ore is transported to the processing plant, it will be reduced to the appropriate size for the chemical-based gold and silver recovery process using a semi-autogenous grinding (SAG) mill followed by two ball mills in parallel. The ball mills will operate 365 days per year, 24 hours per day, seven days per week and will be controlled remotely from the central control room. The ball mills discharge over trommel screens designed to scalp out remnant balls and unground material. The scalped ball mill discharges into a concrete bunker where it can be removed by front-end-loader and the undersize is mixed with the overflow from the SAG mill cyclones and transferred to the CIL feed pump.

3. Cyanide dissolution and storage
Cyanide will be delivered by truck in 16t ISO bulk containers (especially designed and constructed) as bulk solid and will be dissolved directly in the transport containers using alkalized solution (process water and sodium hydroxide) from the dissolution vessel and recirculated in a mix tank equipped with agitators. After complete cyanide dissolution and after reaching optimal concentration and pH, the solution is transferred to a storage tank.
4. Cyanide leaching
The fine crushed ore, consisting of the ball mill cyclone overflow with a solids content of approximately 45% following volumetric classification on screens that scallop out trash and misreporting particles the ground ore reports to the CIL feed pump box. The ground ore is then transferred to the CIL feed box, into which cyanide is added along with slaked lime slurry as required for pH adjustment. Activated carbon is added to the CIL tanks in order to facilitate the leaching process and adsorption of extracted gold and silver.

The CIL feed slurry is mixed with a solution of cyanide and slaked lime (for pH adjustment to 10-11) and leached in two parallel trains into each of seven agitated tanks.

5. Gold and silver recovery
The main process for gold/silver extraction is performed in the CIL circuit.

The main equations for describing that process are:

Bollander’s equation
\[ 2Au + 4CN^- + O_2 + 2H_2O \rightleftharpoons 2Au(CN)_2^- + H_2O_2 + 2OH^- \] (1)

Elsener’s equation
\[ 4Au + 8CN^- + O_2 + 2H_2O \rightleftharpoons 4Au(CN)_2^- + 4OH^- \] (2)

During the reaction the gold forms a gold cyanide complex (equation 1) in alkaline solution. Both equations emphasize the importance of the free cyanide ion and hence the need for a high pH value (greater than 10).

As \( CN^- \) is the active ion in the gold complexation process (equations 1 and 2); it is important that the cyanide is stabilized by the maintenance of a sufficiently high pH. This is achieved through the addition of hydrated lime slurry to the CIL feed and as required to CIL tanks.

The most highly loaded carbon in the first cyanidation tank will be pumped with the residue to one of two loaded carbon recovery screens. The acid-washed carbon (to remove calcium deposits) will be neutralised by rinsing with dilute caustic solution and then transferred to one of two parallel elution columns where a hot cyanide-caustic solution for gold and silver stripping will be used to strip the precious metals from the carbon at a rate of \( 7.1 \) m\(^3\)/h (some 2% NaOH and 3% NaCN).

The stripped carbon from each elution column will be pumped to two dewatering screens operating in parallel, reactivated in the regeneration kiln, classified and added back into the CIL circuit. Carbon reactivation will be on a continuous basis.

The pregnant eluate will be pumped to the electro-winning cells in which the gold and silver is plated onto stainless steel cathodes.

The gold and silver deposited on the cathodes will be removed as a sludge using high-pressure water sprays; the sludge will be dewatered. Precious metals sludge from the filter press will then be loaded into charge containers (boats) on mobile carts. The boats will be inserted into the mercury retorts where the substance will be volatilised and extracted from the boats using a suction pump.

The retorted precious metal sludge is then fluxed and melted in an induction furnace. Doré will be cast into 25 kg ingots in a cascade mould.

Approximately 50% of the cyanide added to the elution circuit is lost due to the process reactions, the balance is reused in the process.
6. Tailings detoxification
The Project will use for cyanide detoxification the Inco SO$_2$/air detoxification process on the tailings discharge residue.

The cyanide detoxification facility will consist of two tanks operating in parallel. The estimated residence time of the sludge in each tank is 1.5 hours. Oxygen will be introduced into the each tank through a sparge; the airflow rate will be controlled. Analytical procedures will provide the operators with quick and accurate cyanide measurements, which will allow for set-point adjustment as required to maintain process control, in order to ensure consistent quality of discharged water.

Tailings from the processing plant will be pumped from the tailings pump box located at the processing plant to several discharge points at the TMF.

7. Tailings Management Facility
The volume of tailings deposited annually will be of some 13 Mt, a volume of 218 Mt being foreseen by the end of operations. The ore processing operations will generate detoxified tailings at a rate of approximately 13 Mt/annum for 17 years, producing a total of approximately 285 Mt of treated tailings. The designed Tailings Impoundment Capacity provides the required storage capacity for the life of the mine, plus an additional contingency capacity.

Approximately half of the water amount used by the process will be ensured by recycling the decant water from the TMF. Water will be reclaimed from the TMF by vertical turbine pumps mounted on a barge located on the TMF decant pond. The reclaim water will be pumped at a rate of 1516 m$^3$/h through a high-density polyethylene (HDPE) pipe to the process water tank within the plant site.

8. ARD treatment
ARD water is typically characterized by high sulphate concentrations, high levels of dissolved metals (Al, Fe, Mn and other heavy metals) and acid pH.

This type of water generated within active/closed/abandoned mining tenements represents a long-term “stress” factor, particularly for the environmental components soil and water (surface water and groundwater). Therefore, appropriate measures for ARD treatment must be applied, with the mention that the remediation strategies should consider the changes in mine water flows and quality occurring over time.

Acid runoff from historical operation (including the Adit 714 runoff) and the new mine will be captured in the Cetate drainage pond. A flow rate of 231 to 371 m$^3$/h ARD water is estimated to be collected.

The Cetate Waste Rock and Mine Drainage Dam will remain operational until it can be demonstrated that water collected in this facility can be discharged directly to the environment in compliance with regulatory consents. Any exposed areas would be re-graded to reduce the residual ponding effect and reinstate where possible the original stream course through this area. A strategic revegetation will be carried out, with the intent that the area becomes naturally overgrown with wetland species. The water treatment lagoon system constructed downstream of the TMF dam will be maintained after closure to ensure permanent semi-passive treatment of run-off.

The acid water captured in the Cetate pond will be pumped at a rate of some 378 m$^3$/h to the wastewater treatment plant, located in the processing plant. The wastewater treatment plant is designed specifically to reduce the dissolved metals concentrations and reach the regulatory quality parameters.

The ARD treatment plant process will employ a process based on the lime neutralisation/precipitation method. When the wastewater plant is operating, discharges from the plant will be used primarily for dust suppression and in the process plant for dilution in the cyanide detoxification process. Clarification underflow residue from the ARD treatment process will report to the Tailings Tank for placement with the tailings in the TMF. Some discharge water may be used to maintain biological baseflows in the Rosia Valley Creek and excess quantities of treated water, that are in compliance with water quality requirements, will be discharged to the Rosia Valley stream.
9. Waste rock stockpiling

Prior to the placement of any waste in the designated waste rock areas, the surface area to be covered will be stripped of topsoil; scarification and compaction of the exposed colluvial and/or weathered bedrock materials will provide a semi-impervious layer under the waste rock disposal sites. Diversion channels around the waste rock piles will capture potential surface waste run-on and divert it around the piles. Run-off from the waste rock piles reports to the water management system and will be collected within the TMF or one of the water management dams, which will allow pumping to the wastewater treatment plant or the process plant.

With the waste rock segregation strategy and the placement of infiltration-reducing cover systems of end-dumped PAG parts of the waste rock facilities, the seepage is very unlikely to need treatment after closure.

For the NAG (non-acid generating) material and portions of the waste rock dumps where PAG material is stack-dumped and "encapsulated" by NAG material, design criteria for the cover systems are as follows:

- prevention of inadvertent access to the wastes
- support of vegetation
- improvement of visual appearance
- prevention of dust blown off the wastes
- erosion control.

B. Description of processes, particularly of operation techniques

1. Gold ore mining

Mining operations at Roşia Montană will employ conventional open-pit mining techniques for drilling and blasting, loading and haulage operations, utilising blast-hole drills, hydraulic shovels, front-end-loaders and off-road dump trucks. The pits will be deepened throughout the operations phase by the mining of a series of benches using drilling, blasting, and heavy excavation equipment. A general description follows:

- Production drilling will be performed by two drills capable of drilling 10 m benches in a single pass;
- A blast-hole pattern of approximately 8 m by 8 m will be used to produce blasted material meeting the required material size specifications for the primary crusher;
- ANFO (Ammonium Nitrate-Fuel Oil mixture) will be the primary blasting agent, supplemented by the use of emulsion (slurry) type explosives; and,
- Charges will be detonated with delays, in such a manner as to minimize noise and vibration with maintenance of economic parameters for rock breaking.

It is estimated that 0.25 kg of explosives will be consumed for each tonne of rock blasted. Due to the numerous underground adits and workings below the pit footprint, added precautions will be taken to prevent unexpected cave-ins and ensure that worker safety is maximised, and also that any archaeological remains are recorded and recovered.

The ANFO explosive mixture (NH₄NO₃ + diesel) will be prepared in the open pit area using special equipment which also provides its packaging in protective foils to ensure protection against adverse meteorological conditions (ammonium nitrate loses its specific characteristics at the contact with water). The Nonel method will be used for blasting initiation with fuse ensuring blasting also in adverse meteorological conditions and facilitating identification of failures (unblasted holes) if they occur.

Perimeter berms around the pits will be constructed upon work completion for the purpose of public safety, and to control vehicle access to the pits. The berms will be constructed of waste rock during the operations.

2. Ore grinding

The grinding circuit for ore will consist of a single SAG mill followed by two ball mills, operating in parallel, with continuous operation and an average throughput rate of 1,625 t/h new feed.
Prior to grinding, dry lime will be added to the crushed ore ahead of grinding in order to ensure a protective alkalinity in the milling circuit and to create an appropriate pH in the CIL circuit.

Dry lime will be added to the SAG mill feed conveyor and slaked lime will be added to the agitated CIL tanks for pH control. Slaked lime is also dosed to the detoxification reactors to maintain pH control and treat acid water.

 Crushed ore from the stockpile will be fed at a constant rate to the SAG mill processing plant. Feed into the mill from the conveyor will be mixed with aqueous mill solution, containing cyanide, which has been recovered as overflow from the CIL tailings thickener. The SAG mill discharge is screened via a trommel to remove coarse particles; the SAG mill discharge will be classified with a trommel, from which the undersize will be directed into a cyclone feed pump box.

The trommel undersize flows by gravity to the cyclone feed pump box from where it is then pumped to the two sets of classifying cyclone clusters. The slurry is here separated into two streams:
- Cyclone overflow, which is the fine material suitable for processing in the CIL;
- Cyclone underflow, which is the coarse material that reports as feed to the ball mills for further grinding.

3. Cyanide dissolution and storage
Cyanide will be delivered in especially designed and constructed bulk containers certified ISO with a capacity of 16t as a dry solid. The cyanide will be dissolved in the containers with a caustic solution (obtained from process water and sodium hydroxide) from the dissolution vessel and recirculated at a rate of some 40 m³/h to a mix tank fitted with agitators. The mix tank will be designed to hold the entire contents of one bulk transportation container.

After complete dissolution of a container, the cyanide solution will be brought to a concentration of some 20% (or 10.6% CN ions) which will have a density of 1.12 and pH of minimum 11 and transferred for storage in a mix tank. From the storage tank cyanide solution is distributed to the CIL (at a rate of some 7.3 m³/h) and elution circuit at a rate of some 0.54 m³/h.

4. Cyanide leaching
The CIL feed slurry is mixed with a solution of cyanide and slaked lime (for pH adjustment to 10-11) and leached in two parallel trains into each of seven agitated tanks. The slurry contains 40-45% solids, has a unit average weight of 1.37-1.45 and it is circulated at a rate of 1565-1836 m³/h ensuring a retention time in each tank of some 3.4 hours.

Oxygen will be introduced into each tank through a sparge; the airflow rate will be 30-50 kg/h in the first two tanks and 20-40 kg/h in the other two. No oxygen is added in the last three tanks of each train.

During the extraction process taking place in this circuit the gold and silver form a gold cyanide complex in alkaline solution. To ensure high recovery rates, excess cyanide free ion is required. Dilute sodium cyanide solution is added as required to the first four tanks of each train of CIL tanks in order to maintain the required cyanide concentration in the circuit (initially 500 mg/l maintaining a concentration of 300 mg/l in the following tanks). This is the equivalent of a cyanide dosing rate of 0.7 kg/t of slurry.

The high pH value (over 10) is required to stabilise cyanide as the CN⁻ is the active ion in the gold and silver complex formation process. This is achieved through the addition of hydrated lime slurry to the CIL feed and as required to CIL tanks.

The CIL tanks are fed with activated carbon particles that adsorb the precious metals leached by the cyanide. The activated carbon concentration in the slurry will be 7-15 g/l. Each tank will have internal screens to prevent the activated carbon particles from discharging from the tank with the residue. Barren carbon is placed in the last CIL tank where it starts to scavenge precious metal values from the leach residue slurry. As the carbon loads with these precious metals it will be periodically pumped counter-current to the leached residue flow to the next upstream tank. The most highly loaded carbon in the first cyanidation tank will be pumped with the residue to one of two loaded carbon recovery screens and the screen underflow residue will be returned to the cyanidation tank from where
it originated and the loaded carbon will drop by gravity to one of two acid-wash columns, where it will be washed in a dilute acid solution to remove calcium deposits.

Chemical reactions with gold, active carbon and air convert cyanide to other chemical compounds such as cyanate (OCN⁻) and thiocyanate (SCN⁻). When continuing cyanate oxidation, ammonia and ammonium ions and carbon dioxide are formed. Cyanide is also lost in the leaching system due to the adsorption on activated carbon of metal complexes (gold, silver, iron, copper, nickel and zinc). Formation of metal complexes of insoluble iron-cyanide complexes can also lead to cyanide losses.

Volatilisation is minimised by maintaining a pH of 10.5 when ionic cyanide is most reactive and not volatile. However, at concentrations of 300 mg/l and pH value of 10.5, approximately 5% of the cyanide is present as the hydrocyanic acid, which is expected to volatilise especially as the tanks are fitted with agitators and some with oxygen spargers. Based on the experience of other leaching circuits it is estimated that approximately 2% of the HCN will volatilise.

It can be estimated that more than 50% of the cyanide is used in the leaching process.

From the last tank of each leaching train, the slurry flows by gravity to the feedwell of the tailings thickener at a rate of some 3600 m³/h, with a solid ratio of 45% and pH of 9-11, where it is mixed with floculants assist in settling of the solids. The thickener provides a method to increase the solids content of the underflow slurry and will generate a relatively clear overflow. Water (overflow) from the thickener will report back to the milling circuit (at a rate of some 985 m³/h and an estimated total cyanide concentration of 219 mg/l and pH 9-11) for re-use and recovery of contained cyanide values (at a rate of some 2708 m³/h, and an estimated total cyanide concentration of 181-189 mg/l or WAD cyanide 177-187 mg/l and pH 9-11).

The settling will ensure recirculation of some 3.2 t/h cyanide in the process water and some 1.9 t/h will report to the detoxification circuit.

5. Gold and silver recovery

The most highly loaded carbon in the first cyanidation tank will be pumped with the residue to one of two loaded carbon recovery screens. The acid-washed carbon (to remove calcium deposits) will be neutralised by rinsing with dilute caustic solution and then transferred to one of two parallel elution columns where a hot cyanide-caustic solution for gold and silver stripping will be used to strip the precious metals from the carbon at a rate of 7.1 m³/h (some 2% NaOH and 3% NaCN).

The stripping process is discontinuous and takes place in three stages:
- heating of eluate solution to 100°C by recirculation through the first heat exchanger (hot oil – preheated eluate solution) – duration 90 min;
- maintaining of eluate solution at 127°C by recirculation through the a heat exchanger (hot oil – hot eluate solution) – duration 240 min;
- cooling of eluate solution at some 60°C by recirculation through the first heat exchanger (hot eluate solution – cold eluate solution) – duration 30 min.

The heat exchangers will use Mobiltherm 603 thermal oil (heated with LPG) and will be washed on a regular basis (automatically) using amidosulphonic acid.

The stripped carbon from each elution column will be pumped to two dewatering screens operating in parallel, reactivated in the regeneration kiln, classified and added back into the CIL circuit. Carbon reactivation will be on a continuous basis.

The pregnant eluate will be pumped to the electro-winning cells in which the gold and silver is plated onto stainless steel cathodes. Electrowinning is done on a batch basis, the process will take place once or twice a day depending on the amount of ore to be processed. The solution work temperature in the cells is 60°C, nominal volume of each cell is 32 m³ and the total volume of a batch is 303 m³, the solution flowrate in the cell is 25 m³/h. The power is supplied via a rectifier with a capacity of 4500 A; the cell process parameters are as follows: current density - 6-20 A/m², voltage 4+10 V and intensity 1300-4330 A.

The gold and silver deposited on the cathodes will be removed as a sludge using high-pressure water sprays; the resulting sludge will be filtered and dewatered in a sludge filter press. The sludge filter will operate in batch mode and will be started and stopped one or more times per day.
Precious metals sludge from the filter press will then be loaded into charge containers (boats) on mobile carts. The boats will be inserted into the mercury retorts where the substance will be volatilised and extracted from the boats using a suction pump. The mercury vapours are discharged to the bottom of the condensing recipient, and the water vapours as well as the mercury vapours are retained in a cooling condensate/water installation, which performs the fog elimination. Condensed mercury will be captured in the charge tank and stored.

The retorted precious metal sludge is then fluxed and melted in an induction furnace. The furnace will operate on a batch campaign basis in association with emptying and filtering of electro-winning cells and retorting. Doré will be cast into 25 kg ingots in a cascade mould. Anticipated operation is three batches per shift to the furnace, with five to 12 shifts per week. Off-gases from the induction furnaces at a temperature of some 950°C will be drawn at a rate of 5000 N m³/h through a scrubber to capture any precious metal or other dusts emitted from the furnace by washing with 0.5% NaOH diluted solution.

There is also a general ventilation system which captures the gases from electro-winning, carbon regeneration system and other sources ensuring a gas exhaust rate of 46280 N m³/h of at some 290°C and provides their wet washing in scrubber at a water rate of 5000 m³/h.

Approximately 50% of the cyanide added to the elution circuit is lost due to the process reactions, the balance is reused in the process.

6. Tailings detoxification

The Project will use for cyanide detoxification the Inco SO₂/air detoxification process on the tailings discharge residue. This is a proven technology that has been adopted in more than 90 mines, worldwide. WAD cyanide concentrations will be reduced using the SO₂/air process below 10 mg/l, before the treated tailings leave the confines of the process plant.

The cyanide detoxification facility will consist of two tanks operating in parallel. Treated water or freshwater will be added to the cyanide detoxification feed header to dilute the underflow of tailings thickener from normally 60% solids to 50% solids. The estimated residence time of the sludge in each tank is 1.5 hours. The sludge reaches the ambient temperature at a rate of some 1125 m³/h, the relative density is some 1.45 while pH is maintained at 8-10.

Oxygen will be introduced into each tank through a sparge. The air flow is some 9 Nm³/h in each tank and will be controlled at each tank through a rotameter.

The source of SO₂ is sodium metabisulphite – \( \text{(Na}_2\text{S}_2\text{O}_5) \) a solution that will be metered into each tank depending in the WAD cyanide concentration in the tailings circuit. The control system then adjusts the flow of the SO₂ to effect detoxification.

A copper sulphate (\( \text{CuSO}_4 \)) solution will be metered into each tank to maintain a required concentration of copper ion in solution to catalyse the detoxification reaction. Copper sulphate control is managed by the control system adjusting the dose rate based on the measures flow of solution into the detoxification reactors.

Lime slurry will be added to each tank via a ring main system, in order to control the pH in the tanks at 8.5.

The pH control system employs duplicated pH probes with error checking to ensure accurate pH control. pH alarms will be able to initiate advisory shut-down procedures for the operations personnel should pH control be lost. An ion selective oxidation-reduction probe will be used in each reactor to evaluate the oxidation potential of the detoxified slurry and ensure no free cyanide remains. This same probe can be used as a control element in the basic automated control system employed. Reagent dosing will be controlled using ratio dosing based on the mass flow of both thickener underflow and the contained cyanide to ensure consistent discharge quality. Analytical procedures will provide the operators with quick and accurate cyanide measurements, which will allow for set-point adjustment as required to maintain process control.

Tailings from the processing plant will be pumped from the tailings pump box located at the processing plant to several discharge points at the TMF at a rate of 2,274 m³/h. The solids content of the tailings being transferred to the TMF will be approximately 49% and WAD cyanide concentration will be below 10 mg/l.
7. Tailings Management Facility
The operation of the Rosia Montanã Project will generate tailings at a rate of approximately 13 Mt/annum for approximately 16 years, producing a total of approximately 218 Mt of treated tailings. The ore processing operations will generate detoxified tailings at a rate of approximately 13 Mt/annum for 17 years, producing a total of approximately 285 Mt of treated tailings. The designed Tailings Impoundment Capacity provides the required storage capacity for the life of the mine, plus an additional contingency capacity.

Approximately half of the water amount used by the process will be ensured by recycling the decant water from the TMF. Water will be reclaimed from the TMF by vertical turbine pumps mounted on a barge located on the TMF decant pond. The reclaim water will be pumped at a rate of 1516 m³/h through a high-density polyethylene (HDPE) pipe to the process water tank within the plant site.

The Secondary Containment Pond pipeline to the TMF will be used to collect and reclaim the seepage from the TMF at a rate of some 114 m³/h. The WAD cyanide concentration of the reclaim water will be below 5mg/l.

The TMF design is extremely robust containing numerous safety measures in addition to the majority of this type of constructions elsewhere in the world. Annex 3.2 illustrates a cross section of the TMF; below the main design elements are presented:
- provide for storage of two Probable Maximum Flood (PMF) events in the TMF;
- a spillway channel will be constructed in the containment pond embankment that will control the discharges from large storm events that will flow into the TMF Reclaim Pond. Thus there is no potential for the erosion of the downstream dam slopes;
- a drainage system at the bottom of the tailings deposit and a filter area between tailings and rockfill to provide moisture reduction and stability of the deposited material;
- a drainage system at the bottom of the tailings deposit and a filter area between tailings and rockfill to provide moisture reduction and stability of the deposited material;
- a drainage system at the bottom of the tailings deposit and a filter area between tailings and rockfill to provide moisture reduction and stability of the deposited material;
- monitoring system on the tailings dam and its proximity to provide early warning regarding potential instability, excessive increase of the water table in the dam body, excessive increase of the volume of water stored in the TMF;
- implementation of a strict quality assurance programme during all dam construction phases;
- implementation of a strict monitoring programme of the volume of water stored in the TMF.

8. ARD treatment
Acid runoff from historical operation (including the Adit 714 runoff) and the new mine will be captured in the Cetate drainage pond. A flow rate of 231 to 371 m³/h ARD water is estimated to be collected.

The Cetate Waste Rock and Mine Drainage Dam will remain operational until it can be demonstrated that water collected in this facility can be discharged directly to the environment in compliance with regulatory consents. Any exposed areas would be re-graded to reduce the residual ponding effect and reinstate where possible the original stream course through this area. A strategic revegetation will be carried out, with the intent that the area becomes naturally overgrown with wetland species.

The water treatment lagoon system constructed downstream of the TMF dam will be maintained after closure to ensure permanent semi-passive treatment of run-off. The acid water captured in the Cetate pond will be pumped at a rate of some 378 m³/h to the wastewater treatment plant, located in the processing plant. Due to the expected oscillations in the pond levels, the pumping station is anticipated to be located on a floating barge.

The wastewater treatment plant is designed specifically to reduce the dissolved metals concentrations and reach the regulatory quality parameters. The plant capacity is designed at 400 m³/hr
with the option for upgrading for additional capacity, if needed in the future. The ARD treatment plant process will employ a process based on the lime neutralisation/precipitation method which includes the following operations:
- air oxidation;
- lime neutralization/precipitation and pH control;
- pH adjustment using carbon dioxide (CO₂);
- flocculation with solids recycle; and
- solids / liquid separation by settling in a clarifier.

Following the neutralisation and oxidation/precipitation steps, the solution will be discharged by gravity to the clarifier for solids - liquid separation.
A flocculant will be added to the clarifier feed tank to aid the settling characteristics of the solids in the clarifier.

When the wastewater plant is operating, discharges from the plant will be used primarily for dust suppression and in the process plant for dilution in the cyanide detoxification process. Clarification underflow residue from the ARD treatment process will report to the Tailings Tank for placement with the tailings in the TMF. Some discharge water may be used to maintain biological baseflows in the Rosia Valley Creek and excess quantities of treated water, that are in compliance with water quality requirements, will be discharged to the Rosia Valley stream.

9. Waste rock stockpiling
Prior to the placement of any waste in the designated waste rock areas, the surface area to be covered will be stripped of topsoil; scarification and compaction of the exposed colluvial and/or weathered bedrock materials will provide a semi-imperVIOUS layer under the waste rock disposal sites. Diversion channels around the waste rock piles will capture potential surface waste run-on and divert it around the piles.

Run-off from the waste rock piles reports to the water management system and will be collected within the TMF or one of the water management dams, which will allow pumping to the wastewater treatment plant or the process plant.

Stockpiling of waste rock in dumps will be conducted selectively, the potential ARD generation waste will be deposited in the inner parts of the waste rock dumps, while the waste with no potential ARD generation will be deposited towards the exterior part of the dumps. The dumps will be provided with storm water drainage systems to ensure their stability over time and collect potential ARD generated by the stockpiled rocks and direct it to the Cetate Water Catchment Dam and/or to wastewater treatment plant.

Both waste rock stockpiles will be reprofiled to facilitate placement of a topsoil layer. The resultant final slopes maintain the overall 2.5H:1V slope with approximately 5 metre wide benches.

Once a raise stage is completed, the slopes and benches will be regraded and covered with soil to reduce seepage and give a durable sublayer for development of vegetation. Drainage from the Cetate Waste Rock Disposal Site will be directed to the Cetate Waste Rock and Mine Drainage Pond and/or wastewater treatment plant.

C. Description of hazardous substances

1. Hazardous substances inventory
Table 3.1 summarizes the chemical substances or solutions used in the precious metal recovery process which may be present on the site.
### Table 3.1. List of hazardous substances present on the site

<table>
<thead>
<tr>
<th>Nr.No.</th>
<th>Name</th>
<th>CAS Number</th>
<th>Location</th>
<th>Total Storage Volume (t)</th>
<th>Physical state</th>
<th>Storage type</th>
<th>Storage conditions</th>
<th>Hazardous level risk phases*</th>
<th>Category as per GD 804/2007 Annex No 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sodium cyanide</td>
<td>143-33-9</td>
<td>NaCN Storage</td>
<td>224</td>
<td>Solid, flakes</td>
<td>ISO CONTAINER</td>
<td>Outside</td>
<td>Highly toxic, hazardous for environment R: 26/27/28-32-50/53</td>
<td>Part 2, item 1 Highly toxic Part 2, it. 9i Part 2, item 1: hazardous</td>
</tr>
<tr>
<td></td>
<td>index no.: 006-007-00-5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hydrochloric acid</td>
<td>7647-01-0</td>
<td>HCl Storage</td>
<td>46</td>
<td>Solution 20 %**</td>
<td>Metal tanks+pipelines</td>
<td>Outside under tarpaulin -inside -in retention basin</td>
<td>Corrosive R: 34-37</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>index no.: 017-002-01-X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sodium hydroxide</td>
<td>1310-73-2</td>
<td>Reagent storage</td>
<td>50</td>
<td>Solid</td>
<td>Big-bag 1000 kg</td>
<td>-inside</td>
<td>Corrosive R 35</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NaOH Storage</td>
<td>72</td>
<td>Solution 20 %</td>
<td>Metal tanks+pipelines</td>
<td>- inside -in retention basin</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>4</td>
<td>Cyanide Slurry**</td>
<td></td>
<td>CIL Area</td>
<td>98000</td>
<td>Solution with 300 mg/l CN</td>
<td>Metal tanks+pipelines</td>
<td>-open -in retention basin</td>
<td>Not classified as hazardous by GD 1408/2008</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Prepared by S.C. OCON ECORISC S.R.L. Turda 40
| Nr.No. | Name                      | CAS Number | Location                   | Total Storage Volume (t) | Physical state                  | Storage type                                      | Storage conditions                     | Hazardous level risk phases* | Category as per GD 804/2007 Annex No 1 |  |
|-------|---------------------------|------------|----------------------------|--------------------------|---------------------------------|--------------------------------------------------|----------------------------------------|----------------------------------|--------------------------------------|---|---|
|       | Decant System             | 5300       |                             | Slurry with 200 mg/l CN  | Construction (concrete + metal) + pipelines | - Outside - in retention basin                    |                                        | N/A                              | Part 2, item 2: Toxic               |   |   |
|       | DETOX                     | 4930       |                             | Slurry with 10-180 mg/l CN | Metal tanks + pipelines        | - Outside - in retention basin                    |                                        | N/A                              |                                      |   |   |
|       | Route from the plant site to TMF | 3800     |                             | Slurry with 10 mg/l CN   | PEHD pipe                      | - Outside                                        |                                        | N/A                              |                                      |   |   |
| 5     | Cyanide rich solution**   | 1460       | Elution area                | Solution 2 % NaOH şi 3 % NaCN | Metal tanks + electrowinning cells + pipelines | - Outside - inside - in retention basin           | Toxic, R: 23/24/25-36/38-52/53       | Part 2, item 2: Toxic               |   |   |
| 6     | Process water*            | 12000      | Tank                       | Solution 5 mg/l CN         | Metal tanks + pipelines        | - Outside - in retention basin                    |                                        | N/A                              |                                      |   |   |
|       | Routes from TMF to water process tank and SCD to TMF | 1000     |                             | Solution 5 mg/l CN         | PEHD Pipe                      | - Outside                                        | Not classified as hazardous by GD 1408/2008 | N/A                             |                                      |   |   |
|       | TMF                       | 100000     |                             | Solution 5 mg/l CN         | TMF                             | - Outside                                        |                                       | N/A                              |                                      |   |   |

Prepared by S.C. OCON ECORISC S.R.L. Turda
<table>
<thead>
<tr>
<th>Nr.No.</th>
<th>Name</th>
<th>CAS Number</th>
<th>Location</th>
<th>Total Storage Volume (t)</th>
<th>Physical state</th>
<th>Storage type</th>
<th>Storage conditions</th>
<th>Hazardous level risk phases*</th>
<th>Category as per GD 804/2007 Annex No 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Ammonium Nitrat</td>
<td>6448-52-2</td>
<td>Explosive storage</td>
<td>100</td>
<td>Solid minimum 28 % N</td>
<td>In silos</td>
<td>In special storage facility</td>
<td>Not classified as hazardous by GD 1408/2008 R8-36/37/38</td>
<td>Part 1: oxidant</td>
</tr>
<tr>
<td>8</td>
<td>Initiation explosives - dynamite</td>
<td>6448-52-2 (azotat de amoniu)</td>
<td>Explosive storage</td>
<td>5</td>
<td>-</td>
<td>Original packaging</td>
<td>In special storage facility</td>
<td>Explosive R: 2-6-44 ADR/RID: 1.1D</td>
<td>Part 2, item5: explosive</td>
</tr>
<tr>
<td>9</td>
<td>Milk of lime</td>
<td>1305-62-0</td>
<td>Lime storage</td>
<td>805</td>
<td>Slurry 15 % CaO</td>
<td>Metal tanks + pipelines</td>
<td>- Outside in retention basin</td>
<td>Irritant R41</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Slaked lime</td>
<td>1305-62-0</td>
<td>Lime storage</td>
<td>600</td>
<td>Powder</td>
<td>Silos</td>
<td>- Outside</td>
<td>Irritant R41</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Quicklime</td>
<td>1305-78-8</td>
<td>Lime storage</td>
<td>860</td>
<td>Granulated</td>
<td>Silos</td>
<td>- Outside</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>10</td>
<td>LPG</td>
<td>68476-85-7</td>
<td>Thermal plant (elution area)</td>
<td>50</td>
<td>Liquid gas</td>
<td>Metal tanks + pipelines</td>
<td>- Outside</td>
<td>Highly flammable R 12</td>
<td>Part 1: Highly flammable</td>
</tr>
<tr>
<td>11</td>
<td>Oxygen</td>
<td>7782-44-7</td>
<td>Oxygen plant</td>
<td>2</td>
<td>Pressurised gas</td>
<td>Metal tanks + pipelines</td>
<td>- Outside</td>
<td>Oxidant R 8</td>
<td>Part 1: oxidant</td>
</tr>
<tr>
<td>12</td>
<td>Diesel</td>
<td>68476-34-6</td>
<td>Fuel storage</td>
<td>520</td>
<td>Fluid</td>
<td>Metal tanks + pipelines</td>
<td>- Outside in retention basin</td>
<td>Highly flammable R10-40-36/37</td>
<td>Part 1: flammable</td>
</tr>
<tr>
<td></td>
<td>Petrol</td>
<td>86290-81-5</td>
<td>Fuel storage</td>
<td>15</td>
<td>Fluid</td>
<td>Metal tanks + pipelines</td>
<td>- Burried</td>
<td>Highly flammable, carcinogen R12-38-45-65</td>
<td>Part 1: flammable</td>
</tr>
<tr>
<td>Nr.No.</td>
<td>Name</td>
<td>CAS Number</td>
<td>Location</td>
<td>Total Storage Volume (t)</td>
<td>Physical state</td>
<td>Storage type</td>
<td>Storage conditions</td>
<td>Hazardous level risk phases*</td>
<td>Category as per GD 804/2007 Annex No 1)</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------</td>
<td>------------</td>
<td>-------------------------------</td>
<td>--------------------------</td>
<td>----------------</td>
<td>----------------------------</td>
<td>---------------------------------------------</td>
<td>-------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>13</td>
<td>Sodium hypochlorite</td>
<td>7681-52-9</td>
<td>Wastewater treatment Plant</td>
<td>5</td>
<td>Fluid</td>
<td>Plastic barrels</td>
<td>- Outside under tarpaulin</td>
<td>Corrosive R31-34</td>
<td>N/A</td>
</tr>
<tr>
<td>14</td>
<td>Sodium metabisulphite</td>
<td>7681-57-4</td>
<td>Reagent storage</td>
<td>120</td>
<td>Solid</td>
<td>Big -bag 1000 kg</td>
<td>-inside</td>
<td>Harmful R: 22-31-41</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DETOX</td>
<td>300</td>
<td>Solution 20 %</td>
<td>Metal tanks + pipelines</td>
<td>-Outside in retention basin</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>15</td>
<td>Copper Sulphate</td>
<td>7758-99-8</td>
<td>Reagent storage</td>
<td>10</td>
<td>Solid</td>
<td>Big -bag 1000 kg</td>
<td>-inside</td>
<td>Harmful, hazardous for environment R: 22-36/38-50/53</td>
<td>Part 2, item 9i: hazardous for environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7758-99-7</td>
<td>DETOX</td>
<td>72</td>
<td>Solution 15 %*</td>
<td>Metal tanks + pipelines</td>
<td>- Outside in retention basin</td>
<td>Harmful, hazardous for environment R22-51/53</td>
<td>Part 2, item 9ii: hazardous for environment</td>
</tr>
<tr>
<td>16</td>
<td>ARD water**</td>
<td></td>
<td>Cetate pond</td>
<td>500000</td>
<td>Acid water</td>
<td>Catchment pond</td>
<td>- Outside</td>
<td>Not classified as hazardous by GD 1408/2008</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pipeline from Cetate pond to plant site</td>
<td>140</td>
<td>Acid water</td>
<td>PEHD pipe</td>
<td>- Burried</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>17</td>
<td>Mercury</td>
<td>7439-97-6</td>
<td>Reagent storage</td>
<td>1</td>
<td>Fluid</td>
<td>Special packaging</td>
<td>-inside</td>
<td>Harmful, hazardous for environment R: 23-33-50/53</td>
<td>Part 2 item 2: Toxic</td>
</tr>
</tbody>
</table>

* Part 2, item 9i: hazardous for environment  
* Part 2, item 9ii: hazardous for environment
### Table of Reagent and Flocculant Storage

<table>
<thead>
<tr>
<th>Nr.No.</th>
<th>Name</th>
<th>CAS Number</th>
<th>Location</th>
<th>Total Storage Volume (t)</th>
<th>Physical state</th>
<th>Storage type</th>
<th>Storage conditions</th>
<th>Hazardous level risk phases*</th>
<th>Category as per GD 804/2007 Annex No 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Flocculant</td>
<td></td>
<td>Reagent storage</td>
<td>10</td>
<td>Solid</td>
<td>Big-bag 1000 kg</td>
<td>-inside</td>
<td>Not classified as hazardous by GD 1408/2008</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>DETOX</td>
<td></td>
<td></td>
<td>68</td>
<td>Solution 0.25 %</td>
<td>Metal tanks + pipelines</td>
<td>- Outside - in retention basin</td>
<td></td>
<td>N/A</td>
</tr>
</tbody>
</table>

* Risk phrases were specified as per the attached Technical Safety Sheets (Annex 3.3)

** The methodology provided by GD 1408/2008 with reference to GD 92/2003 was used to define the phrase risks of mixtures: Annex 1, for health risks and Annex 2: environmental risks
Description of Risk Phrases R-phrases (according to GD 1408/2008):

R 2  Risk of explosion by shock, friction, fire or other sources of ignition
R 6  Explosive with or without contact with air
R 8  Contact with combustible material may cause fire
R 10 Flammable
R 12 Highly flammable
R 22 Harmful if swallowed
R 23 Toxic by inhalation
R 31 Contact with acids liberates toxic gas
R 32 Contact with acids liberates very toxic gas
R 33 Danger of cumulative effects
R 34 Causes burns
R 35 Causes severe burns
R 37 Irritating to respiratory system
R 38 Irritating to skin
R 40 Limited evidence of a carcinogenic effect
R 41 Risk of serious damage to eyes
R 44 Risk of explosion if heated under confinement
R 45 May cause cancer
R 65 Harmful: may cause lung damage if swallowed
R 36/37 Irritating to eyes and respiratory system
R 36/38 Irritating to eyes, respiratory system and skin
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R 51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R 52/53 Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R 23/24/25 Toxic by inhalation, in contact with skin and if swallowed
R 26/27/28 Very toxic by inhalation, in contact with skin and if swallowed
R 36/37/38 Irritating to eyes, respiratory system and skin

Classification of hazardous substances present on the Project site according to GD 804/2007 is summarised in Table 3.2
**Table 3.2.** List of hazardous substances present on the site which exceed the specific relevant amounts according to the Seveso Directive (GD 804/2007)

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Category as per GD 804/2007 (Annex no. 1)</th>
<th>Relevant amount (t)</th>
<th>Total Storage Capacity (t)</th>
<th>Physical State</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cianură de sodiu/Sodium cyanide solid/solid</td>
<td>Part 2, item 1: Highly toxic</td>
<td>5</td>
<td>20</td>
<td>224</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part 2, item 9i: Hazardous for environment</td>
<td>100</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Cianura de sodiu soluție</td>
<td>Partea 2, pctII: Foarte toxic</td>
<td>5</td>
<td>20</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part 2, item 9ii: Hazardous for environment</td>
<td>200</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Soluție bogată cu cianuri</td>
<td>Part 2, item 2: Toxic</td>
<td>50</td>
<td>200</td>
<td>1460</td>
</tr>
<tr>
<td>4</td>
<td>GPL</td>
<td>Part 1: extrem de inflamabil/Highly flammable</td>
<td>50</td>
<td>200</td>
<td>50</td>
</tr>
</tbody>
</table>

2. Characteristics of the main hazardous substances

The characteristics of the main hazardous substances are presented in the attached Safety Technical Sheets (*Annex 3.3*).

The characteristics of the ore and water (solutions, slurry) involved in the process are as follows:

- **Ore**
  
  In addition to Au and Ag it contains metals such as: Mg, Ca, Na, Cu, Hg, As, Pb, Zn, Fe, Mn etc, in the form of apatite, mixed Fe and Mn carbonate, muscovite, orthoclase, pyrite, quartz and rutile.

- **Slurry**
  
  It is the result of the cyanide leaching process and maintains in its composition the substances contained in the raw material plus calcium hydroxide, sodium cyanide and small amounts of chlorides and reduced concentrations of gold and silver. It should be noted that following the chemical processes, their form is radically changed, the presence of cyanides (soluble and insoluble) determining their hazardous nature. It should be also noted that as a result of recycling, the decant water is gradually enriched in the soluble forms tending to reach the saturation limit. The slurry is a mixture of solid and water, with approximately 48% solids (mass ratio). The composition of the liquid phase varies “within large limits (see Table 3.3).
Table 3.3. Composition of slurry liquid phase

<table>
<thead>
<tr>
<th>Indicator</th>
<th>MU</th>
<th>Apă în tulbureală (CIL) Water in slurry (CIL)</th>
<th>Apă în tulbureală (După Detox) Water in slurry (after DETOX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN total</td>
<td>mg/l</td>
<td>193-210</td>
<td>5.8-19.3</td>
</tr>
<tr>
<td>CN Cnue</td>
<td>mg/l</td>
<td>180-199</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Cu</td>
<td>mg/l</td>
<td>8.7-10.4</td>
<td>9-17</td>
</tr>
<tr>
<td>Zn</td>
<td>mg/l</td>
<td>5.2-6.2</td>
<td>0-0.6</td>
</tr>
<tr>
<td>OCN</td>
<td>mg/l</td>
<td>110-120</td>
<td>205-210</td>
</tr>
<tr>
<td>Co</td>
<td>mg/l</td>
<td>0.3-0.5</td>
<td>0.4-0.7</td>
</tr>
<tr>
<td>Ni</td>
<td>mg/l</td>
<td>0.1-5.3</td>
<td>0.3-3.1</td>
</tr>
<tr>
<td>Fe</td>
<td>mg/l</td>
<td>1.9-3.4</td>
<td>2.2-2.7</td>
</tr>
<tr>
<td>PH</td>
<td></td>
<td>10.5-11</td>
<td>8.1-8.4</td>
</tr>
</tbody>
</table>

- Process water with cyanide

It is mainly composed of decant water recycled from the TMF and variable amounts of treated water from the ARD Treatment Plant and fresh raw water. The average chemical composition estimated for the water stored in the process water tank is summarized in Table 3.4.

Table 3.4. Estimated average chemical composition of the process water

<table>
<thead>
<tr>
<th>Indicator</th>
<th>MU</th>
<th>Apă decantată Decant Water (din iazul de decantare TMF) in the TMF pond</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN total</td>
<td>mg/l</td>
<td>1.13-5.09</td>
</tr>
<tr>
<td>CN Cnue</td>
<td>mg/l</td>
<td>0.22-0.77</td>
</tr>
<tr>
<td>Cu</td>
<td>mg/l</td>
<td>0.1-0.15</td>
</tr>
<tr>
<td>Zn</td>
<td>mg/l</td>
<td>&lt; 0.2</td>
</tr>
<tr>
<td>OCN</td>
<td>mg/l</td>
<td>350-390</td>
</tr>
<tr>
<td>Co</td>
<td>mg/l</td>
<td>0.1-0.5</td>
</tr>
<tr>
<td>Ni</td>
<td>mg/l</td>
<td>0.2-0.4</td>
</tr>
<tr>
<td>Fe</td>
<td>mg/l</td>
<td>0.2-1.4</td>
</tr>
<tr>
<td>PH</td>
<td></td>
<td>8-11</td>
</tr>
</tbody>
</table>

- Pregnant solution

It is the result of the elution process; contains some 3% NaCN (sodium cyanide in excess and gold and silver complex cyanides and other substances (e.g. mercury) plus 2% NaOH and impurities. During electro-winning in addition to gold and silver recovery a series of chemical and electrochemical processes occur leading to the gradual reduction of the cyanide concentrations which may reach 50% or less of the initial amount.

- Acid water collected in the Cetate pond

It is the result of acid runoff from historical operation (including the Adit 714 runoff) and the new mine. The estimated composition of this water will be very similar to the composition determined by the conducted analysis (Table 3.5).

Table 3.5. Estimated chemical composition of acid water collected in the Cetate drainage pond

<table>
<thead>
<tr>
<th>Indicator</th>
<th>MU</th>
<th>Roșia Stream</th>
<th>Adit 714</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td></td>
<td>2.9 – 5.0</td>
<td>2.7 – 3.4</td>
</tr>
<tr>
<td>Arsenic</td>
<td>mg/l</td>
<td>0.006 – 0.047</td>
<td>0.079 – 1.74</td>
</tr>
<tr>
<td>Cadmiu/Cadmium</td>
<td>mg/l</td>
<td>0.014 – 0.038</td>
<td>0.097 – 0.351</td>
</tr>
</tbody>
</table>

Prepared by S.C. OCON ECORISC S.R.L. Turda
3. Toxicological and ecotoxicological characteristics of cyanide

3.1 Cyanide effect on human health

Sodium cyanide is an industrial chemical substance largely used and highly valuable and certainly a poison that acts quickly so that in the absence of first aid it can kill within minutes. Sodium cyanide is eliminated from the body through the liver and the potential for causing cancer is unknown. Humans suffering non-lethal intoxications will recover quickly and completely; experience shows that when humans are not exposed to concentrations much above the regulatory limits for longer periods of time there is no long-term effect. While cyanide is a highly toxic chemical substance which should be used with great care, it is rarely the cause of accidental death.

HCN in liquid or gas form may enter the body by inhalation, ingestion or skin contact. The rate of skin absorption is enhanced when the skin is cut, abraded or moist. Inhaled salts of cyanide are readily dissolved and absorbed upon contact with moist mucous membranes. The toxicity of hydrogen cyanide to humans is dependent on the nature of the exposure. Due to the variability of dose-response effects between individuals, the toxicity of a substance is typically expressed as the concentration or dose that is lethal to 50% of the exposed population (LC50 or LD50). The LC50 for gaseous hydrogen cyanide is 100-300 parts per million. Inhalation of cyanide in this range results in death within 10-60 minutes, with death coming more quickly as the concentration increases. Inhalation of 2,000 parts per million hydrogen cyanide causes death within one minute. The LD50 for ingestion is 50-200 milligrams, or 1-3 milligrams per kilogram of body weight, calculated as hydrogen cyanide. For contact with unabraded skin, the LD50 is 100 milligrams (as hydrogen cyanide) per kilogram of body weight.

Although the time, dose and manner of exposure may differ, the biochemical action of cyanide is the same upon entering the body. Once in the bloodstream, cyanide forms a stable complex with a form of cytochrome oxidase, an enzyme that promotes the transfer of electrons in the mitochondria of cells during the synthesis of ATP. Without proper cytochrome oxidase function, cells cannot utilize the oxygen present in the bloodstream, resulting in cytotoxic hypoxia or cellular asphyxiation. The lack of available oxygen causes a shift from aerobic to anaerobic metabolism, leading to the accumulation of lactate in the blood. The combined effect of the hypoxia and lactate acidosis is depression of the central nervous system that can result in respiratory arrest and death. At higher lethal concentrations, cyanide poisoning also affects other organs and systems in the body, including the heart.

Initial symptoms of cyanide poisoning can occur from exposure to 20 to 40 ppm of gaseous hydrogen cyanide, and may include headache, drowsiness, vertigo, weak and rapid pulse, deep and rapid breathing, a bright-red color in the face, nausea and vomiting. Convulsions, dilated pupils, clammy skin, a weaker and more rapid pulse and slower, shallower breathing can follow these symptoms. Finally, the heartbeat becomes slow and irregular, body temperature falls, the lips, face and extremities take on a blue color, the individual falls into a coma, and death occurs. These symptoms can occur...
from sublethal exposure to cyanide, but will diminish as the body detoxifies the poison and excretes it primarily as thiocyanate and 2 amino thiazoline 4 carboxilic acid, with other minor metabolites. The pathophysiology of cyanide poisoning is due to the enzymatic cytochrome system interruption leading to the cancellation of cellular production of ATP, metabolic, acidose and decrease of oxygen consumption. These changes lead to the depression of the cardiovascular system and central nervous system. Acute cyanide poisoning leads to coma, convulsions and cardiac dysrhythmia. Chronical exposure to cyanide results in skin irritations, dermatitis, disrupted respiration.

The central nervous system is one of the target organs in terms of cyanide toxicity. Cyanide reduced the memory along with reduction in the levels of dopamine and 5-hydroxytryptamine in the hippocampus. Pre-existing malnutrition exaggerated these effects.

The body has several mechanisms to effectively detoxify cyanide. The majority of cyanide reacts with thiosulfate to produce thiocyanate in reactions catalyzed by sulfur transferase enzymes such as rhodanese. The thiocyanate is then excreted in the urine over a period of days. Although thiocyanate is approximately seven times less toxic than cyanide, increased thiocyanate concentrations in the body resulting from chronic cyanide exposure can adversely affect the thyroid. Cyanide has a greater affinity for methemoglobin than for cytochrome oxidase, and will preferentially form cyanomethemoglobin. If these and other detoxification mechanisms are not overwhelmed by the concentration and duration of cyanide exposure, they can prevent an acute cyanide-poisoning incident from being fatal.

Some of the available antidotes to cyanide poisoning take advantage of these natural detoxifying mechanisms. Sodium thiosulfate, administered intravenously, provides sulphur to enhance the sulphur transferase-mediated transformation of cyanide to thiocyanate. Amyl nitrite, sodium nitrite and dimethyl aminophenol (DMAP) are used to increase the amount of methemoglobin in the blood, which then binds with cyanide to form non-toxic cyanomethemoglobin. Cobalt compounds are also used to form stable, non-toxic cyanide complexes, but as with nitrite and DMAP, cobalt itself is toxic. Cyanide does not accumulate or biomagnify, so chronic exposure to sublethal concentrations of cyanide does not appear to result in acute toxicity. However, chronic cyanide poisoning has been observed in individuals whose diet includes significant amounts of cyanogenic plants such as cassava. Chronic cyanide exposure is linked to demyelination, lesions of the optic nerve, ataxia, hypertonia, Leber's optic atrophy, goiters and depressed thyroid function. There is no evidence that chronic cyanide exposure has teratogenic, mutagenic or carcinogenic effects.

### 3.2 Cyanide in the environment

Cyanide is produced naturally in the environment by various bacteria, algae, fungi and numerous species of plants including beans (coffee, chickpeas and lima), fruits (seeds and pits of apple, cherry, pear, apricot, peach and plum), almond and cashew nuts, vegetables of the cabbage family, grains (alfalfa, and sorghum), roots (cassava, potato, radish and turnip), white clover and young bamboo shoots. Incomplete combustion during forest fires is believed to be a major environmental source of cyanide. Industrial activities including gold production have the potential to release cyanide in the environment in much higher concentrations than those from natural sources. Although cyanide reacts readily in the environment and degrades or forms complexes and salts of varying stabilities, it is toxic to many living organisms at very low concentrations.

**Effects on aquatic organisms**

Sodium cyanide is a poison that acts very fast and prevents the use of oxygen at cellular level. The high toxicity of cyanide to aquatic life has been long studied and it was discovered that the HCN molecule is the main cause of cyanide toxicity. **Toxicity of most solutions with sodium cyanide complexes tested on fish is attributed mainly to HNC resulting from complex form dissolution?** I don’t understand anything. Although acute toxicity levels vary with certain parameters such as season, species, other aquatic parameters, free cyanide concentrations of 0.005 – 0.003 mg/l are considered non-hazardous for aquatic organisms. The degree of dissociation of various metallocyanide complexes at equilibrium increases with decreased concentration and decreased pH. The zinc- and cadmium- cyanide complexes dissociate...
almost completely in very dilute alkaline solutions; thus these complexes can result in acute toxicity to fish at any pH. In equally dilute solutions there is much less dissociation for the nickel-cyanide complex; hence more stable cyanide complexes are formed with copper. Acute toxicity to fish of diluted solutions containing anions of complex silver-cyanide or copper-cyanide forms may be caused particularly or entirely by non-dissociated ions, although complex ions are much less toxic than HCN. Ferrocyanide complex ions are very stable and non-toxic. In the dark, acute toxic levels of HCN are attained only in concentrated and aged solutions. However, dilute solutions of these complexes are subject to extensive and rapid photolysis on exposure to direct sunlight yielding toxic HCN. Decomposition under the influence of light depends on the ultraviolet radiation exposure and is reduced if the water is poorly lighted in deep, high turbidity waters or water located in shaded areas. Fish and aquatic invertebrates are particularly sensitive to cyanide exposure. Concentrations of free cyanide in the aquatic environment ranging from 5.0 to 7.2 micrograms per liter reduce swimming performance as do reproduction in many species of fish. Other adverse effects include delayed mortality, pathology, susceptibility to predation, disrupted respiration, osmoregulatory disturbances and altered growth patterns. Concentrations of 20 to 76 micrograms per liter free cyanide cause the death of many species, and concentrations in excess of 200 micrograms per liter are rapidly toxic to most species of fish. Invertebrates experience adverse non-lethal effects at 18 to 43 micrograms per liter free cyanide, and lethal effects at 30 to 100 micrograms per liter (although concentrations in the range of 3 to 7 micrograms per liter caused death in the amphipod Gammarus pulex).

Algae and macrophytes can tolerate much higher environmental concentrations of free cyanide than fish and invertebrates, and do not exhibit adverse effects at 160 micrograms per liter or more. Aquatic plants are unaffected by cyanide at concentrations that are lethal to most species of freshwater and marine fish and invertebrates. However, differing sensitivities to cyanide can result in changes to plant community structure, with cyanide exposures leaving a plant community dominated by less sensitive species.

The sensitivity of aquatic organisms to cyanide is highly species specific, and is also affected by water pH, temperature and oxygen content, as well as the life stage and condition of the organism.

- Effects on birds
  Reported oral LD50 for birds range from 0.8 milligrams per kilogram of body weight (American racing pigeon) to 11.1 milligrams per kilogram of body weight (domestic chickens). Symptoms including panting, eye blinking, salivation and lethargy appear within one-half to five minutes after ingestion in more sensitive species, and up to ten minutes after ingestion by more resistant species. Exposures to high doses resulted in deep, labored breathing followed by gasping and shallow intermittent breathing in all species. Mortality typically occurred in 15 to 30 minutes; however birds that survived for one hour frequently recovered, possibly due to the rapid metabolism of cyanide to thiocyanate and its subsequent excretion.

Ingestion of WAD cyanide solutions by birds may cause delayed mortality. It appears that birds may drink water containing WAD cyanide that is not immediately fatal, but which breaks down in the acidic conditions in the stomach and produces sufficiently high cyanide concentrations to be toxic. Sublethal effects of cyanide exposure to birds, such as an increase in their susceptibility to predators, have not been fully investigated and reported.

- Effects on mammals
  Cyanide toxicity to mammals is relatively common due to the large number of cyanogenic forage plants such as sorghum, sudan grasses and corn. Dry growing conditions enhance the accumulation of cyanogenic glycosides in certain plants as well as increase the use of these plants as forage. Reported oral LD50 for mammals range from 2.1 milligrams per kilogram of body weight (coyote) to 6.0-10.0 milligrams per kilogram of body weight (laboratory white rats). Symptoms of acute poisoning usually occur within ten minutes of ingestion, including: initial excitability with muscle tremors; salivation; lacrimation; defecation; urination; labored breathing; followed by muscular incoordination, gasping and convulsions. In general, cyanide sensitivity for common livestock decreases from cattle to sheep to horses to pigs. Deer and elk appear to be relatively resistant.
- Cyanide in soil

Almost all cyanides in the soils affected by cyanide pollution are present as iron complexes, predominantly as ferroferic cyanide. Free cyanide is detectable in these soils, only immediately after the pollution occurrence. Ferroferic cyanide is often stable and not very mobile, particularly in acid conditions normally associated with soils in mining sites, and have low toxicity. Ferroferric cyanide becomes soluble when pH increases (pH above 6), but the resulting hexacyanoferrate ion will also have low toxicity due to the insignificant dissociation in free cyanide. Other complexes or metallic-cyanic salts are not associated with soils within this type of sites in significant amounts to generate an increase in toxicity. Although the UV rays can transform iron cyanide complexes in highly toxic free cyanide the kinetic of this photodegradation in soils is not known. Even so, photodegradation is relevant only at the soil surface and the resulting gas will dilute rapidly and disperse in air to down to non-toxic levels. Although present in the environment and available in many plant species, cyanide toxicity is not widespread due to a number of significant factors. Cyanide has low persistence in the environment and is not accumulated or stored in any mammal studied. There is no reported biomagnification of cyanide in the food chain. Although chronic cyanide intoxication exists, cyanide has a low chronic toxicity. Repeated sublethal doses of cyanide seldom result in cumulative adverse effects. Many species can tolerate cyanide in substantial yet sublethal intermittent doses for long periods of time.

4. Physical and chemical properties of cyanide under normal conditions of use and predictable accident conditions

Cyanide is very reactive, forming simple salts with alkali earth cations and ionic complexes of varying strengths with numerous metal cations. The stability of these salts is dependent on the cation and on pH. The salts of sodium, potassium and calcium cyanide are quite toxic, as they are highly soluble in water, and thus readily dissolve to form free cyanide. On the contrary, the heavy metal cyanide compounds are generally insoluble with the exception of mercury cyanide Hg(CN)_2 which is a covalent insoluble solution. Due to the weak acid nature of hydrocyanic acid, cyanide in aqueous solution is stable only in strongly alkaline ranges.

Cyanide forms ionic complexes of varying strengths with numerous metal cations. Weak or moderately stable complexes such as those of cadmium, copper and zinc are classified as weak-acid dissociable (WAD). Although metal-cyanide complexes by themselves are much less toxic than free cyanide, their dissociation releases free cyanide as well as the metal cation which can also be toxic. Even in the neutral pH range of most surface water, WAD metal-cyanide complexes can dissociate sufficiently to be environmentally harmful if in high enough concentrations. Table 3.6 summarizes the dissociation constant and approximate free cyanide concentration for various initial concentrations of cyanic complex:

Table 3.6. Dissociation constant and approximate concentration of free cyanide

<table>
<thead>
<tr>
<th>No.</th>
<th>Complex</th>
<th>Dissociation Constant</th>
<th>Initial concentration of complex [mg/l]</th>
<th>Concentration of free CN- [mg/l]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ag(CN)_2</td>
<td>1x10^−21</td>
<td>1.23x10−6</td>
<td>12.4x10−6</td>
</tr>
<tr>
<td>2</td>
<td>Cu(CN)2−3</td>
<td>5x10^−28</td>
<td>2.65x10−4</td>
<td>8.37x10−4</td>
</tr>
<tr>
<td>3</td>
<td>Cd(CN)2−4</td>
<td>1.4x10^−12</td>
<td>1.6</td>
<td>5.0</td>
</tr>
<tr>
<td>4</td>
<td>Zn(CN)2−4</td>
<td>1.3x10^−17</td>
<td>1.04</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Cyanide forms complexes with gold, mercury, cobalt and iron that are very stable even under mildly acidic conditions. Iron cyanide complexes are of particular importance due to the abundance of iron typically available in soils and the extreme stability of this complex under most environmental conditions. However, iron cyanides are subject to photochemical decomposition and will release cyanide if exposed to ultraviolet light.

Metal cyanide complexes also form salt-type compounds with alkali or heavy metal cations, such as potassium ferrocyanide (K₄Fe(CN)_6) or copper ferrocyanide (Cu₂[Fe(CN)₆]), the solubility of which...
varies with the metal cyanide and the cation? all alkali salts of iron cyanides are very soluble, upon dissolution these double salts dissociate and the liberated metal cyanide complex can produce free cyanide. Heavy metal salts of iron cyanides form insoluble precipitates with iron, copper, nickel, manganese, lead, zinc, cadmium, tin and silver. These non-toxic salts remain stable over a pH range between 2 to 11. Iron cyanide complexes generally have a higher stability. Although the hexacyanoferrite (III) also called ferri-cyanide ion \([\text{Fe(CN)}_6^{3-}\]) and is more stable than the hexacyanoferrat ion also called ferro-cyanide ion \([\text{Fe(CN)}_6^{4-}\]), their stability constant being \(10^{44}\) and \(10^{27}\), respectively, the equilibrium: \([\text{Fe(CN)}_6^{n-}] < \rightarrow \text{Fe}^{6-n} + 6\text{CN}^-\) is reached much quicker in the first case than in the second. Thus, the \([\text{Fe(CN)}_6^{3-}]\) ion is much more inert and therefore non-toxic as opposed to \([\text{Fe(CN)}_6^{4-}]\) although the stability constant values would indicate a converse behavior.

Cyanide reacts with some sulfur species to form less toxic thiocyanate. Potential sulfur sources include free sulfur and sulfide minerals such as chalcopyrite (CuFeS2), chalcocite (Cu2S) and pyrrhotite (FeS), as well as their oxidation products, such as polysulfides and thiosulfate. Thiocyanate dissociates under weak acidic conditions, but is typically not considered to be a WAD species because it has similar complexing properties to cyanide. Thiocyanate is approximately 7 times less toxic than hydrogen cyanide but is very irritating to the lungs, as thiocyanate chemically and biologically oxidizes into carbonate, sulfate and ammonia.

The oxidation of cyanide, either by natural processes or from the treatment of effluents containing cyanide, can produce cyanate, \(\text{OCN}^-\). Cyanate is less toxic than HCN, and readily hydrolyzes to ammonia and carbon dioxide. Oxidation of cyanide to less toxic cyanate normally requires a strong oxidizing agent such as ozone, hydrogen peroxide, \(\text{SO}_2/\text{air}\) or hypochlorite. However, adsorption of cyanate on both organic and inorganic materials in the soil appears to promote its oxidation under natural conditions.

Cyanide and cyanide-metal complexes are adsorbed on organic and inorganic constituents in soil, including oxides of aluminium, iron and manganese, certain types of clays, feldspars and organic carbon. Although the strength of cyanide retention on inorganic materials is unclear, cyanide is strongly bound to organic matter.

Under aerobic conditions, microbial activity can degrade cyanide to ammonia, which then oxidizes to nitrate. This process has been shown effective with cyanide concentrations of up to 200 parts per million. Although biological degradation also occurs under anaerobic conditions, cyanide concentrations greater than 2 parts per million are toxic to these microorganisms. Biological oxidation decomposes free cyanide in \(\text{HCO}_3^-\) and \(\text{NH}_3\) producing \(\text{NO}_2^-\) and \(\text{NO}_3^-\) via subsequent nitrification. Other degradation products such as \(\text{SCN}^-\) are also subject to biological degradation and formation of \(\text{HCO}_3^-\), \(\text{HSO}_4^-\) and \(\text{NH}_4^-\).

As pH decreases, HCN can be subject to hydrolyze resulting in formic acid or ammonium formate. Although this is not a quick reaction, it can be significant for the water table where anaerobic conditions occur.

One of the most important reactions affecting the free cyanide concentration is HCN volatilization which is highly important in terms of hazards in case of accidents. Free cyanide is not resistant in most surface water as the pH of this water is normally 8, thus HCN is volatilized and dispersed. The amount of cyanide lost through this pathway increases with decreasing pH, increased aeration of solution and with increasing temperature.

Gas HCN release from the free cyanide containing solution will very much depend on their salinity. Figure 3.1 shows pH and salinity dependence of the cyan ion hydrolysis.
The meaning of the “I” symbol is ion strength, or salinity. Note that there will be the more gas HCN the lower the solution pH is than the pKa. The correlation between pKa and salinity is:

<table>
<thead>
<tr>
<th>I</th>
<th>0</th>
<th>0.1</th>
<th>0.5</th>
<th>1</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>pKa</td>
<td>9.22</td>
<td>9.05</td>
<td>8.95</td>
<td>8.95</td>
<td>9.22</td>
<td>9.66</td>
</tr>
</tbody>
</table>

Gas HCN release will be at first diminished by salinity increase, but at salinity more than 3 it will be fostered. Therefore, in very saline solutions gas HCN will form even at higher pH values. 0.5 to 1 salinity will allow work with slightly lower pH values, with the same amount of HCN volatilizing, therefore safer operating conditions.
IV. Identification of Relevant Safety Sections and Sources of Hazard

A. This Section describes in detail potential accident scenarios and their probability of occurrence, circumstances in which they may occur, including a summary of events that may play a role in triggering one of the scenarios, taking into consideration both internal and external causes for the facility.

In the following sections, possible accident scenarios are described, circumstances in which they may occur and a qualitative assessment of the probability of occurrence, as well as of the size/seriousness of the consequences, for each Project phase and each of the safety sections identified.

Minning Operations Areas

1. Explosions during in-pit mixing of ANFO The ammonium nitrate and fuel oil mix (ANFO) is an explosive mix (under the legislation on explosive materials) and will be subject to the same general safety requirements as all civil use explosives. The probability of the explosive mix to self ignite is low, as this mix is rather impervious and involving special devices with all the safety measures in place. Under certain conditions of storage or use, such as long exposure to a heat source or even to the sunlight, it may detonate accidentally due to an increased ignition sensitivity. However, such cases are extremely rare.

The seriousness of such an accident occurring is rather high, as it may result in loss of life.

2. The explosion of undetonated holes after blasting is low probability. Although misses are possible, they can be detected during the mandatory blasting front check conducted by the blaster after each blasting operation. The probability of not detecting the potential misses during the front check is medium. If detected, a plan will be developed to liquidate such unspent explosives, either by drilling blasting holes next to them, causing their destruction in subsequent detonation, or by applying additional loads on top, in the secondary blasting of oversize rocks. On the other hand, the shotmen will be carefully selected upon recruitment, and provided with special training for explosives operation, and will be regularly subjected to psychological checks.

Should blasting holes still remain undetonated and explode in an uncontrolled manner, the resulting accident may be serious, causing loss of life and material damage.

3. Vibrations due to the use of explosives for mining purposes. The use of explosives is a source of noise, vibrations and seismic waves, they may generate health risks and risks to the local buildings. Pit blasting operations are conducted based on well defined schemes, with explosive amounts carefully calculated for the mining purpose, so that the generated seismic wave should not affect the local structures.

The potential of explosive blasting to generate destructive effects on constructions is low.

4. Collapse of the work front at the open pit may occur in the following situations:
   a. The use of too much explosive is less likely, as pit blasting is conducted based on well established schemes and according to the terrain conditions.
   b. The existence of an underground void below the pit bench is possible, as the historic mining works locations on the site are not all known.
   c. The occurrence of cracks in the massif or of friable interspersions that would cause the “break” of more rock than initially predicted is low probability, as the massif rock has been investigated and its geo-mechanical characteristics are known, and the topographers and geologists will conduct daily inspections of the work front to identify any potential crack.
   d. The appearance of an aquifer in the operations area and failure to capture it ranks as low probability.
The probability of caving in to occur is low if the operating technologies are properly complied with and exploration precedes any opening of a new work front, and if the blasting technologies are correctly applied.

The consequences may be of moderate seriousness and include:

- human casualties involving the workers at the work front;
- damage to the pit equipment and potential spill of fuel onto the soil;
- damage to pipelines or electrical cables located on or near the affected site;
- collapse of access roads, hence impossibility to continue operations before the roads are repaired.

5. Road and occupational accidents occurring in the on-site ore haulage of raw materials and materials to working places are assigned medium probability, due to the rigorous organizations of all these works, to proper road development, to ongoing training of the operational staff, and the provision of adequate safety equipment and measures.

Such accidents may cause more or less serious injuries to one or several workers and potential minor material damage.

b. On-site haulage routes

1. Road and occupational accidents occurring in the on-site ore haulage from the pit to the process plant are assigned medium probability, due to the rigorous organizations of all these works, to proper road development, to ongoing training of the operational staff, and the provision of adequate safety equipment and measures.

Such accidents may cause more or less serious injuries to one or several workers and potential minor material damage.

c. Process plant

1. Total destruction of the plant installations by terrorist attack, with standard or nuclear weapons, involving simultaneous damage to the HCl tank (including containment) and to the NaCN solution tank, the tanks containing enriched solution, to one or more leaching tanks, leading to spillage of their entire content.

The probability of occurrence is very low for armed attack, as the facility is not of strategic significance, and such an attack would assume the existence of a previous conflict, and hence anticipation of such an event, which would provide enough time to stop operations and remove all sources of contamination (sodium cyanide and cyanide solutions, hydrochloric acid). A terrorist attack is a low probability event (even if higher than for an armed attack) and, as it may not be anticipated, its effects would certainly be very serious. Even if the event involves the simultaneous explosion of the cyanide tank or a leaching tank and the hydrochloric acid tank, the probability for the hydrochloric acid solution and the cyanide to come into contact is very low, due to their respective location in different areas and at a sufficiently safe distance from each other (more than 50 m). Also, the land adjacent to the acid and cyanide solution storage facilities, respectively, will be graded to drain in different directions, which will make the mix of acid and cyanide solutions practically impossible.

If, however, acid comes into contact with the cyanide containing solutions, large amounts of hydrocyanic acid will be generated and volatilized into the ambient air around the process plant, in concentrations exceeding the fatal dose. Depending on the atmospheric conditions, the area affected by fatal doses of HCN may extend to long distances, even off site, and affect residential areas, with the potential to kill people caught into the toxic cloud without a gas mask.

2. Serious damage to the sodium cyanide solution tank, resulting in the spillage of the entire content thereof (180 m3 solution containing about 40 t NaCN). It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (important contraction of the building material at abnormally low temperatures compounded by freezing of the entire contents, especially of the screws that fasten the manhole cover).
The probability of occurrence is rather low, considering that the tank is located in a close building and the tank is designed to meet the strength requirements established for static, dynamic, and seismic loads.

Even if the whole sodium cyanide solution contained in the storage tank spills out, the amount will be contained in the impervious collection tank which is designed to collect the entire content of the storage tank and the cyanide blending vessel. The containment tank is also provided with a sump and a submersible pump able to return all the spills into the process. Should the spilled volume nonetheless exceed the containment capacity of the secondary containment system, the excess solution will be directed to the collection tank of the DETOX plant, where it can be collected, treated and pumped into the TMF. Such a spill may generate (especially in high temperature conditions) a release of HCN in toxic ambient concentrations in the immediate vicinity of the impacted area. People present on the impacted site may also get sprinkled by the spills.

3. Breakage of a solid cyanide container, followed by spillage of its content (max. 16t). It may occur during on-site transport or handling; the probability is low, as the container is specially designed and built.

Breakage of a solid cyanide storage tank is not a very serious occurrence, but may affect the people in its immediate vicinity and, in certain circumstances (rain, etc.) may cause relatively small spills of cyanide on adjacent areas.

4. Serious damage to the HCl solution storage tank, resulting in the spillage of the entire content thereof (20 m³). It may occur under terrorist attack, as a fissure in the tank due to high mechanical stress (seism, accidental hitting, accidental break of the bottom nozzles, of the discharge piping, faulty material).

Although the probability of occurrence is medium, the containment tank will ensure collection of the maximum content of the vessel, and the probability of the containment system to fail at the same time is extremely low. It is possible, however, for a small part of the acid to spill out of the collection tank if the fault occurs high enough for the liquid jet to fall beyond the tank border.

Spillage of hydrochloric acid from the storage tank into the containment system will release corrosive HCl vapors into the impacted area, and may cause harm to the people in its close vicinity, but such intoxications are not typically very serious, as the fog aspect and pungent smell will warn people off. A more serious concern would be spray getting into the eyes of the people on the very site of the accident.

5. Breakage of a tanker carrying hydrochloric acid solution, followed by spillage of its content (max. 20 m³). May occur during on-site transport or unloading.

The probability is medium, as the materials used in building the container are relatively frail (plastic material) ad involves road transport.

Spillage of hydrochloric acid will release corrosive HCl vapors into the impacted area, and may cause harm to the people in its close vicinity, but such intoxications are not typically very serious, as the fog aspect and pungent smell will warn people off. A more serious concern is for the acid to come into contact with the cyanide potentially present in the impacted area, which may release HCN, with potential harm to the people nearby. A very serious occurrence involves the spill getting into the containment system of the cyanide containing tanks, already (potentially) holding cyanide bearing water or cyanide leaks, when massive release of HCN might even exceed he lethal concentration. Depending on the atmospheric conditions, the area affected by toxic concentrations of HCN may extend off site, and affect people caught into the toxic cloud without a gas mask.

6. Serious damage to a leaching tank, resulting in the spillage of the entire content thereof (5000 m³ and max. 14 x 5000 m³ = 70000 m³) It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (seism, important contraction/expansion of the tank building material at abnormally low/ high temperatures, break of the screws that fasten the manhole cover, etc.).
The probability of occurrence is rather low, considering that the tanks are placed in a concrete containment tank, relatively far from the site roads and are designed to meet the strength and stability requirement established for static, dynamic, and seismic loads.

Spillage of the whole amount of cyanide slurry contained in the leaching tank(s), if very fast, may cause a discharge over the secondary containment border and passage into the DETOX plant collection tank, where it can be collected, treated and pumped into the TMF. Such a spill may generate (especially in high temperature conditions) a release of HCN in toxic ambient concentrations in the immediate vicinity of the impacted area. People present on the impacted site may also get sprinkled by the spills.

7. **Serious damage to the thickener**, resulting in the spillage of the entire content thereof (max. 3700 m³). It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (seism, important contraction/expansion of the tank building material at abnormally low/ high temperatures, break of discharge nozzle).

The probability of occurrence is rather low, considering that it is designed to meet the strength and stability requirements establish for static, dynamic, and seismic loads.

The thickener is placed in an impervious containment tank (together with the DETOX reactors) which is designed to contain the entire content of the facility. The containment tank is also provided with a sump and a submersible pump able to return all the spills into the process. Should the spilled volume nonetheless exceed the containment capacity of the secondary containment system, the excess solution will be directed to the collection tank of the DETOX plant, where it can be collected, treated and pumped into the TMF. Such a spill may generate (especially in high temperature conditions) a release of HCN in toxic ambient concentrations in the immediate vicinity of the impacted area. People present on the impacted site may also get sprinkled by the spills.

8. **Serious damage to the access platform or railings thereof over the leaching tanks**, resulting in people accidentally falling into the slurry mass. It is hardly likely both due to the constructive system and to the fact that any important fault may be easily detected by visual inspection.

The seriousness of such an event is high, with the injured person suffering from chemical burns over the whole body, or even dying from drowning or ingesting a solution of cyanides and toxic metals.

9. **Serious damage to the DETOX water treatment facility**, resulting in the spillage of the entire content of one or both reaction vessels (max 2 x 1600 m³). It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (important contraction/expansion of the tank building material at abnormally low/ high temperatures, break of the screws that fasten the manhole cover, etc.).

The probability of occurrence is low, considering that the equipment is designed and built to meet the strength and stability requirements establish for static, dynamic, and seismic loads.

Spillage of the entire cyanide loaded water contained in the DETOX facility will cause its discharge onto the concrete pad on which the facility is mounted, into the containment system, which has sufficient capacity to cope with the maximum potential spill. The containment tank is also provided with a sump and a submersible pump able to return all the spills into the process or directly into the TMF. Such a spill may generate (especially in high temperature conditions) a release of HCN in toxic ambient concentrations in the immediate vicinity of the impacted area, but the level of the release will not involve toxic concentrations (due to the high alkalinity and low concentration of free cyanide). People present on the impacted site may get sprinkled by the spill.

10. **Operating errors/failure of the DETOX facility**. Probability of occurrence is medium, due to ongoing and regular checks (involving redox sensors and laboratory analyses) of the physical and chemical parameters of the tailings slurry prior to discharge into the decant pond.

Inadequate treatment of the discharge (too high cyanide content) will not generate serious effects due to dilution of the relatively low amount of liquid (over a short time) into the very large
amount of clarified water in the pond. Anyway, the water collected in the pond will not discharge into the natural receiver, but will be recycled in the process instead.

11. Operating errors and/or failures in the measurement and control devices, resulting in a lower pH in the leaching tank, thickener and/or DETOX slurry. Hardly likely, due to automated control and regular laboratory checks of the physical and chemical parameters of the slurry and the continuous monitoring of ambient HCN levels.

The effects of such failure may be rather serious, due to the increased concentrations of HCN above the leaching tanks (especially at higher ambient temperatures) that would affect the workers on the operations platform. pH reduction will be very slow (even with total absence of lime wash input) due to the large amount of fluid in each tank, hazardous pH levels may only be attained within hours in the first leaching tank, by which time the failure cannot fail to be identified and remedied, therefore the effects will be medium and short term.

12. Serious damage to the rich solution storage tank(s), resulting in the spillage of the entire content thereof (max. 420 m³). It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (seism, important contraction of the tank building material at abnormally low temperatures).

The probability of occurrence is rather low, considering that the tanks are designed to meet the strength and stability requirements established for static, dynamic, and seismic loads.

The 5 storage tanks for enriched solution are placed within an impervious containment system designed to contain the entire content of the storage tanks. The containment tank is also provided with a sump and a submersible pump able to return all the spills into the process. Should the spilled volume nonetheless exceed the containment capacity of the secondary containment system, the excess solution will be directed to the collection tank of the DETOX plant, where it can be collected, treated and pumped into the TMF. Such a spill may generate (especially in high temperature conditions) a release of HCN in toxic ambient concentrations in the immediate vicinity of the impacted area. People present on the impacted site may also get sprinkled by the spills.

13. Damage to the 15% CuSO₄ solution storage tank, resulting in the spillage of the entire content thereof. It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (seism, important contraction of the tank building material at abnormally low temperatures). The probability of occurrence is rather low, considering that the tanks are designed to meet the strength and stability requirements established for static, dynamic, and seismic loads.

The consequences of such an incident would be minor, as the tank is placed within an impervious containment tank provided with a sump and a submersible pump able to return all the spills into the process. The acidity of the copper sulfate solution may determine a release of HCN in the air in the immediate vicinity of the spill, should it occur at the same time as leaks of cyanide containing suspensions. People present on the impacted site may also get sprinkled by the spills.

14. Damage to the 20% Na₂S₂O₅ solution storage tank, resulting in the spillage of the entire content thereof. It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (seism, important contraction of the tank building material at abnormally low temperatures). The probability of occurrence is rather low, considering that the tanks are designed to meet the strength and stability requirements established for static, dynamic, and seismic loads.

The consequences of such an incident would be minor, as the tank is placed within an impervious containment tank provided with a sump and a submersible pump able to return all the spills into the process. The acidity of the sodium metabisulfite solution may determine a release of HCN and/or SO₂ in the air in the immediate vicinity of the spill, should it occur at the same time as cyanide containing suspensions. People present on the impacted site may also get sprinkled by the spills.

15. Accidents in the reagent storage area. Reagent storage involves specially designed warehouses equipped with prevention and response systems, in the original packaging, and observance
of the incompatibility rules, therefore accidents of this kind have a low probability of occurrence and the potential consequences are minor.

16. **Serious damage to the sodium hydroxide solution tank**, resulting in the spillage of the entire content thereof (40 m³) and/or the blending vessel (20 m³). It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (important contraction of the building material at abnormally low temperatures compounded by freezing of the entire contents, especially of the screws that fasten the manhole cover).

The probability of occurrence is rather low, considering that the tank is located in a close building and the tank is designed to meet the strength requirements established for static, dynamic, and seismic loads.

Even if the whole sodium hydroxide solution contained in the storage tank spills out, the amount will be contained in the impervious collection tank which is designed to collect the entire content of the storage tank and the cyanide blending vessel. The containment tank is also provided with a sump and a submersible pump able to return all the spills into the process. People present on the impacted site may also get sprinkled by the spills.

17. **Serious damage to the lime wash storage tanks**, resulting in the spillage of the entire content of the lime wash preparation vessel (max. 700 m³). It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (seism, important contraction/expansion of the tank building material at abnormally low/high temperatures, break of discharge nozzle).

The probability of occurrence is low, considering that the equipment is designed and built to meet the strength and stability requirements established for static, dynamic, and seismic loads.

Spillage of the lime wash contained in the tank will cause its discharge onto the concrete pad on which the facility is mounted, and then, through the drainage system, it may be carried into the storm water tank. People present on the impacted site may get sprinkled by the spill.

18. **Operating errors - acid wash of activated carbon**. They have medium probability.

Insufficient rinsing of the activated carbon may cause release of higher amounts of HCN upon contact with the rinsing acid, but this will occur within the elution column, which is equipped with a ventilation system discharging through the dispersion stack. Potential residual cyanide amounts on the carbon will not be very high, and even in the event of the ventilation system malfunctioning, the effects cannot be too serious.

19. **Operating errors in electrolysis**. They are less probable due to the periodical check of the physical and chemical parameters conducted by means of laboratory analysis and monitoring.

Too low a content of NaOH in the rich solution subject to electrolysis may enhance releases of toxic gases (including HCN) in the cell area during the process. As the ventilation system will ensure the capturing and stack discharge of such releases, they may only affect potential operators present in the electrolysis area unless the ventilation system is malfunctioning.

20. **Damage to the LPG storage tank and distribution system**, resulting in tank explosion and ignition of the released gas. Probability is relatively low, due to the special regime applied in the tank design, execution and control.

Explosion of the LPG storage tank may be very serious in the short term, causing material damage, and even personal injury.

21. **Serious damage to the process water storage tank**, resulting in the spillage of the entire content thereof (max. 12300 m³). It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (seism, important contraction/expansion of the tank building material at abnormally low/high temperatures, break of the screws that fasten the manhole cover, break of the discharge nozzles).
The probability of occurrence is rather low, considering that the tanks are designed to meet the strength and stability requirements established for static, dynamic, and seismic loads.

Spillage of the entire amount of (cyanide bearing) process water in the storage tank will cause its discharge into the containment system. The impact area may not exceed the impervious pad around the tank. Such a spill may generate (especially in high temperature conditions) a release of HCN in toxic ambient concentrations in the immediate vicinity of the impacted area, but the level of the release will not involve toxic concentrations (due to the high alkalinity and low concentration of free cyanide).

People present on the impacted site may also get sprinkled by the spills.

22. Damage to the sodium hypochlorite used in water disinfection for treatment. These are medium probability events and may occur if the plastic barrels are knocked during handling.

Due to the oxidizing effect and high alkalinity of the hypochlorite solutions, potential spills may cause chemical burns to the exposed persons but effects are generally less severe. Such events may result in more serious consequences in case of contact with acids, when it will break down and release chlorine gas into the air, but the only potentially injured will be the persons close to the spill and only in the short term.

23. Damage to the lime wash-ARD reactor, resulting in the spillage of the entire content thereof. It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (seism, important contraction/expansion of the tank building material at abnormally low/high temperatures, break of discharge nozzle). The probability of occurrence is low, considering that the equipment is designed and built to meet the strength and stability requirements establish for static, dynamic, and seismic loads.

Spillage of lime wash contained in the storage tank will cause its discharge into the containment system, whence it will be pumped back into the process. Only the people present on the impacted site may get sprinkled by the spill, therefore the consequences will be minor.

24. Damage to the flocculant -ARD reactor, resulting in the spillage of the entire content thereof. It may occur under terrorist attack, or a crack developing in the tank wall due to very high mechanical stress (seism, important contraction/expansion of the tank building material at abnormally low/high temperatures, break of discharge nozzle). The probability of occurrence is low, considering that the equipment is designed and built to meet the strength and stability requirements establish for static, dynamic, and seismic loads.

Spillage of solution contained in the storage tank will cause its discharge into the containment system, whence it will be pumped back into the process. Only the people present on the impacted site may get sprinkled by the spill, therefore the consequences will be minor.

25. Damage to the ARD clarifier, resulting in the spillage of the entire content thereof. It may occur during a terrorist or armed attack due to very high mechanical stress (seism). The probability of occurrence is low, considering that the equipment is designed and built to meet the strength and stability requirements establish for static, dynamic, and seismic loads.

Spillage of the solution contained in the tank will cause its discharge onto the containment system and pumped back into the process, or possibly, through the drainage system, it may be carried into the storm water tank. Only the people present on the impacted site may get hurt in the accident, therefore the consequences will be moderate.

26. Damage to the compressed air facility, consisting of explosion of the buffer vessels and/or pressurized handling pipes. It may only occur if the safety valves get jammed or malfunction, and the probability of occurrence is low due to the special equipment involved and to the special, ISCIR-compliant design, execution and control.

This kind of failure may cause serious injuries but only to the people on the impacted site.

27. Damage to the oxygen production and distribution facility, consisting of explosion of the buffer vessels and/or pressurized handling pipes. It may only occur if the safety valves get jammed or
malfuction, or upon contact with oils or lubricants and the probability of occurrence is low due to the special equipment involved and to the special, ISCIR-compliant design, execution and control.

This kind of failure may cause serious injuries but only to the people on the impacted site, or generate local fires if the oxygen comes into contact with organic substances.

28. **Damage to the electricity supply and distribution system**, consisting of shorts and/or overheating followed by ignition of the conductor insulation and even of the power transformer.

Such events are of medium probability of occurrence as the design and execution of the system is based on the regulated safety standards, the materials are high quality, there are automated safety and control devices that will provide (partial or total) supply cuts as soon as the normal operating parameters of the system are exceeded.

The only event of this kind that might have serious consequences consisting of important material damage to the transformer station that might also involve personal injury for the response teams. An indirect effect of more serious consequences would be a site-wide power cut. Break down and fire in the fuel tanks (diesel and gasoline).

29. **Power cuts caused by factors beyond the control of the company** are low probability events, and may only occur in exceptional situations in the national power supply system. Reserve power generators have been provided.

Contingent power cuts may have rather serious, but short-term consequences, consisting of solution spills (no pumping into the TMF) and, for a longer-term cut during very low temperature spells, solution freezing in the piping systems with an increased potential for break down upon restarting the facility.

30. **Break down and/or fire in the fuel storage facilities** may occur due to terrorist attack or in compliance with the operating rules and have low probability of occurrence.

Such accidents may cause more or less serious injuries to one or several workers and minor material damage.

31. **Breakdown in the cyanide handling systems** (pipes, casings, pumps) resulting in spills. They may occur with medium probability throughout the operation phase (slightly higher at pump start and in the areas provided with sealing flanges).

Breakdown of the cyanide solution handling systems have relatively low seriousness (spill amounts are typically very small) but people may get sprayed. Of more concern are the cases where the spilt solutions come into contact with acid solutions and HCN may be released.

32. **Breakdown in the cyanide slurry handling and/or pre-treatment systems** (pipes, casings, pumps) resulting in spills, that may occur with medium probability throughout the operation phase (slightly higher at pump start and in the areas provided with sealing flanges).

Such spills only involve very low hazard, as the amounts are low and will be collected onto concrete areas and directed to the emergency tank. Potential sprinkling of the operators in the impacted area may only have minor effects.

33. **Breakdown in the handling systems of cyanide containing solutions/suspensions** (pipes, casings, pumps) resulting in spills. They may occur with medium probability throughout the operation phase (slightly higher at pump start and in the areas provided with sealing flanges).

Such spills involve relatively small amounts of material and may only occur on impervious areas on which they will be collected and directed to the emergency tank. Due to the relatively low cyanide content and high pH, HCN releases are practically impossible (except in accidental contact with hydrochloric acid). Due to high alkalinity, sprinkling of the operators in the impacted area may have rather serious consequences.
34. Breakdown in the hydrochloric acid handling systems (pipes, casings, pumps) resulting in spills, that may occur with medium probability throughout the operation phase (slightly higher at pump start and in the areas provided with sealing flanges).

Spillage of hydrochloric acid will release corrosive HCl vapors into the impacted area, but in this type of failure the spills involve very small amounts, therefore potential harm to the people in its close vicinity is hardly likely, and such intoxications are not typically very serious, as the fog aspect and pungent smell will ward people off. A more serious concern is for the acid to come into contact with the cyanide potentially present in the impacted area, which may release HCN (in very small amounts), with potential harm to the people in close vicinity.

35. Breakdown in the sodium hydroxide handling systems (pipes, casings, pumps) resulting in spills, that may occur with medium probability throughout the operation phase (slightly higher at pump start and in the areas provided with sealing flanges).

The spill of NaOH solution on floors only involves the risk of sprinkling the operators in the area, while potential personal injury might be serious if the corrosive drops reach the eyes and immediate rinsing and first aid measures are not taken.

36. Suicidal attempts by ingestion of cyanide solution. It is rather unlikely, due to limited access to the premises, especially in the operational areas, and the fact that the cyanide handling system is a closed loop one and the company personnel are subject to psychiatric controls during recruitment and regularly afterwards.

The consequences of such an event would be very serious, almost certainly resulting in death.

37. Occupational accidents occurring during the on-site maintenance and repairs activities or response action are assigned medium probability, due to the rigorous organization of all these works, conducted under the direct supervision of the specialist middle management, to ongoing training of the operational staff, and the provision of personal protective equipment and adequate and high quality tools and devices.

Occupational accidents occurring during maintenance and repairs work or response action may cause more or less serious injuries or intoxication to several workers.

d. Pipeline Routes

1. Fissure in the tailings pipe due to wear or other causes. The probability is rather low, due to erosion, especially in sensitive areas (elbows, flanges, compensators, valves). The use of polyethylene as a construction material will substantially reduce its probability.

Such breakdowns will cause spill of material containing hazardous substances in small amounts, that will affect limited areas, and will be typically collected entirely into the impervious drainage system, therefore the effects will be minor.

2. Fissure in the decant water pipeline due to wear. The probability is low due to the absence of solids that might cause erosion. However, the risk is slightly higher in the flexible area (between the barge and the fixed pipe on the ground) also due to the fast and sizeable oscillations of the free liquid levels in the pond.

Such breakdowns will cause spill of material containing hazardous substances in small amounts, that will affect limited areas, and will be typically collected entirely into the drainage system and the TMF, therefore the effects will be minor.

3. Break, crack, or failure of a joint in the slurry or decant water pipeline systems. They may be caused by faults in the material, malfunction of the guiding systems or expansion compensators, or by water hammer effect at pump start. They have low probability, but increasing with extreme temperature events.

Such breakdowns will have moderate short-term effects, as they will involve spill of rather large amounts of material containing hazardous substances that the drainage system will not be able to
4. Breakdown in the ARD piping system from the Cetate Dam to the ARD wastewater treatment plant may be caused by faults in the material, malfunction of the guiding systems or expansion compensators, or by water hammer effect at pump start. They have low probability, but increasing with extreme temperature events.

Such breakdowns may cause minor short-term effects, as the safety systems will allow fast detection and trigger immediate pump stop.

5. Occupational accidents occurring during the on-site maintenance and repairs activities or response action are assigned medium probability, due to the rigorous organization of all these works, conducted under the direct supervision of the specialist middle management, to ongoing training of the operational staff, and the provision of personal protective equipment and adequate and high quality tools and devices.

Occupational accidents occurring during maintenance and repairs work or response action may cause more or less injuries to one or several workers and may be considered events with minor consequences.

ev. Tailings Management Facility

1. Malfunctioning of the dam

Malfunctioning of the dam, followed by uncontrolled release of tailings and water from the TMF and SCS for a certain period of time is an event that may impact on the downstream river system if the volume of water and tailings is very high.

Risk analysis associated with dam break and release of tailings and water over the crest were subject to a detailed study using the event tree approach (Hazard Assessment of Corna Dam in Tailings Management Facility, NGI, Report no. 20081558-1, 27 April 2009, 107 pages). The study was prepared by the Norwegian Geotechnical Institute (NGI) upon the request of S.C. Roșia Montană Gold Corporation S.A. NGI is an institution with years experience in the field which has offices in several localities in Norway and other worldwide countries (USA and Malaysia) and employees 210 specials from over 25 countries.

The event tree approach provides a clear understanding of how a series of events that can lead to the dam failure may occur, by presenting a logical succession of events or situations at the TMF and estimating their probability of occurrence as well as potential effects. The analysis results were quantified in terms of probability of occurrence associated with dam break or dam crest overflow. The impacts were assessed in terms of quality based on “Table 2. Simplified Impact List”

As part of the work, a geomorphology study was conducted and a report prepared by Emeritus Professor Dick Chandler, Imperial College of Science and Technology (Chandler, 2008). The geomorphological survey was conducted to establish the likelihood of geologic hazards for the construction and operation of the Corna Dam, tailings pond and waste disposal dump at Roșia Montană, with particular reference to the possibility of pre-existing landsliding at the site.

An event tree workshop was held in Bucharest in January 2009 to develop the event trees and reach a consensus when quantifying the hazards. The workshop assembled experts on tailings dams and hazard and risk analyses.

In accordance with the good practice standards, RMGC also established an independent Committee for the technical review of the report, consisting of tailings dam experts.

Based on probabilistic analyses, the potential conditions and triggers of accidents were estimated, as well as all potential modes of non-performance for the dam and combinations of the scenarios were cumulatively assessed. Therefore, the scenarios took into consideration a series of factors:
a. Potential conditions - Most critical times during life of the dam (schematic illustration in Figure 1 of NGI Report, 2009): completion of starter dam (1.25 years), change in the construction method (4 years), final dam completion (16 years), as well as an intermediate period (9-12 years);

b. Triggers:
- Extreme precipitation (rainfall, flood and snowmelt);
- Earthquake;
- Natural terrain slide and Carnic waste stockpile failure in valley slopes

Acts of war or sabotage, impact by meteorites or other extreme events of this type, with probability of occurrence less than 10^-7 per year were not considered, as they would result in so low probabilities of non-performance that they are not realistic to consider.

c. Non-performance modes ("failure" modes) - schematic illustration in Figure 2 of NGI Report 2009)
- Foundation failure
- Dam slope instability downstream or upstream
- Unravelling of downstream toe and slope
- Dam abutment failure followed by breach;
- Liquefaction of the tailings.

d. Conditions which can affect the TMF operation
- Construction deficiencies
- Insufficient quality control
- Unforeseen construction schedule changes

Table 4.1 presents the short version of the prioritised analysis. The event tree analyses considered rather the most plausible scenarios, including all possible modes of failure for the Corna Dam under extreme triggers such as the 10,000 year-earthquake and extreme precipitation.

Table 4.1. Risk analysis associated with dam break and release of tailings and water over the crest

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Time</th>
<th>Trigger</th>
<th>Non-performance mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter Dam</td>
<td>1.5 yrs</td>
<td>Earthquake shaking</td>
<td>Foundation failure</td>
</tr>
<tr>
<td>Starter Dam</td>
<td>1.5 yrs</td>
<td>Earthquake shaking</td>
<td>Dam slope instability</td>
</tr>
<tr>
<td>Starter Dam</td>
<td>1.5 yrs</td>
<td>Earthquake shaking</td>
<td>Abutment failure</td>
</tr>
<tr>
<td>Starter Dam</td>
<td>1.5 yrs</td>
<td>Earthquake shaking</td>
<td>Toe unravelling</td>
</tr>
<tr>
<td>Completed Corna dam</td>
<td>16 yrs</td>
<td>Earthquake shaking</td>
<td>Foundation failure</td>
</tr>
<tr>
<td>Completed Corna dam</td>
<td>16 yrs</td>
<td>Earthquake shaking</td>
<td>Downstream slope instability and liquefaction</td>
</tr>
<tr>
<td>Completed Corna dam</td>
<td>16 yrs</td>
<td>Earthquake shaking</td>
<td>Abutment failure</td>
</tr>
<tr>
<td>Starter Dam</td>
<td>1.5 yrs</td>
<td>Precipitation, flood, snowmelt</td>
<td>Foundation failure</td>
</tr>
<tr>
<td>Starter Dam</td>
<td>1.5 yrs</td>
<td>Precipitation, flood, snowmelt</td>
<td>Dam slope instability</td>
</tr>
<tr>
<td>Starter Dam</td>
<td>1.5 yrs</td>
<td>Precipitation, flood, snowmelt</td>
<td>Abutment failure</td>
</tr>
<tr>
<td>Starter Dam</td>
<td>1.5 yrs</td>
<td>Precipitation, flood, snowmelt</td>
<td>Internal erosion and toe unravelling</td>
</tr>
<tr>
<td>Starter Dam + 2 raises</td>
<td>4 yrs</td>
<td>Precipitation, flood, snowmelt</td>
<td>Operational delays</td>
</tr>
<tr>
<td>Starter Dam + 2 raises</td>
<td>4 yrs</td>
<td>---</td>
<td>Natural terrain slide in valley slope</td>
</tr>
<tr>
<td>Event</td>
<td>Duration</td>
<td>Failure Type</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>----------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>Intermediate stage</td>
<td>9-12 yrs</td>
<td>Failure of Carnic waste stockpile</td>
<td></td>
</tr>
<tr>
<td>Completed Corna Dam</td>
<td>16 yrs</td>
<td>Failure of Carnic waste stockpile</td>
<td></td>
</tr>
<tr>
<td>Starter dam</td>
<td>1.5 yrs</td>
<td>Internal erosion</td>
<td></td>
</tr>
<tr>
<td>Intermediate stage</td>
<td>9-12 yrs</td>
<td>Liquefaction of tailings</td>
<td></td>
</tr>
</tbody>
</table>

Each of the event trees is presented in a series of figures in Appendix A and completed with a summarizing figure with the accumulated probabilities in each tree for each consequence category. Appendix A describes the presentation of the trees and the reasoning for the probabilities assigned.
The total probability of non-performance is the sum of all contributing probabilities to the non-performance, for either the Starter Dam or the completed Corna Dam (or any intermediate stage).

It should be noted that for the completed Corna dam, the analyses do not consider the capture of some of the discharge flow in the SCD and the semi-passive treatment lagoons directly below the SCD. The SCD will have a capacity of 53,000 m³ when the main dam will be completed. The lagoons will extend for a distance of 500 m beyond the SCD and have a capacity of 33,000 m³ above their operating capacity. The SCD and the lagoons will not be full during normal operating conditions and would mitigate, or even contain, the released tailings and water.
The highest probability of non-performance is approximately 1 x 10^-6/yr, or once in a million years and the associated low negative impacts are the result of the TMF design criteria. In summary, they include the following:

- Operational freeboard at all times of one meter above storage elevation for maximum reclaim pond and 2 PMP (probable maximum flood) volumes; the freeboard leads to a storage volume capacity at all times of 2 PMP (equivalent to 5.5 millions m³ volume), corresponding to a capacity of two 1/10,000-year rainfall occurring within the same 24 hours;
- Gentle slopes for the Starter Dam (\(\approx 2H:1V\) upstream and \(\approx 2H:1V\) downstream) and also for the Corna Dam slopes (\(3H:1V\));
- Use of rock quarry material for the Starter Dam construction (good quality rockfill);
- "Well drained" tailings beach at the upstream face of the dam, where equipment can be moved for repairs, in case of movement or partial breach;
- Secondary Containment Dam (SCD) with containment capacity of 43,000 m³ when the main dam is completed after 16 years; in the early construction years, the SCD has much higher containment capacity;
- Spillway to release water from 1 in 10 year flood in a controlled manner on top of a previous 24 hour Probable Maximum Flood (PMF) event;
- Diversion channels along the sides of the valley to divert excess rainfall runoff away from the TMF pond to minimise the risk of overtopping;
- Comprehensive geotechnical monitoring system for safety surveillance;
- Careful control of construction by owner and contractor/engineer.

The analysis conducted pursuant to the NGI Report, 2009 and debates within the Bucharest workshop in 2009 led to the following outcome:

- The extreme scenario of dam breach as presented in the EIA Report (see the Environmental Impact Assessment Report, Part 7 Risks, 2006, page 120 of 205) was considered in this report as highly improbable, with a probability of occurrence in the range of \(10^{-8}\) or \(10^{-9}\) per year. The respective study considers releases of 7.8 million m³ of tailings and 3.8 million m³ of water; and 27.7 million m³ of tailings and 5.9 million m³ of water during 24 hours. These releases would involve a breach 60-m deep over a length of 385 metres, which the experts consider impossible for a dam built with good quality rockfill material, and downstream slope of \(3H:1V\).
- The debates led to the conclusion that the most severe case would be equivalent to a breach of the Corna Dam extending 5 to 8 metres below the crest and extending over a length of 100 to 200 metres along the centreline. The ensuing release due to such a breach would be a maximum of 250,000 m³ of tailings and 26,000 m³ of water (P. Corser, MWH, personal communication, March 2009). Following this event a tailings and water overflow would result about 100 times lower than the overflow resulting following the two extreme scenarios considered in the EIA report.
- For the first years of TMF operation, the risk analysis showed that any amount of water released from the pond (anyway with a very low probability of occurrence) would be retained in the area between the SCS and toe of the TMF dam and would not flow into the river.
- None of the plausible accident successions reflected in the event trees results in a probability of non-performance higher than \(1 \times 10^{-6}/yr\), or once in a million years return period.
- The highest probabilities of non-performance (approximately once in a million years) were associated with earthquake shaking generating instability of the main dam and static liquefaction of the tailings at time 9 to 12 years, as well as internal erosion of the starter dam.
- None of the scenarios would result in more than some material damage and some contamination, both in the vicinity downstream of the dam. They would cause no trans-boundary effects.
- The low computed probabilities of occurrence suggest that there is no need for impact mitigation measures. Instrumentation and monitoring during construction and operation of the dam is probably the most cost-effective measure to provide reliable results on the behaviour of the dam, and would provide the means to intervene early and efficiently if some unexpected event should occur.

- The estimated probabilities for a non-performance of the dam are lower than what is used as reference criteria for dams and other containment structures around the world and lower than the probabilities of non-performance for most other engineered structures. The event tree analyses suggest that the probability of non-performance of the Roșia Montană TMF is about 100 times lower than the probability of non-performance of comparable containment dams around the world.

RMGC made a commitment to do periodic reviews and to update the hazard assessment when the final design has been completed and at key times of the construction schedule, and if any unexpected event should occur.

2. Breakdowns in the Secondary Containment System

   Designed to collect seepage through the Corna dam and storm waters washing the downstream area thereof, a breakdown in this system may result in exceeded containment capacity and discharge into the recipient water (Corna Valley) of excess water, which is an unlikely event.

   The potential consequences are of moderate seriousness and relatively short-term, as the predicted toxic content (cyanides, heavy metals) of this water is low, mainly due to dilution.

3. Breakdown of the decant water pumping station (floating barge) resulting in discontinued water recycling at the process plant and due to pump failure or power cuts. The probability is medium, but he presence of back up pumps will limit the effects to the short term.

   Even if it is an unwanted event, that might affect normal business at the TMF and even at the plant, the seriousness is moderate and short term.

4. Serious failures or incidents that make treatment of the cyanidated slurry impossible before discharge into the TMF, due to malfunctioning reagent dosage systems or discontinued reagent supply.

   Even if faults in the dosage system are probable enough, the presence of the monitoring systems and the parallel operation of two DETOX facilities will considerably reduce this risk. Difficulties in reagent supply may occur due to the remoteness of the supply sources and to access difficulty to the plant site (caused by floods, snow, access road deterioration, etc.), but such an incident is predictable and therefore allows for the adoption of the necessary measures.

   Failure to treat the water (loaded with cyanide) may generate moderate short term effects as they will be reduced by dilution and therefore may not impact significantly on the receiving water quality.

5. Development of toxic aerosols and HCN on the pond surface will occur permanently, the amount of water released into the air depending on both the physical and chemical characteristics of the pumped and impounded water and on the weather conditions.

   With strong insolation and high temperature, the amount of HCN released into the air on the pond surface will increase, but if the pH is maintained within normal process limits, HCN ambient concentrations will remain below the toxic threshold, even in close proximity to the water surface.

6. Damage at the electricity supply and distribution system of the floating barge and SCS, consisting of shorts and/or overheating followed by ignition of the conductor insulation.

   Such events are of medium probability of occurrence as the design and execution of the system is based on the regulated safety standards, the materials are high quality, there are automated safety and control devices that will provide (partial or total) supply cuts as soon as the normal operating parameters of the system are exceeded.
Such events are of low seriousness and short duration, the consequences being material
damage and interrupted pump back of solutions (normally not causing a stop of operations at
the plant). Of slightly more concern is the interruption of pump back from the secondary containment
system which might result in the discharge of the contained solutions into the receiving water, and the
discharge rate exceeds the capacity of the treatment system.

7. **Power cuts caused by factors beyond the control of the company** are low probability events,
and may only occur in exceptional situations in the national power supply system.
Contingent discontinuation of power supply may have moderate consequences consisting of
short-term interruption of decant water pumping.

8. **Suicidal attempts by ingestion of cyanide containing solution.** It is very unlikely, due to
limited access to the TMF premises, and the company personnel are subject to psychiatric controls
during recruitment and regularly afterwards.
The consequences of such an event would be very serious, almost certainly resulting in death.

9. **Occupational accidents occurring during the on-site maintenance and repairs activities or
response action** are assigned medium probability, due to the rigorous organization of all these works,
conducted under the direct supervision of the specialist middle management, to ongoing training of the
operational staff, and the provision of personal protective equipment and adequate and high quality
tools and devices.
Occupational accidents occurring during maintenance and repairs work or response action may
cause more or less injuries to one or several workers and may be considered events with minor
consequences.

*f. Cetate waste and mine drainage dam and pond*

1. **Dam break resulting in the development of breaches** may occur in case of terrorist attacks
or a classic or nuclear attack, an earthquake, etc.
The probability of occurrence is very low for a terrorist or armed attack. The pond location is
exposed to minor seismic risk and the dam was designed to withstand an earthquake of magnitude
greater than 8.
Such an accident may have serious consequences including impact on extensive land areas,
impact on downstream water quality, plus material damage and potential human injuries.

2. **Breaks resulting in overflow** are low probability of occurrence, as they may only occur in
the case of failure to observe the operating parameters. Extreme weather events (abundant
precipitation, extremely low temperatures) increase the probability of such breakdowns to occur.
Such breakdowns have relative low seriousness, resulting in short-term impact on downstream
water quality.

3. **Damage to the pumping station**, consisting of pump malfunction or power cuts and resulting
in the interruption of ARD pumping to the wastewater treatment facility have a medium probability of
occurrence.
Under normal operating conditions, the consequences would be minor and short-term.

*g. Stockpiles*

1. **Risk of waste rock pile crumbling** - loss of stability in the waste rock stockpiles is
determined by the configuration and physical and mechanical characteristics of the foundation ground,
the hydrodynamic particularities of the local waters and their interaction with the stockpiled materials,
the geotechnical features of the waste rock (porosity, internal friction angle, cohesion, specific weight,
humidity, degree of compaction, etc.). The probability of occurrence is medium, with the observance
of the technical design criteria for pile stability, established for the specific conditions of the site and
the characteristics of the material. The stockpiles will be monitored by visual inspection, manual and automatic topographical measurements and the deposition will be made in raises, with leveling and compaction of the stockpiled material.

The seriousness of the accident may be major, due to the massif amounts of stockpiled waste rock and to the fact that a landslide may cause damage to buildings or access roads on the site.

h. Explosives storage

1. Explosion or fire at the storage facility. Ammonium nitrate is not an explosive substance, but may explode in the presence of fuel oil or detonators. As specific security and protection must be provided for such a facility, the probability of explosion on this site is relatively low.

An explosion of the whole amount of material at the storage facility will be very strong, and may cause the death of persons nearby, but will not affect buildings or structures, all located more than 1 km away.

2. Road accident involving a vehicle providing on-site transportation of explosives. The probability of occurrence of such an accident is low, as transport speed on site is regulated and on-site transport vehicles are specially assigned to this purpose.

The seriousness is rather high as, in the case of accident, ammonium nitrate may come into contact and mix with fuel oil and, in the case of fire or overheating, will cause a very strong explosion. This might trigger a chain effect, if other facilities in the area may be affected and in their turn cause further accidents.

B. Assessment of the size and seriousness of the consequences of the identified major accidents

1. Quantitative risk assessment

For the identification of potential major accidents associated with the Rosia Montana Project a qualitative assessment of the hazards associated with the potential accident scenarios presented above was carried out.

A qualitative analysis has for its main objective to establish the list of possible hazards, enable event ranking based on risk and is the first step in the quantitative risk assessment methodology. Quantitative risk assessment is based on computing the level of risk as a product of the seriousness (consequence) and the probability of an event.

a. The qualitative measure of consequences - it is classified into five levels of seriousness, which have the following meanings:

1. Insignificant
   - For humans (population): insignificant harm
   - Ecosystems: Some minor, short term and reversible adverse effects on a few species or parts of the ecosystem
   - Socio-political: Insignificant social effects with no reason of concern for the community

2. Minor
   - For humans (population): first aid is necessary
   - Emissions: emissions on the site that are immediately contained
   - Ecosystems: considerable fast and reversible damage for a few species or part of the ecosystem, animals forced to leave their usual habitat, plants unable to develop according to natural rules, air quality creates local nuisance, water pollution exceeds background levels for a short period of time
   - Socio-political: Social effects with little reason of concern for the community

3. Moderate
- For humans (population): medical treatment is necessary
- Economy: reduced production capacity
- Emissions: emissions on the site that are contained with outside help
- Ecosystems: temporary reversible damage, damage to habitats and animal population migration, plants unable to survive, air quality impacted by potentially long term health risk compounds, potential damage to aquatic life, pollution requiring physical treatment, limited soil contamination that can be remediated quickly
- Socio-political: Social effects of moderate concern for the community

4. Major
- For humans (population): serious harm
- Economy: interruption of production activity
- Emissions: off site emissions with no harmful effects
- Ecosystems: death of some animals, large scale damage, damage to local species and loss of existing habitats, air quality requires “safe refuge” or evacuation decisions, soil remediation is only possible based on long-term programs;
- Socio-political: Social effects of serious concern for the community

5. Catastrophic
- For humans (population): fatalities
- Economy: production stop
- Emissions: off site toxic emissions with harmful effects
- Ecosystems: death of large numbers of animals, loss of species of flora, air quality requires evacuation, extensive and permanent soil pollution
- Socio-political: social effects of very high concern for the community

b. The probability to occur measure - involves classification into five levels which have the following meaning:

1. Rare (improbable) may only occur in exceptional situations
2. Hardly likely to occur
3. Possible - may occur some time
4. Probable - may most likely occur
5. Almost certain - may most likely occur in most cases

Using the information obtained from the analysis, an event’s risk is placed in a matrix like the following:

<table>
<thead>
<tr>
<th>Consequence</th>
<th>Insignificant</th>
<th>Minor</th>
<th>Moderate</th>
<th>Major</th>
<th>Catastrophic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improbable</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Hardly likely</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Possible</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Probable</td>
<td>4</td>
<td>8</td>
<td>12</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Almost certain</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Levels of Risk</th>
<th>Definition</th>
<th>Actions to be taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low risk</td>
<td>Business as usual</td>
<td></td>
</tr>
</tbody>
</table>

Prepared by S.C. OCON ECORISC S.R.L. Turda
For the assessment of the risk associated with the operations to be carried out by the Project numerical values for each level of seriousness of the consequences and probability of occurrence were assigned; the risk associated to each scenario is the product of the two assigned values. In setting the values associated with the probability and seriousness levels, consideration is given to the existence of technical safety structures and equipment provided in the design.

For a more clear presentation of the conclusions of the accidental risk analysis specific to the Rosia Montana operations, a risk quantification matrix is presented below (Table 4.2) drawn up based on the possible accident scenarios described above.
### Risk Quantification Matrix

<table>
<thead>
<tr>
<th>No.</th>
<th>Hazard</th>
<th>Probability</th>
<th>Seriousness</th>
<th>Risk</th>
<th>Potential Impacts</th>
<th>Prevention Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>a. Mining areas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Explosions during in-pit mixing of ANFO</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>Loss of life or serious injury of the operator of the blending device</td>
<td>Avoidance of heat or sources of fire (sparks) near the blending device</td>
</tr>
<tr>
<td>2</td>
<td>Misfired blasting holes (misses) left after blasting</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>Loss of life or serious injury of the personnel in the area, material damage</td>
<td>Work front check by the blaster after each blasting and misfires will be detonated in the next blast</td>
</tr>
<tr>
<td>3</td>
<td>Vibrations due to the use of explosives for mining purposes</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>May be badly perceived by the human factor and cause structural damage to buildings</td>
<td>Precise calculation of explosive quantities, for efficient blasting and to prevent impacts from vibrations</td>
</tr>
<tr>
<td>4</td>
<td>Collapse of the work front at the pit</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>Material damage and human accidents</td>
<td>Observance of process parameters required by the operating method and daily check of the work front by the surveyors, geologists and foremen</td>
</tr>
<tr>
<td>5</td>
<td>Road and occupational accidents</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Material damage and human accidents</td>
<td>Adjusting travel speed at the pit to weather conditions, the state of roads and traffic</td>
</tr>
<tr>
<td></td>
<td><strong>b. Site haul routes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Road and occupational accidents</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Workforce injury, material damage</td>
<td>Adequate training and equipment</td>
</tr>
<tr>
<td></td>
<td><strong>c. Process Plant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Total destruction of plant facilities</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>Impact on the local soils from massive toxic discharges, potential toxic air emissions</td>
<td>Adequate location of risk sources at the plant (cyanide fluids drainage separate from acidic drainage)</td>
</tr>
<tr>
<td>2</td>
<td>Serious damage to the sodium cyanide storage tank</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>Toxic spills, local HCN emissions</td>
<td>Leak detection systems, visual inspections, containment tank</td>
</tr>
<tr>
<td>3</td>
<td>Breakage of a solid NaCN container</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>Local spills on soil</td>
<td>Special container design, on-site traffic management, special training of the drivers, decontamination measures</td>
</tr>
<tr>
<td>No.</td>
<td>Event Description</td>
<td>Probability</td>
<td>Likelihood</td>
<td>Hazards/Effects</td>
<td>Preventive Measures</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------------------</td>
<td>-------------</td>
<td>------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Serious damage to the HCl solution holding tank</td>
<td>2</td>
<td>3</td>
<td>Toxic spills, sprinkling, local toxic HCl vapor emissions</td>
<td>Leak detection systems, visual inspections, impervious containment tank</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Breakage of the hydrochloric acid hauling road tanker</td>
<td>3</td>
<td>3</td>
<td>Local spills on soil</td>
<td>Special container design, on-site traffic management, special training of the drivers, decontamination measures</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Serious damage to a leaching tank</td>
<td>2</td>
<td>3</td>
<td>Toxic spills, local HCN emissions</td>
<td>Leak detection systems, visual inspections, containment tank</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Serious damage to the thickener</td>
<td>2</td>
<td>3</td>
<td>Toxic spills, local HCN emissions</td>
<td>Leak detection systems, visual inspections, impervious containment tank</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Serious damage to the access platform or railings above the leaching tank</td>
<td>1</td>
<td>3</td>
<td>Operator injury</td>
<td>Adequate design and construction, visual inspection</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Serious damage to the DETOX water treatment facility</td>
<td>2</td>
<td>2</td>
<td>Toxic spills, local HCN emissions</td>
<td>Leak detection systems, visual inspections, impervious containment tank</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Operating errors/failure of the DETOX facility</td>
<td>3</td>
<td>2</td>
<td>Excess CN content of the slurry pumped into the TMF</td>
<td>Automated and laboratory monitoring, operator training</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Operating errors and/or failures in the measurement and control devices, resulting in a lower pH in the leaching tank, thickener and/or DETOX slurry</td>
<td>3</td>
<td>3</td>
<td>Local HCN emissions to the ambient air</td>
<td>Automated and laboratory monitoring, operator training, automated detection and warning systems</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Serious damage to the rich solution holding tanks</td>
<td>2</td>
<td>3</td>
<td>Toxic spills, local HCN emissions</td>
<td>Leak detection systems, visual inspections, impervious containment tank</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Damage to the 15% CuSO4 solution tank</td>
<td>2</td>
<td>2</td>
<td>Toxic spills, local HCN emissions</td>
<td>Leaks detected, visual inspections, impervious containment tank</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Damage to the 20% Na2S2O5 solution tank</td>
<td>2</td>
<td>3</td>
<td>Corrosive spills, operator sprinkling and chemical burns</td>
<td>Special storage facility design, on-site traffic management, special training of the drivers and handlers, decontamination measures</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Damage to the reagent storage facilities (copper sulfate, sodium metabisulfite, etc.)</td>
<td>2</td>
<td>3</td>
<td>Local spills on soil</td>
<td>Special storage facility design, on-site traffic management, special training of the drivers and handlers, decontamination measures</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Serious damage to the sodium hydroxide solution tank</td>
<td>2</td>
<td>2</td>
<td>Corrosive spills, operator sprinkling and chemical burns</td>
<td>Leaks detected, visual inspections, impervious containment tank</td>
<td></td>
</tr>
<tr>
<td>Event Description</td>
<td>Frequency</td>
<td>Severity</td>
<td>Consequences</td>
<td>Preventive Measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>----------</td>
<td>--------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serious damage to the lime wash holding tank</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>Corrosive spills, operator sprinkling and chemical burns</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Leak detection systems, visual inspections, containment tank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating errors - acid wash of activated carbon</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>Local HCN emissions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ventilation system and gas scrubber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating errors in electrolysis</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>Local HCN emissions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ventilation system and gas scrubber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explosion of the LPG storage tank</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>Workforce injury, material damage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Special tank design and construction, special operator training, special regular checks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serious damage to the process water holding tank</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>Spills of hazardous content liquids on soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Leak detection systems, visual inspections, containment tank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage to the sodium hypochlorite bottles</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Spills of hazardous content liquids on soil and potential toxic chlorine emissions to the local ambient</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dedicated storage and transport containers, special operator training, separate storage, away from heat and sources of acids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage to the ARD lime wash reactor</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Spills of hazardous content liquids on soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Leak detection systems, visual inspections, impervious containment tank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage to the ARD-flocculant reactor</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Spills of hazardous content liquids on soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Leak detection systems, visual inspections, impervious containment tank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARD clarified breakdown</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>Spills of hazardous content liquids on soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Leak detection systems, visual inspections, impervious containment tank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage of the compressed air facility</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>Workforce injury, material damage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Special tank design and construction, special operator training, special regular checks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage of the oxygen production and distribution facility</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>Workforce injury, material damage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Special tank design and construction, special operator training, special regular checks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failures of the electricity supply and distribution system, involving fire</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>Local production stop, workforce injury, material damage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Special tank design and construction, special operator training, special regular checks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary power supply cut</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>Interruption of production activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Special operator training, power generator, special regular checks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage and/or fire at the fuel tanks</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>Workforce injury, material damage, Adequate training and equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID</td>
<td>Description</td>
<td>Probability</td>
<td>Severity</td>
<td>Probability Value</td>
<td>Consequence</td>
<td>Countermeasures</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------------------------------</td>
<td>-------------</td>
<td>----------</td>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>31</td>
<td>Damage of the cyanide solution handling systems</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Toxic spills, local HCN emissions</td>
<td>Special design and construction, fire prevention and control measures</td>
</tr>
<tr>
<td>32</td>
<td>Damage of the cyanidated slurry handling systems</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Toxic spills, local HCN emissions</td>
<td>Special design and construction, ongoing visual inspection, special regular inspections</td>
</tr>
<tr>
<td>33</td>
<td>Damage of the cyanide containing solutions/suspensions handling systems</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Toxic spills, local HCN emissions</td>
<td>Special design and construction, ongoing visual inspection, special regular inspections</td>
</tr>
<tr>
<td>34</td>
<td>Damage of the hydrochloric acid solution handling systems</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>Corrosive spills, sprinkling, local toxic HCl vapor emissions</td>
<td>Special design and construction, ongoing visual inspection, special regular inspections</td>
</tr>
<tr>
<td>35</td>
<td>Damage of the sodium hydroxide solution handling systems</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>Corrosive spills, operator sprinkling and chemical burns</td>
<td>Special design and construction, ongoing visual inspection, special regular inspections</td>
</tr>
<tr>
<td>36</td>
<td>Suicidal attempt</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>Death</td>
<td>Access restrictions to the hazardous areas, psychological check on recruitment and regularly afterwards</td>
</tr>
<tr>
<td>37</td>
<td>Occupational accidents during maintenance and repair works</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Workforce injury, material damage</td>
<td>Adequate workforce training and equipment</td>
</tr>
</tbody>
</table>

**d. Pipeline Routes**

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Probability</th>
<th>Severity</th>
<th>Probability Value</th>
<th>Consequence</th>
<th>Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fissure in the tailings pipe</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Toxic spills on adjacent soils, sprinkling, local HCN emissions</td>
<td>Special design and construction, leak detection system, ongoing visual inspection, special regular inspections, decontamination measures</td>
</tr>
<tr>
<td>2</td>
<td>Fissure in the decant water pipe</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>Spills of hazardous content liquids on adjacent soils</td>
<td>Special design and construction, leak detection system, ongoing visual inspection, special regular inspections, decontamination</td>
</tr>
</tbody>
</table>

Prepared by S.C. OCON ECORISC S.R.L. Turda
<table>
<thead>
<tr>
<th>No.</th>
<th>Event Description</th>
<th>Frequency</th>
<th>Risk Level</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Break of the tailings pipe or decant water handling</td>
<td>2</td>
<td>3</td>
<td>Toxic spills on adjacent soils, sprinkling, local HCN emissions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Special design and construction, leak detection system, ongoing visual inspection, special</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>regular inspections, decontamination measures</td>
</tr>
<tr>
<td>4</td>
<td>Damage of the pipelines carrying ARD from Cetate pond</td>
<td>2</td>
<td>2</td>
<td>Spills of hazardous content liquids on adjacent soils</td>
</tr>
<tr>
<td></td>
<td>to the WWTP</td>
<td></td>
<td></td>
<td>Special design and construction, leak detection system, ongoing visual inspection, special</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>regular inspections, decontamination measures</td>
</tr>
<tr>
<td>5</td>
<td>Occupational accidents during maintenance and repair</td>
<td>3</td>
<td>2</td>
<td>Workforce injury, material damage</td>
</tr>
<tr>
<td></td>
<td>works</td>
<td></td>
<td></td>
<td>Adequate workforce training and equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Special design and construction, leak detection system, ongoing visual inspection, special</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>regular inspections, decontamination measures</td>
</tr>
<tr>
<td>6</td>
<td>Malfunctioning of the dam</td>
<td></td>
<td></td>
<td>Discharge of contaminated water into the receiving watercourse</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Operator and maintenance workers’ training, backup equipment available</td>
</tr>
<tr>
<td>7</td>
<td>Breakdowns in the Secondary Containment System</td>
<td>2</td>
<td>2</td>
<td>Rise of water levels in the pond</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Operator training, production stop if necessary</td>
</tr>
<tr>
<td>8</td>
<td>Incidents preventing wastewater treatment discharged</td>
<td>2</td>
<td>2</td>
<td>Increased CN concentration in the pond</td>
</tr>
<tr>
<td></td>
<td>into the DETOX system</td>
<td></td>
<td></td>
<td>Automated and analytical monitoring of the DETOX facility, operator training, production stop</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>if necessary</td>
</tr>
<tr>
<td>9</td>
<td>Development of toxic and HCN aerosols on the pond</td>
<td>4</td>
<td>2</td>
<td>Permanent HCN emissions to the ambient air</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maintaining low CN concentrations by providing slurry treatment prior to before TMT discharge,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>capturing of upstream ARD and diversion channels</td>
</tr>
<tr>
<td>10</td>
<td>Failures of the electricity supply and distribution</td>
<td>2</td>
<td>2</td>
<td>Temporary stop of pumping into and out of the pond</td>
</tr>
<tr>
<td></td>
<td>system</td>
<td></td>
<td></td>
<td>Special facility design and construction, special operator training, special regular checks</td>
</tr>
<tr>
<td>11</td>
<td>Temporary power supply cut</td>
<td>2</td>
<td>3</td>
<td>Interruption of production activity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Special operator training</td>
</tr>
<tr>
<td>12</td>
<td>Suicidal attempt</td>
<td>1</td>
<td>5</td>
<td>Death</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Access restrictions to the hazardous areas, psychological check on recruitment and regularly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>afterwards</td>
</tr>
</tbody>
</table>

Prepared by S.C. OCON ECORISC S.R.L. Turda
### Safety Report

S.C. Roșia Montană Gold Corporation S.A.

**Ed. 2010**

<table>
<thead>
<tr>
<th></th>
<th>Occupational accidents</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td></td>
<td>3</td>
<td>2</td>
<td>6</td>
<td></td>
<td>Workforce injury, material damage</td>
</tr>
</tbody>
</table>

### f. Cetate ARD Catchment Dam

1. **Dam break and breach development**
   - 2 | 4 | 8 | Acidic water floods, population injuries, material damage, impact on aquatic fauna | Dam design and building according to the norms, continuous monitoring, spillway |

2. **Dam overflow**
   - 3 | 2 | 6 | ARD discharge with impact on aquatic life | Dam design and building according to the norms, continuous monitoring, spillway |

3. **Damage of the dam -ARD pumping station**
   - 3 | 2 | 6 | Rise of pond water level and potential spill of acidic water downstream of the dam | Operator and maintenance workers’ training, backup equipment available |

### g. Stockpiles

1. **Risk of waste rock pile crumbling**
   - 2 | 3 | 6 | Damage to the site roads and industrial facilities in the impacted area | Observance of the deposition technology, stockpile compacting and grading, daily monitoring by means of topographical measurements |

### h. Explosives storage

1. **Explosion or fire at the storage facility.**
   - 2 | 4 | 8 | Human casualties (security guard and workers in the impact area) | Observance of explosive storage facility construction conditions under the norms in force. Restricted access to the storage facility area to the security personnel and shotmen |

2. **Road accident involving a vehicle providing on-site transportation of explosives**
   - 2 | 4 | 8 | Material damage in the impact area, human casualties (driver, shotman and potential workers in the impact area) | Conducting technical inspections of the vehicles, use of safe transportation, adjusting speed to weather conditions and the state of pit roads |

**Note:** The analysis on the risk of occurrence of dam non-performance scenarios (Corna TMF) is presented in the section describing the scenarios and in more detail in the NGI Report, 2009.
The table below (Table 4.3) presents a summary of the qualitative risk analysis. The cells show the index of the safety zone and the corresponding scenario number.

**Table 4.3. Qualitative Risk Analysis**

<table>
<thead>
<tr>
<th>PROBABILITY</th>
<th>Almost certain</th>
<th>Likely</th>
<th>Possible</th>
<th>Hardly likely</th>
<th>Improbable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Scenarios</td>
<td>a.3,5 b.1 c.10, 22,23,24,31,32,33,37, d.1,4 e.3,9 f.2,3</td>
<td>e.5</td>
<td>e.34,35</td>
<td>e.9,13,16,18,21,26 d.2,4 e.2,4,6 f.5,6,7</td>
<td>e.1,7,11,30</td>
</tr>
<tr>
<td>GRAVITATEA</td>
<td>Insignificant</td>
<td>Minor</td>
<td>Moderate</td>
<td>Major</td>
<td>Catastrophic</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

The results of qualitative risk analysis show that all the accident scenarios considered involve low or very low risks.

However, it was considered useful and necessary to provide a more detailed analysis, based on a quantitative risk assessment for all the scenarios entailing major consequences, involving a risk index greater than 9, which are considered potentially major accidents.

2. Quantitative Risk Analysis

The extent of the risk assessment and the intensity of prevention and mitigation measures should be proportionate to the risk involved. Simple hazard identification models and quantitative risk analysis are not always sufficient and therefore detailed assessment is necessary. There are several methods used in quantitative risk assessment. Selection of a specific technique depends on the accident scenario analyzed.

Under the Extractive Waste Managing Directive, major-accident hazards must be identified and the necessary features must be incorporated into the design, construction, operation and maintenance, closure and after-closure of the waste facility in order to prevent such accidents and to limit their adverse consequences for human health and the environment, including any transboundary impacts.

If necessary, the operator shall demonstrate, through a risk assessment that takes site-specific conditions into account, that WAD cyanide concentration need not be lowered below the 10 mg/l limit provided by the Directive.

The operator also needs to adopt and implement systematic major hazard identification procedures under normal and abnormal operating conditions and assess the probability and seriousness thereof and must alert the general public on the nature of the main major accident hazards, including of the potential impacts on the local population and the environment.

Under GD 804/2007 on the control of major accident hazard activities involving dangerous substances, a major accident means any fire, explosion, or accidental release of dangerous substances,
resulting in an uncontrolled process during the operation of any site subject to GD 804/2007 and leading to immediate or delayed occurrence of serious hazards on human health and/or environment within or outside the site and where one or several hazardous substances are involved.

a. Presentation of the Physical-Mathematical Models Used in Assessing the Consequences of Major Accidents

1. Toxic Gas Dispersion - the SLAB Model
To assess the way in which HCN and Chlorine disperse into the air, dispersion was modeled using the SLAB software, which simulates the atmospheric dispersion of heavier-than-air gas emissions. The initial version of this software was developed by Morgan, with further developments funded by USAF Engineering and Services Center (since 1968) and the American Petroleum Institute (since 1987). The current version of the SLAB software may deal with situations like: instant releases, of finite duration or ongoing, from various sources: liquid pool evaporating on the ground, horizontal or vertical jet located at various elevations above ground (discharge stacks) or instant releases at ground level.

SLAB View is a Windows interface for the SLAB software, which simulates the atmospheric dispersion of heavier-than-air gas emissions developed by Lakes Environmental Software, a Canadian company.

Atmospheric emission dispersion is calculated by the solutions to the mass conservation, momentum, energy and species equations.

The SLAB software is based on the superficial layer theory. The description of concentration variations in the gas plume is done by a series of differential equations based on the conservation of total mass and components, energy, and impulse in the three directions. This model is supplemented by equations describing the shape of the gas plume and equations for gas physical properties modeling. Gas dispersion simulation using the SLAB software integrates modeled equations with wind direction.

Atmospheric dispersion of the spill is calculated by the solutions to the mass conservation, momentum, energy and class/category/species equations. Conservation equations are spatially averaged in order to treat the plume as a stable smoke stripe, a transitive smoke cloud, or a combination of the two, depending on the spill duration. A continuous discharge (very long duration of the source) is treated as a stable smoke stripe. For a finite discharge, cloud dispersion is initially described using the stable smoke stripe mode and will remain in the smoke stripe mode as long as the source is active. With the closure of the source, the cloud is treated as a smoke cloud and further dispersion is calculated using the transitive smoke cloud mode. For an instant smoke release, the transitive smoke cloud dispersion mode is used throughout.

2. Fire and explosion simulations using EFFECTSGis 5.5 – Environmental and Industrial Safety software
EFFECTSGis 5.5 is a Windows interface, including a mini-GIS interface and was built to analyze the effects of industrial accidents and their consequences.

The software was developed by TNO Built Environment and Geosciences, a Dutch expert group that also developed the Dutch Yellow Book and the Green Book.

Simulation results are displayed as text or in graphical format. The user may opt for the mini-GIS interface, where digital maps may also be used. On these maps, the software will display the calculated iso-property contours (pressure, concentration, radiated heat, etc.).

Fire and explosion simulations have been conducted with the following software models:
- Explosion in vapor cloud model - the Multi-Energy Method
The model was developed by Van der Berg and published in Journal of Hazardous Materials, vol. 12, in 1985.
The model considers that an explosion occurs in a vapor cloud only if the cloud is in an area with obstacles, causing turbulence in the cloud and where the cloud is limited by the obstacles. The part of the cloud not located in such an area will burn without exploding. The theory was checked experimentally. Before starting the simulation, the mass of the explosive substance in the cloud needs to be calculated.

- Methods for fires and thermal radiations
In computing the heat radiated by given flame shape, the software uses the Thomas equation and the Burgess equation.
Simulations of toxic dispersion in the ambient air, fires and explosions, the high mortality radius and the irreversible lesion radius were also calculated.
These are the distances on which the value calculated for the specific indicator for the considered type of accident exceeds the reference threshold for the respective area.
The reference thresholds considered are given in the Table 4.4.

<table>
<thead>
<tr>
<th>Type of scenario</th>
<th>Indicator</th>
<th>PRAG I (HIGH MORTALITY)</th>
<th>PRAG II (NON-REVERSIBLE LESIONS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air dispersion</td>
<td>Toxic dispersion</td>
<td>LC₅₀</td>
<td>IDLH 200 kJ/m²</td>
</tr>
<tr>
<td></td>
<td>Fire ball</td>
<td>Fire ball radius</td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td>Jet-fire</td>
<td>12.5 kW/m²</td>
<td>5 kW/m²</td>
</tr>
<tr>
<td></td>
<td>Pool fire</td>
<td>12.5 kW/m²</td>
<td>5 kW/m²</td>
</tr>
<tr>
<td></td>
<td>Flash fire</td>
<td>LFL</td>
<td>0.5 LFL</td>
</tr>
<tr>
<td>Explosion</td>
<td>BLEVE</td>
<td>Fire ball radius</td>
<td>200 kJ/m²</td>
</tr>
<tr>
<td></td>
<td>UVCE</td>
<td>0.3 bar</td>
<td>0.07 bar</td>
</tr>
<tr>
<td></td>
<td>CVE</td>
<td>0.3 bar</td>
<td>0.07 bar</td>
</tr>
</tbody>
</table>

These areas are displayed on the map in the form of concentric circles originating at the point of damage (toxic emission, explosion, fire, etc.).

b. Detailed risk analysis
The qualitative risk analysis allowed identification of the following accident scenarios (for the operations phase) that may be considered potentially major accidents:

1. Explosions during in - pit mixing of ANFO
The explosive quantities used for pit blasting are about 6 to 8 t for each blasting, therefore significant enough were the ammonium nitrate and fuel oil mix to explode before being placed into the drillings and detonated in a controlled manner.
Due to routine measures explosive handling measures and to the fact that it will only be handled by certified (and properly qualified) persons, such accidents have a very low probability of occurrence. Also, the possibility of the ANFO mix exploding at ambient temperature is very unlikely, in normal operating conditions, as the ignition temperature of the NH₄NO₃ is at least 1600°C, and that of fuel oil >500°C.
Ammonium nitrate, if not mixed with organic substances, may burn without exploding, even at temperatures higher than 1600°C, but if mixed with organics, such as fuel oil, explosion is inherent, and the damages are significant for a few meter radius, depending on the blasted amount. At more than 2100°C, ammonium nitrate will thermally break down, and if mixed with organic substances pressurized, the breakdown will be explosive.

Therefore, should the ANFO mix explode at the open pit, the explosion radius would affect all the personnel in the vicinity of the mixture preparation equipment, at the work front, and the equipment on the work front, and might cause the crumbling of the open pit benches and access roads.

2. Total destruction of plant facilities

The total destruction of plant facilities may only be caused by terrorist, or classic weapon or nuclear attack. Therefore, damage may be caused to the HCl tank (including containment) and to the NaCN solution tank, the tanks containing enriched solution, to one or more leaching tanks, leading to spillage of their entire content.

Considering hydrochloric acid solution concentration 32% and density 1.15 kg/l, the maximum amount of pure HCl contained in the spill will be 7360 kg.

Considering cyanide solution concentration 23 % and density 1.25 kg/l, the maximum amount of pure NaCN contained in the spill will be 86250 kg. The sodium cyanide solution also contains variable quantities of sodium hydroxide (1-3%) and sodium carbonate (0.5-2.5 %). For the calculation, we shall consider the solution containing minimum 1% NaOH, i.e. 3750 kg.

In these circumstances, a perfect mix of the two solutions will initially assume neutralizing the hydrochloric acid with the sodium hydroxide in the cyanide solution based on reaction:

\[ \text{HCl} + \text{NaOH} = \text{NaCl} + \text{H}_2\text{O} \]

where 3422 kg HCl will be used with a residual 3938 kg reacting with the sodium cyanide to form hydrocyanic acid:

\[ \text{NaCN} + \text{HCl} = \text{HCN} + \text{NaCl} \]

The resulting amount of HCN is 2913 kg, with 5287 kg NaCN being used. Therefore, HCN concentration in the resulting solution will be 9.1 g/l (0.337 mol/l).

It is theoretically possible to have a failure causing a hydrochloric acid spill followed by an overlapping cyanide spill, when the amount of released hydrocyanic acid would be maximum. In this situation, the acid will be neutralized by the sodium hydroxide and sodium cyanide until the acid is exhausted, with the solution then diluted by excess cyanide. The maximum release of hydrocyanic acid would occur initially, when the heat released in the exothermal neutralization reaction will strongly heat a relatively low amount of liquid.

HCN release would be maximum if the 20 m³ of hydrochloric acid spill at the same time as an equimolecular amount of sodium cyanide solution, i.e.18.4 m³. The so-formed mix (38.4m³) will contain 2913 kg HCN, therefore the HCN concentration will be 75.86 g/l (2.8 mol/l). In this situation, it may be considered that all of the resulting HCN will instantly become gaseous and disperse in the ambient air near the breakage.

Considering the results obtained in the simulations of HCN dispersion into the air in the modeled accident (Annex no 5) it may be considered that in certain situations and weather conditions, unfavorable to dispersion, persons within a radius of about 40 of the emission source and that would be surprised by the toxic cloud for more than 1 minute without respiratory protection equipment will almost certainly die. It may also be considered that, on a radius of about 310 m, persons exposed for more than 10 minutes may suffer serious intoxications that may also lead to death. Toxic effects may occur in persons up to about 2 km downwind of the process plant.
3. Operating errors and/or failures in the measurement and control devices, resulting in a lower pH in the leaching tank, thickener and/or DETOX slurry

To assess the seriousness of the impacts that might be caused by a breakdown resulting in massive hydrocyanic spills into the air, we have simulated its dispersion using the SLAB model above.

For exposure to have health impacts, a person should be in the spill area, within the HCN cloud, without respiratory protection, for a certain period of time, the effects getting more serious with exposure time.

The air quality regulations in force for protected areas (STAS 12574 / 87) do not provide a maximum acceptable concentration for HCN, but the limit exposure values approved by GD 1218/2006 require a peak acceptable concentration of 1 mg/m³ = 1 ppm (not to be exceeded at any time during the day) and an average acceptable concentration of 0.3 mg/m³ (for an 8 hr averaging time accounting for a work shift).

Literature shows that exposure to concentrations of **2000 ppm** is lethal in one minute (LC50 - Lethal concentration with 50% death of victims), exposure to concentrations of **100-300 ppm** is lethal in 10-60 minutes, and for concentrations of **20-40 ppm**, specific symptoms of poisoning will occur. Therefore, these concentration levels of hydrocyanic acid were considered representative and were used in the simulations, with the attached reports showing graphically, in different colors, the various areas affected by concentrations of hydrocyanic acid exceeding the above levels. IDLH areas (Immediately Dangerous to Life or Health air concentration values) were also calculated for **50 ppm** for 30 minutes exposure (ambient concentration of any toxic, corrosive or suffocating substance that poses an immediate threat for life or may cause irrevocable or delayed adverse effects on health, or intervene on an individual’s capacity to escape a dangerous atmosphere).

All the HCN dispersion simulations were developed for the worst dispersion conditions including:

- Wind speed v = 0.5 m/s
- Atmospheric stability class: stable

The following additional conditions were also considered:

- Concentrations were calculated at the level of 2 m above ground;
- Average ambient temperature: 5 °C
- Relative air humidity: 80%.

The following possible situations were also included in the analysis:

**a. Accidental HCN emission from the CIL tanks**

The accident may be caused by the inadequate quality of the lime wash combined with faulty pH monitoring systems.

**Calculation of emission rate**

**Input data:**

- Emission surface area = 14 x 274.5 = **3843 m²**
- Tank diam. 18.7 m
- Tank area 274.5 kJ/m²
- Cyanide concentration in the tank:
  - 300 g/l CN (565 mg/l NaCN)

**Calculation formula:**

\[ E = \left(0.013 \times [\text{HCN}(aq)] + 0.46\right) \times A \times T / 10^6 \times 1000 \]

where:

- E = HCN emission (kg)
- [HCN(aq)] = [NaCN] \times 10^{9.2 - \text{pH}}
- [NaCN] = concentration in the CIL tanks (mg/l)
- pH = pH in the CIL tanks
- A = Total surface area (m²) of the CIL tanks (m²)
Safety Report
S.C. Roșia Montană Gold Corporation S.A.

Prepared by S.C. OCON ECORISC S.R.L. Turda

T = Emission period (hours)

**Calculated emission rate:**

<table>
<thead>
<tr>
<th>Nr. crt.</th>
<th>pH</th>
<th>HCN Emission (Kg/sec)</th>
<th>OBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>0.000615</td>
<td>Normal operating</td>
</tr>
<tr>
<td>2</td>
<td>10.5</td>
<td>0.000884</td>
<td>conditions</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>0.001734</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9.5</td>
<td>0.004421</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>0.012918</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>8.5</td>
<td>0.039788</td>
<td>Simulated situation</td>
</tr>
</tbody>
</table>

In conducting the simulations, the worst possible scenario was considered, i.e. when pH values are maintained at 8.5 over a period of time of more than 2 hours and the pH drop simultaneously affects all the 14 CIL tanks.

**Results:**

The area affected by concentrations of 290 ppm over a 10 min exposure time is within a circle of 36 m radius and the 50 ppm IDLH threshold for 30 min exposure will be reached over an area of 157.5 m radius. The center of these circles is the middle of the CIL tanks platform.

The impacted areas are shown in graphic form in *Annex no.6*, and the instant cloud concentrations (max. 290 ppm) in *Annex 4C3*.

**b. Accidental HCN emission from the decanter**

The accident may be caused by a drop of pH in the CIL tanks combined with an overdose of flocculant solution and faulty pH monitoring systems.

Calculation of emission rate

**Input data:**

- Emission surface area = 1385 m$^2$
- Decanter diam 42 m
- Decanter area 1385 m$^2$
- Cyanide concentration in the decanter = 219 g/l CN (412 mg/l NaCN)

**Calculation formula:**

\[
E = (0.013 \times [HCN(aq)] + 0.46) \times A \times T / 10^6 \times 1000
\]

where:
- \(E\) = HCN emission (kg)
- \([HCN(aq)]\) = \([NaCN]\) * 10$^{9.2-pH}$
- \([NaCN]\) = NaCN concentration in the decanter (mg/l)
- \(pH\) = pH in the decanter
- \(A\) = Total surface area (m$^2$) of the CIL decanter (m$^2$)
- \(T\) = Emission period (hours)
Calculated emission rate:

<table>
<thead>
<tr>
<th>No.</th>
<th>pH</th>
<th>HCN Emission</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>0.00021</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10.5</td>
<td>0.00028</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>0.000504</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9.5</td>
<td>0.001721</td>
<td>Normal operating conditions</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>0.003443</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>8.5</td>
<td>0.010504</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>0.032835</td>
<td>Simulated situation</td>
</tr>
</tbody>
</table>

In conducting the simulations, the worst possible scenario was considered, i.e. when pH values are maintained at 8 over a period of time of more than 2 hours.

**Results:**
The area affected by concentrations of 300 ppm over a 10 min exposure time is within a circle of 65 m radius and the 30 ppm IDLH threshold for 30 min exposure will be reached over an area of 104 m radius. The center of these circles is mid-distance between the two DETOX facilities.

The impacted areas are shown in graphic form in Annex 4C4 and the instant cloud concentrations (max. 572 ppm) in Annex 4C5.

c. **Accidental HCN emission from the DETOX facility**
The accident may be caused by a drop of pH in the reactors generated by an overdose of metabisulfite solution and/or copper combined with faulty pH monitoring systems.

**Calculation of emission rate**

**Input data:**
- Emission surface area = 2 x 132.7 = 265 m²
- Reactor diam. 13 m
- Reactor area 132.7 m²
- Cyanide concentration in the reactor
  a. inflow 180 mg/l CN (339 mg/l NaCN)
  b. outflow 10 mg/l CN (19 mg/l NaCN) Note: normally, reactor concentrations should be max. 10 mg/l WAD
- calculated average 179 mg/l NaCN

**Calculation formula:**

\[ E = (0.013 \times [HCN(aq)] + 0.46) \times A \times T / 10^6 \times 1000 \]

where:
- E = HCN emission (kg)
- [HCN(aq)] = [NaCN] \times 10^{0.2 - \text{pH}}
- [NaCN] = NaCN concentration in the decanter (mg/l)
- pH = pH in the reactor
- A = Total surface area (m²) of the reactors (m²)
- T = Emission period (hours)
Calculated emission rate:

<table>
<thead>
<tr>
<th>No.</th>
<th>pH</th>
<th>HCN Emission</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>6.10992E-05</td>
<td>Normal operating conditions</td>
</tr>
<tr>
<td>2</td>
<td>9.5</td>
<td>0.000119711</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>0.000305342</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8.5</td>
<td>0.000992336</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>0.002748673</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7.5</td>
<td>0.00861885</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>0.027181981</td>
<td>Simulated situation</td>
</tr>
</tbody>
</table>

In conducting the simulations, the worst possible scenario was considered, i.e. when pH values are maintained at 7 over a period of time of more than 2 hours and the pH drop simultaneously affects both reactors.

**Results:**

The area affected by high 1900 ppm concentrations for a 1 min exposure time is located within a 10 m radius circle. The area affected by concentrations of 300 ppm over a 10 min exposure time is within a circle of 27 m radius and the 50 ppm IDLH threshold for 30 min exposure will be reached over an area of 33 m radius. The center of these circles is the distance between the two DETOX facilities.

The impacted areas are shown in graphic form in Annex 4C6 and the instant cloud concentrations (max. 1900 ppm) in Annex 4C7.

**4. Explosion of the LPG storage tank**

The LPG storage tank has a 50 ton capacity and is located outdoors, near the heating plant. The simulation was conducted for the worst case scenario, considering an explosion of the full tank. In the Figure 4.2 are presented the effects on people in the explosion area:
5. Damage and/or fire at the fuel tanks

The fuel storage facility contains two types of fuel, i.e. 800 m$^3$ diesel and 20 m$^3$ gasoline. Diesel is stored in an outdoor tank placed in a containment vat, and the gasoline is stored in a sunken tank.

Gasoline storage in an underground tank does not involve risk, therefore fire and explosion simulations will only refer to the diesel tank.

Simulations were conducted for the worst case scenarios, considering ignition and combustion all the diesel.

The following situations were considered:

- **Fire in the tank**
  - The fire will start in the fuel tank caused by a terrorist attack or by failure to comply with the operating conditions.
  - Threshold I with heat radiation 12.5 kW/m$^2$ is within a 10.5 m radius circle and Threshold II, of heat radiation 5 kW/m$^2$ is within a circle of 15 m radius.
  - The results of these simulations are shown in **Annex 4C9**.

- **Fire in the containment vat covering 600 m$^2$ after the entire tank content has spilt into it.**
  - Threshold I with heat radiation 12.5 kW/m$^2$ is within a 22.5 m radius circle and Threshold II, of heat radiation 5 kW/m$^2$ is within a circle of 31 m radius.
  - The results of these simulations are shown in **Annex 4C10**.
c. Vapor explosion in the tank when it is full of vapors (800 m³)

Maximum overpressure is 0.2 bar and located in the tank, without reaching Threshold I at overpressure higher than 0.3 bar and Threshold II at overpressure higher than 0.07 bar is within a circle of 272 m radius.

The results of these simulations are shown in Annex 4C11.

6. Suicidal attempt

Although such an event may be considered a major accident because it would more than likely end in the person’s death, a quantitative assessment is practically impossible to conduct. Preventive measures will be implemented in restricting access to the areas where cyanide and cyanide containing solutions are handled and psychological checks will be conducted upon recruitment and periodically afterwards for all the workforce will help reduce the risk of such incidents to an acceptable level.

7. Non-performance of the TMF

For the quantitative assessment of risk parameters, RMGC employed internationally recognised experts. This, Paul Whitehead - professor at the Reading University, United Kingdom and Steven Chapra - professor at the Tufts University in Boston, USA prepared a series of pollutant and dispersion modeling studies for the Aries- Mures river systems (Water quality modeling study for Rosia Montana, Abrud, Aries and Mures river systems: Assessment of strategies for restoration of potential pollution impacts, April 2007, Dispersion modeling study in the Aries and Mures river basins - Appendix to the Water quality modeling report, October 2007). These studies were subsequently detailed, completed and updated by two additional studies: Potential impact of metals on the Aries-Mures river system as a result of the plausible accident scenario at the Corna TMF, June 2009 and Study for modeling of pollutant dispersion within the Aries-Mures river system as a result of potential accident scenarios, 2009. Norwegian Geotechnical Institute (NGI) was contracted to estimate the exceedance probabilities in case of TMF failure scenarios. Mr. Patrick Corser, Main Engineer and Head of Mining Department, MWH (internationally recognized American company) contributed to the preparation of both studies (dispersion modeling and risk analysis) with the addition of recommendations from cyanide management experts.

Furthermore, a workshop was held in Bucharest in January 2009 to reach a consensus when quantifying the hazards, probabilities and worst case scenarios for the Corna TMF failure. The workshop assembled experts on tailings dams and hazard and risk analyses.

The water quality and pollutant dispersion modeling studies used both the INCA model and HERMES model, with inputs simulating the Rosia Montana conditions, followed by an assessment of the results in terms of data variability sensibility using the Monte Carlo analysis. The INCA model is largely used in Europe for modeling of water flow rates and quality within river systems. The model was adapted to the Project requirements and an additional module INCA-MINE was developed to estimate the daily flow rates and concentrations of cyanide, ammonium and 8 metals from rivers (cadmium, zinc, mercury, arsenic, copper, chromium, manganese). The model was calibrated based on the experience and actual data previously collected to confirm its accuracy and was applied to the entire river system downstream of the Rosia Montana Project up to the Hungarian border at Nadlac, on the Mures River. The model also allows analysis of discharge from a point source over a short period of time similar to the tailings dam break or a failure due to inappropriate water management resulting in the overflow of the dam.

This new dispersion model is based on the classical dispersion equation, as especially requested by the Hungarian team, and also includes the effects of dilution generated by the river tributaries as well as any chemical decomposition process which may occur in the river system. The model assumes that the side and vertical slopes are minimal, thus the pollutants may decompose as per differential equation kinetic model. This is detailed in the Annex to the Water Quality Modeling Report, October 2007.
a. Possible dam non-performance scenarios

As part of the EIA process, the worst case scenarios were analysed which involve releases of pollutant from the TMF into the river, defined pursuant to the NGI analysis conducted in 2009 and debates within the Bucharest workshop held in January 2009. Two types of situations were considered:

- First, the question was raised whether an event similar to the event in Baia Mare from 2000 may occur in Rosia Montana, in case the water level in the TMF would raise due to extreme rainfall and snowmelt and the water would overflow the dam (UNEP 2000, Cyanide spill at Baia Mare Romania, Report of UNEP/OCHA Assessment Mission, Geneva).
- The second type of situations under consideration are associated with the TMF dam failure involving a quick release of tailings and water.

The Section A below describes the pollution potential in case of an dam overflow event while Section B describes the dam failure event. The released volumes and initial cyanide concentrations were estimated by MWH who benefited of contribution from experts in the field. The risk analysis was conducted by the Norwegian Geotechnical Institute using an event tree risk analysis.

A. Release of tailings and water over the dam crest due to rainfalls/snowmelt

The TMF was designed to retain in addition to the tailings and operational effluents from the process plant, water from heavy rainfalls and/or snowmelt. The Tailing Management Facility has been designed for two Probable Maximum Precipitation (PMP) events and the associated Probable Maximum Flood (PMF) plus one meter of freeboard allowance. The two volumes resulting from the 2 PMF events are generated by the water from a Probable Maximum Precipitation event - which is equivalent to a volume of water from 1:10000 year 24-hour event. In rather unrealistic situations associated with a volume of water higher that 2 PMF events the excess water will be discharged through a spillway so that there is no risk associated with the dam safety. The spillway structure on the dam will be constructed for a 1:10 -year storm event which is assumed to occur immediately after the two PMP events. In case of an event requiring discharge through the dam spillway a discharge rate through the spillway of 2,3 m³/sec for 12 hours was considered, which generates a cumulated volume of 100.000 m³ estimated to flow into the river.

The average return period of two PMF events within 24 hours with the generated volume of water able to be stored in the TMF is estimated at 1:100 million years which is even lower in case an additional flood event with a return period of 1:10 years occurs within the same 24 hours. These probabilities confirm that this type of events are not realistic scenarios.

However, pollutant modeling was conducted for the Aries-Mures-Tisa river system for the unlikely situation when contaminated water would be discharged into the river through the spillway without out prior treatment. Both conditions involving high and low water flows of the emissary were considered although it is very unlikely that the release of tailings and water over the dam crest may occur at the same time as low water flow condition.

In order to analyse the highest impact, the situation of the site after 17 years of operation was considered when the tailings in the TMF are at the maximum level. The models calculates the maximum concentrations and ensures the modeling of their dispersion in the river as well as the dilution caused by the watercourses and tributaries. The models conservatively assume a minimal cyanide loss due to natural volatilization (or evaporation) and degradation, all being natural processes occurring normally and reducing the cyanide concentrations in the river. A degradation rate of 0.1 per day was assumed for the WAD cyanide. A conservative degradation rate of 0 in any conditions was assumed for the SAD cyanide. (Based on the tests conducted using samples of material collected from the site, an average of WAD cyanide concentration of 60% of the total and 40% SAD cyanide of the total cyanide according to standards was estimated).

Figure 4.3 illustrates a typical example for the cyanide concentration estimated downstream for high water flows in the rivers. The results of the study show that at the Hungarian border the maximum cyanide concentrations are lower and much below the cyanide limit level permitted in the Hungarian watercourses (which is 0.1 mg/l total CN) and below the standard level for drinking water which is 0.05mg/l total CN. Moreover, the standards for surface water or drinking water are not
exceeded in any location along the river, not even in the vicinity of the point of discharge into the Abrud river.

*Table 4.5* summarizes the maximum estimated cyanide concentrations in the river within the TMF site on the Corna Valley and downstream of the Corna Valley for high river flow rate.
Figure 4.3. Estimation of cyanide concentrations (mg/l) for an event resulting in the release of tailings over the dam crest followed by discharge into the Mures river system in conditions of increased water flows for the volumes of materials stored after 17 years of operation (the water flow rate estimated to be discharged from the Corna TMF is of 2.3 m³/sec during 12 hours, which means a total volume of 100,000 m³)

Table 4.5. Maximum cyanide concentrations (mg/l) estimated considering the worst rainfall event followed by a flood in case of increased river flow for the volumes of materials stored in year 17 of operations

<table>
<thead>
<tr>
<th>Location</th>
<th>Days run</th>
<th>Maximum concentrations estimated for total cyanide mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrud</td>
<td>0.1</td>
<td>0.045</td>
</tr>
<tr>
<td>Câmpeni</td>
<td>0.1</td>
<td>0.023</td>
</tr>
<tr>
<td>Baia de Arieş</td>
<td>0.5</td>
<td>0.016</td>
</tr>
<tr>
<td>Turda</td>
<td>0.5</td>
<td>0.011</td>
</tr>
<tr>
<td>Ocna Mureş</td>
<td>0.7</td>
<td>0.007</td>
</tr>
<tr>
<td>Alba Iulia</td>
<td>1.0</td>
<td>0.005</td>
</tr>
<tr>
<td>Deva</td>
<td>1.7</td>
<td>0.005</td>
</tr>
<tr>
<td>Sâvârşin</td>
<td>2.4</td>
<td>0.004</td>
</tr>
<tr>
<td>Arad</td>
<td>3.2</td>
<td>0.004</td>
</tr>
<tr>
<td>Nădlac</td>
<td>3.8</td>
<td>0.004</td>
</tr>
</tbody>
</table>

The resulting cyanide concentrations are lower than those provided by the standards for water in rivers and drinking water, respectively - and the risk probability is below 1 to 100 million years. These data demonstrate that the probability of an event involving dam crest overflow is extremely low and can be considered impossible.

This analysis illustrates that in case of heavy rainfalls (and/or snowmelt), although the designed TMF capacity is exceeded by the amount of rain/water resulting from snowmelt, the dam overflow would lead to cyanide concentrations in Hungary far from those resulting during the accident.
in Baia Mare. Following the event in Baia Mare, the cyanide concentrations at the Hungarian border were 200 times higher than the standard for surface water and 400 times higher that the drinking water standard. A release which is highly improbable for the Rosia Montana TMF would not exceed the regulatory cyanide levels in Romania or at the Hungarian border for both surface water and drinking water.

B. Dam failure scenarios

Two categories of conditions were considered for the dam failure. First, the extreme scenarios described in the EIA Report for the dam break were considered. The second category of modeled scenarios are those with an extremely low probability of occurrence considered however more plausible than the scenarios in the first category.

- TMF dam break conditions considered in the Environmental Impact Assessment Report, 2006

For the cases described in the Environmental Impact Assessment Report (see the EIA Report, Part 7 Risks, page 120 of 250) releases of 7.8 million m³ of tailings and 3.8 million m³ of water; and 27.7 million m³ of tailings and 5.9 million m³ of water during 24 hours are considered. These releases would involve a breach 390 m wide and 60 m high and this was considered impossible for a rockfill dam with downstream slope of 3H:1V.

The risk analysis conducted with the support of TMF and risk assessment experts participating at the Bucharest workshop and based on the event tree approach replaces the extreme dam break scenarios mentioned earlier and described in the EIA Report. It was concluded that the probability of occurrence for the above-mentioned dam break scenarios is too low (less than 1 to 100 million years) to be considered realistic. Scenarios with higher probability of occurrence were identified which were considered in the event tree analysis.

The impact on water quality was assessed although the most serious cases have a low probability of occurrence down to being unrealistic. In the first case, the results indicate that as the plume of contaminated material flows, the water quality at the Hungarian border reaches a level above the regulatory level provided for surface water (i.e. 0.76 mg/l total cyanide compared to 0.1 mg/l total cyanide standard). In the second case, which is more serious, the water quality reaches 1.08 mg/l total cyanide. These cases assume low flow rate conditions, which in terms of impact is the worst case scenario. These massive water releases are considered highly unrealistic due to the extremely low probability of occurrence.

- Scenarios with low probability of occurrence, but more plausible

The Norwegian Geotechnical Institute considered the risk associated with more plausible scenarios in terms of their environmental impact. The highest risk (probability of occurrence) associated with a plausible non-performance of the dam has a probability of once in 1 million years. The event tree analyses suggest that the probability of non-performance of the Roșia Montană TMF is about 100 times lower than the probability of non-performance of comparable containment dams around the world.

The experts participating in the workshop estimated that the most severe case would be equivalent to a breach of the Corna Dam extending 5 to 8 metres below the crest and extending over a length of 100 to 200 metres along the centreline. The ensuing release due to such a breach would be conservatively estimated at between 125,000 m³ and 250,000 m³ of tailings and between 13,000 m³ and 26,000 m³ of water for a period of 24 hours. This event would result in a release of tailings and water approximately 100 times lower than the release generated by the two extreme scenarios considered within the EIA Report.

The scenario related to the dam break in the last year of operations when the TMF stores the maximum volume of tailings was considered. For the first years of TMF operation, the risk analysis showed that any amount of water released from the pond (anyway with a very low probability of occurrence) would be retained in the area between the SCS and toe of the TMF dam and would not flow into the river.
The modeling results for low flow and high flow conditions are summarized in Tables 4.6 and 4.7 and Figures 4.4 and 4.5. The modeling results for both cases show that the downstream water quality criteria are met with respect to surface water and drinking water regulatory levels even in the immediate vicinity of the site. In low flow conditions a short term exceedance of regulatory levels may occur over a 80 km distance from the site. It should be noted that simultaneous occurrence of these two conditions, dam break and low water flow in the river, have an extremely low probability of occurrence of 1 to 4 million years. The lowest probability of occurrence is related to the low flow conditions statistically occurring 3 months a year.

The impact of such a dam failure has not considered certain characteristics of the proposed Project which may further reduce the environmental impact. Specifically, the model does not consider the capture of some of the discharge flow in the SCD and the semi-passive treatment lagoons directly below the SCD. The lagoons SCD will have a capacity of 53,000 m³. It is proposed that the lagoons will extend for a distance of 500 m beyond the SCD and have a capacity of 33,000 m³ above their operating capacity. The SCD and the lagoons will not be full during normal operating conditions and would mitigate, or even contain, the released tailings and water. Furthermore, the possibility to use the storages in the area which have an available storage capacity of 10 million m³ of water (e.g. Mihoesti Storage upstream of Campeni) is also reviewed in order to ensure rapid dilution of the contaminated plume as an emergency response measure that will remove the limit level exceedance risk in the immediate vicinity of the site. Obviously this measure would be applied for flows that will not cause flooding of downstream localities.

Table 4.6. Movement time and maximum cyanide concentrations in case of release of 26,000 m³ of polluted water during 24 hours at a total cyanide concentration in the TMF of 5mg/l, in high flow conditions

<table>
<thead>
<tr>
<th>Locations</th>
<th>Days run</th>
<th>Maximum total cyanide concentration mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrud</td>
<td>0.14</td>
<td>0.0090</td>
</tr>
<tr>
<td>Câmpeni</td>
<td>0.22</td>
<td>0.0046</td>
</tr>
<tr>
<td>Baia de Arieș</td>
<td>1.04</td>
<td>0.0032</td>
</tr>
<tr>
<td>Turda</td>
<td>1.16</td>
<td>0.0023</td>
</tr>
<tr>
<td>Ocna Mureș</td>
<td>1.32</td>
<td>0.0014</td>
</tr>
<tr>
<td>Alba Iulia</td>
<td>1.71</td>
<td>0.0010</td>
</tr>
<tr>
<td>Deva</td>
<td>2.28</td>
<td>0.0009</td>
</tr>
<tr>
<td>Săvârșin</td>
<td>3.11</td>
<td>0.0009</td>
</tr>
<tr>
<td>Arad</td>
<td>3.40</td>
<td>0.0009</td>
</tr>
<tr>
<td>Nădlac</td>
<td>3.65</td>
<td>0.0008</td>
</tr>
</tbody>
</table>
Figure 4.4. Cyanide concentrations in case of release of 26,000 m³ of polluted water during 24 hours at a total cyanide concentration in the TMF of 5mg/l, in high flow conditions

Table 4.7. Movement time and maximum cyanide concentrations in case of release of 26,000 m³ of polluted water during 24 hours at a total cyanide concentration in the TMF of 5mg/l, in low flow conditions

<table>
<thead>
<tr>
<th>Stations</th>
<th>Days run</th>
<th>Total cyanide concentration mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrud</td>
<td>1.00</td>
<td>1.6817</td>
</tr>
<tr>
<td>Câmpeni</td>
<td>1.08</td>
<td>0.8853</td>
</tr>
<tr>
<td>Baia de Arieş</td>
<td>1.49</td>
<td>0.5296</td>
</tr>
<tr>
<td>Turda</td>
<td>3.80</td>
<td>0.1475</td>
</tr>
<tr>
<td>Ocna Mureş</td>
<td>6.37</td>
<td>0.0448</td>
</tr>
<tr>
<td>Alba Iulia</td>
<td>10.78</td>
<td>0.0192</td>
</tr>
<tr>
<td>Deva</td>
<td>14.55</td>
<td>0.0117</td>
</tr>
<tr>
<td>Sâvîrşin</td>
<td>19.11</td>
<td>0.0081</td>
</tr>
<tr>
<td>Arad</td>
<td>20.66</td>
<td>0.0070</td>
</tr>
<tr>
<td>Nadlac</td>
<td>21.97</td>
<td>0.0063</td>
</tr>
</tbody>
</table>
Figure 4.5. Cyanide concentrations in case of release of 26,000 m³ of polluted water during 24 hours at a total cyanide concentration in the TMF of 5mg/l, in low flow conditions (Note: The ordinate scale was reduced in order to show the concentrations on the lower courses of the river system)

The impact of metals on the water quality of the Aries-Mures river system was assessed for the same scenario (release of 26,000 m³ of contaminated water) and under the same effluent low flow and high flow conditions (Potential impact of metals on the Aries-Mures river system as a result of the plausible accident scenario at the Corna TMF, Professor Paul Whitehead, June 2009). The water in the TMF will contain various concentrations of metals, as presented in Table 4.8. As shown in the table, many of the concentrations are below the regulatory levels, only the levels of sulfate, calcium, arsenic and molybdenum are exceeded.
Table 4.8. Concentrations of metals in the TMF

<table>
<thead>
<tr>
<th></th>
<th>Romanian standard for surface water mg/l</th>
<th>Concentration in the TMF mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfates</td>
<td>600</td>
<td>2562</td>
</tr>
<tr>
<td>Total Cyanide*</td>
<td>0.1</td>
<td>3.2</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Calcium</td>
<td>300.6</td>
<td>594</td>
</tr>
<tr>
<td>Lead</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Chromium</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Total Iron</td>
<td>5</td>
<td>0.9</td>
</tr>
<tr>
<td>Copper</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>0.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Manganese</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Magnesium</td>
<td>100</td>
<td>9.4</td>
</tr>
<tr>
<td>Cobalt</td>
<td>1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

* Cyanide was subject to additional studies, the results are described above.

In order to assess the impact of metals released in case of an accident at the TMF the dispersions of the 4 metals exceeding the regulatory levels were simulated. A detailed description of the model is included in Annex 1 to the report.

The simulations showed that the metals released in case of a TMF dam breach will have concentrations that will decrease rapidly below the regulatory levels as a result of downstream dilution and dispersion. Sulfates and molybdenum will have levels slightly above the regulatory levels but only in the immediate vicinity downstream (Abrud) and low flow conditions.

b. Potential impacts on human life and aquatic ecosystems

Based on the risk analysis conducted by the Norwegian Geotechnical Institute in cooperation with international dam and risk assessment experts, the scenarios related to the dam break and release of tailings in the last years of TMF operation may result in and we quote from the risk experts’ report “some material damage and some contamination of vicinity downstream”, but no more than that. The river bed cannot be exceeded. The tailings may flow over a distance of some hundreds of meters from the TMF dam over a sufficiently distance low to pose certain risks on the adjacent property and humans.

The highest cyanide levels (defined based on the cases with the most serious impacts occurring in the worst location, i.e. near the site) resulting from the release of tailings/water at the scale and duration determined by the accident conditions were assessed as much below the concentration levels and/or exposure time which may affect humans, birds or non-aquatic species.

These levels are safe for aquatic flora which has also the capacity to handle exposures to concentrations and duration much higher than the cyanide limit levels provided for river water even in the situation related to a model involving the worst case release.

The concentrations may affect the most sensitive aquatic invertebrate specie, however the exposure time is so low that the impact would be insignificant.

Fish are the most vulnerable species due to their acute sensitivity to contaminated water because they live in the respective environment. All fish and even the most vulnerable species (river trout) require a minimum cyanide concentration level and minimum exposure time before the most...
vulnerable specimens of the least resistant species to suffer lethal effects. The post-accident conditions, may in the worst case pose a threat on the most vulnerable fish specimens within the most sensitive species, but the low concentration and temporary exposure are of such nature that only the weakest specimens would suffer lethal effects. It is obvious that a complete extinction of the species will not occur not even for the most sensitive species, so that they will continue to live in the respective water courses.

It should be noted that while the intention is that the mitigation of the pollution caused by ARD water releases should ensure restoration of aquatic life, there is no aquatic life that can survive in the acidic water and heavy metal contamination conditions which currently exist in the watercourses over a distance of up to 40 km of the site.

In conclusion, the environmental impact risk is low due to the limited and temporary impact. The impact should also be measured against the immediate benefits brought by the proposed environmental rehabilitation activities aiming to remove the existing heavy metal contamination.

c. Potential transboundary impacts

Based on the Rosia Montana TMF technical characteristics, technical design and defined operational criteria the credible failure scenarios or TMF dam tailings and water overflow generate no impact on the water quality at the Hungarian border.

d. Conclusion

Regardless of the existing situation, the risk of accident is extremely low. In case of a potential accident, the contaminated release is limited both in terms of quantity and duration. In most situations, even in case of such an accident, the water quality in the river is maintained at a level higher than the regulatory levels for the quality of surface water and drinking water, also at the point of discharge into the river. In all these situations, the safety conditions are restored hundreds of kilometers before the released water reaches the Hungarian border. The risk analysis establishes that the major accident scenario is unrealistic. Both the very low accident risk as well as the obvious benefits of the environmental rehabilitation operation indicate that the Project implementation might have a positive impact on some environmental components.

8. Development of HCN on the pond surface

Simulated emissions of HCN from the TMF pond surface and of their dispersion into the ambient air as presented in Chapter 4.2 show that the level of 400μg/m³ hourly average and 179μg/m³ 8hr average will not be exceeded. These HCN concentrations are only slightly over the odor threshold (0.17ppm) and much below potentially dangerous concentrations. Initial symptoms of cyanide poisoning can occur from exposure to 20 to 40 ppm of gaseous hydrogen cyanide, and may include headache, drowsiness, vertigo, weak and rapid pulse, deep and rapid breathing, a bright-red color in the face, nausea and vomiting.

Cyanide does not accumulate or biomagnify, so chronic exposure to sublethal concentrations of cyanide does not appear to result in acute toxicity. There is no evidence that chronic cyanide exposure has teratogenic, mutagenic or carcinogenic effects.

9. Dam break and breach development at the Cetate ARD Catchment Dam

Flood modeling was in case of a break in Cetate dam was based on the design parameters obtained from the hydro-meteorological study Assessment of rainfall intensity, frequency and runoff for the Roşia Montană Project - Radu Drobot, the natural features of the impacted area (topography, river network, etc.), and the design parameters of the Project structures (dam height, reservoir volume, spillway capacity, pumping flow, etc.). This was achieved by means of the rain-runoff type modeling software HEC-HMS (Hydrological Engineering Center – Hydrological Modeling System).

The hydrograph resulting for dam break was obtained by application of the BREACH model based on the above parameters. Based on these input parameters, the BREACH model helped predict the following breach parameters:
- break time: 1h;
- final breach breadth at the base: 20 m;
- breach slope inclinations: 1,11:1 (H:V);
- final breach elevation at the base: 710 m ASL
- Total spill volume: 800000 m$^3$ (under normal operating conditions the volume stored in the pond is about 500000 m$^3$).

After the hydrograph was obtained by means of the above model, a modeling for downstream attenuation was also developed. This involved assessing energy loss in the river bed using the values of the Manning constant. The Manning coefficient used in the model for the downstream talweg was 0.04. For the cross section of the valley slopes value 0.06 was selected for its corresponding to the maximum values of watercourses with grass, friable rocks and boulders. The slope between the transversal profiles at talweg level was obtained by digital topography in the range of 4.5% near Cetate Dam and a minimum 0.3% at kilometer 9.7. The general average slope was established at 1.6%.

The main results obtained in the application of the FLDWAV model in FLDWAV Inundation Map (Annex 4C12) for Maximum Peak Flow from the Cetate Dambreak Report regarding the maximum flood wave height on various flow sections are given in Table 4.9.

### Table 4.9. Maximum flood wave height on various flow sections

<table>
<thead>
<tr>
<th>Distance (km)</th>
<th>Propagation (hours)</th>
<th>Max Flow (m$^3$/s)</th>
<th>Maximum speed sc (m/s)</th>
<th>H water (m)</th>
<th>H above baseflow (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0.6</td>
<td>1206</td>
<td>6.5</td>
<td>5.8</td>
<td>4.8</td>
</tr>
<tr>
<td>0.5</td>
<td>0.6</td>
<td>1204</td>
<td>14.0</td>
<td>6.1</td>
<td>4.3</td>
</tr>
<tr>
<td>1.0</td>
<td>0.6</td>
<td>1205</td>
<td>9.0</td>
<td>2.8</td>
<td>1.8</td>
</tr>
<tr>
<td>1.6</td>
<td>0.6</td>
<td>1203</td>
<td>10.8</td>
<td>4.2</td>
<td>3.4</td>
</tr>
<tr>
<td>2.0</td>
<td>0.6</td>
<td>1204</td>
<td>7.5</td>
<td>2.4</td>
<td>2.1</td>
</tr>
<tr>
<td>3.0</td>
<td>0.7</td>
<td>1202</td>
<td>5.6</td>
<td>4.3</td>
<td>3.4</td>
</tr>
<tr>
<td>3.7</td>
<td>0.7</td>
<td>1200</td>
<td>3.2</td>
<td>5.0</td>
<td>4.0</td>
</tr>
<tr>
<td>4.1</td>
<td>0.8</td>
<td>1192</td>
<td>3.7</td>
<td>4.7</td>
<td>3.6</td>
</tr>
<tr>
<td>4.7</td>
<td>0.8</td>
<td>1183</td>
<td>4.5</td>
<td>4.2</td>
<td>3.1</td>
</tr>
<tr>
<td>5.1</td>
<td>0.8</td>
<td>1177</td>
<td>2.3</td>
<td>3.4</td>
<td>2.7</td>
</tr>
<tr>
<td>5.9</td>
<td>0.8</td>
<td>1067</td>
<td>2.5</td>
<td>6.2</td>
<td>4.9</td>
</tr>
<tr>
<td>7.4</td>
<td>1.0</td>
<td>935</td>
<td>7.5</td>
<td>7.1</td>
<td>4.9</td>
</tr>
<tr>
<td>8.9</td>
<td>1.1</td>
<td>915</td>
<td>4.7</td>
<td>5.7</td>
<td>4.3</td>
</tr>
<tr>
<td>9.4</td>
<td>1.1</td>
<td>913</td>
<td>4.9</td>
<td>3.9</td>
<td>2.9</td>
</tr>
<tr>
<td>10.5</td>
<td>1.2</td>
<td>877</td>
<td>5.2</td>
<td>3.3</td>
<td>2.3</td>
</tr>
</tbody>
</table>

The table shows that, during the propagation time of the maximum flow down to the last section considered (10.5 km) is 1.2 hr (1 h 12 min) at maximum flow in the last section 877 m$^3$/s and water depth about 3.3 m or 2.3 m above the base flow. In the above section, the highest flow rate recorded on the Aries under natural conditions was 870 m$^3$/s in March 1981 and on the Abrud at its flow into the Aries 163 m$^3$/s in December 1995.

A review of the flood hydrographs will show a slight attenuation of the hydrograph downstream of the dam. The peak of the flood hydrograph is about 4.9 above base flow immediately downstream of the dam and in the narrow Abrud valley 5.9-7.5 km downstream of the dam. The broader Aries alley allows the flood wave to propagate on a significantly wider bed, which results in a highly attenuated hydrograph.

After applying the sensitivity study, it was found that only in changing the time of the breach development will the results change. Thus, if the dam break occurs in a shorter time (0.5 hr instead of 1 hour) the height of the flood wave will increase by 1 m, and for a slower breach (4 h instead of 1 h) the flood wave will decrease by 1.9 m on average.

### 10. Explosion or fire at the storage facility
a. Consideration on the explosion risk of ammonium nitrate and dynamite

The most common form in which ammonium nitrate can be found is as a chemical fertilizer. It comes in a variety of forms, but they are classified into two groups, based on the nitrogen content. All fertilizers containing more than 28% nitrogen are considered potentially hazardous.

Generally speaking, the risk associated to the use of ammonium nitrate is low. Safety increases in the case of fertilizers if they are manufactured in compact non-porous form, as this will not allow absorption of impurities that might enhance explosion susceptibility.

In regard to its hazardous properties, they are determined by the physical properties of the material (particle size, porosity, density), the chemical properties (purity, stabilizers, moisture), environmental factors (containment, compatibility with other materials) and conditions such as temperature or pressure.

When fed enough energy, ammonium nitrate can decompose thermally. However, the main risk associated to it is the maintenance of fire, even in the absence of air, due to the oxidizing properties and the presence of oxygen in its molecule. Thermal decomposition initiates at temperatures over 169 dgr. Celsius, but becomes notable at over 200 dgr. For pure ammonium nitrate, decomposition stops as soon as the energy source is removed, but in combination with materials or compounds that act as catalysts in the break down reaction (combustible materials, acids, chlorides, metal ions, etc.) it will be self-sustaining. In principle, ammonium nitrate may detonate if impure. This means that neither open fire, nor friction, nor starter sources such as gas explosion may cause detonation. There are only two ways in which an explosive decomposition may be initiated: initiation by another explosive, or transition from thermal decomposition or deflagration. For both ways, it should be noted that the presence of organic impurities strongly influences the ease of initiating an explosion.

Dynamite is a strong 2nd order explosive, with a positive oxygen balance and an important volume of gases. Practically, dynamite is the form in which trinitroglycerine can be safely handled. Dynamite is rather insensitive to impact, friction and shock. Moreover, in certain conditions, it may burn without triggering an explosive reaction.

The problem most often associated with the use of dynamite relates to its safe storage, as nitroglycerine tends to leave the inert mixture and form fine droplets on the surface, which highly increases the risk in usage. At temperatures above 80 deg. Celsius, nitroglycerine in the dynamite starts decomposing. At temperature above 135 deg., the decomposition process becomes violent, and at 218 deg. explosion occurs.

Unlike ammonium nitrate, dynamite is far more susceptible to accidents that may initiate explosive decomposition.

b. Assessment of potential impacts

Ammonium nitrate is stored in above-ground facility, and its construction is not antiex, as follows:
- 80 tons in the underground facility, closed in storage;
- 20 tons in the working shed;
- TNT Equivalent, $e_{TNT} = 0.32$

Dynamite is stored in an underground facility, north-east of the ammonium nitrate storage and connected to surface by an underground passage, as follows:
- 4 tons in the underground facility;
- 1 ton in the working shed;
- TNT Equivalent, $e_{TNT} = 0.9$

Considering that the more dangerous material is dynamite, two of the working hypotheses consider that the explosion will be initiated by it. However, because of the safety measures adopted in storing most of the quantity underground, the effects of a dynamite explosion as such will have negligible impacts on the aboveground environment (effects consist in potential collapse of the underground passage where dynamite is stored). Therefore, we start from the assumption that a
A dynamite explosion will trigger explosion of the ammonium nitrate storage facility, placed above ground, and were the impacts on the human environment are much more serious. The assumptions will also include the “worst case scenario” – the maximum credible accident.

In calculating overpressures at the front of the shock wave that may cause damage to goods and affect human health, the similarity laws above and tables of correspondence will be used.

In investigating substance behavior in explosion, the following working assumptions will be considered:

**Assumption #1: Initiating detonation of the ammonium nitrate from a substance explosion in the work shed**

It is assumed that explosion of the substances present in the work shed will initiate an explosion of the main ammonium nitrate storage facility. Therefore, there will be two explosions: first to explode would be the 20 t of ammonium nitrate and 1 t of dynamite, then the second explosion will involve the 80 t of ammonium nitrate. However, the effects would be cumulative, as the initiation of the second explosion will occur shortly after the first (< 10^{-1} s).

**Assumption #2: Initiation of ammonium nitrate by the buried dynamite**

In this case, it is assumed that initiation of the nitrate storage facility is due to the development of an explosive reaction in the underground dynamite storage facility. The over pressure developed will have two effects: it will cause an earthquake after the collapse of the underground passage and initiate the detonation of ammonium nitrate in the main storage facility. It is also assumed that the initiation of the stored nitrate will trigger initiation of the substances in the work shed.

**Assumption #3: Explosion of the ammonium nitrate storage facility**

The third alternative assumes ammonium initiation in storage. A secondary effect would be explosive initiation of the substances in the working shed.

As all the above scenarios involve an equivalent quantity of explosive material, the results will be similar. The figures below show the results of the simulations.
Assumption #4: Explosion of the work shed

In this hypothesis it is assumed that initiation of the substances in the work shed will not initiate ammonium nitrate in the storage facility. The figures below show the results of the simulations.
Graficul suprapresiunilor

- efecte grave asupra oamenilor
- efecte asupra bunurilor
Distances at which damage caused by the explosion are felt are:

<table>
<thead>
<tr>
<th>Hypotheses 1,2,3 Distance (m)</th>
<th>Effect</th>
<th>Hypothesis 4 Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Detailed pulmonary accidents</td>
<td>25</td>
</tr>
<tr>
<td>65</td>
<td>Complete destruction of buildings</td>
<td>35</td>
</tr>
<tr>
<td>110</td>
<td>Overturn of vehicles</td>
<td>60</td>
</tr>
<tr>
<td>145</td>
<td>Partial destruction of supporting reinforced concrete structures</td>
<td>70</td>
</tr>
<tr>
<td>160</td>
<td>Eardrum break, important damage to buildings with a metal support structure</td>
<td>90</td>
</tr>
<tr>
<td>220</td>
<td>Destruction of concrete wall buildings, destruction of oil product tanks</td>
<td>130</td>
</tr>
<tr>
<td>480</td>
<td>Knock people down, destruction of lightweight walls, bending of metal plates</td>
<td>280</td>
</tr>
<tr>
<td>900</td>
<td>Mortar falling off and insignificant damage to buildings</td>
<td>500</td>
</tr>
<tr>
<td>2700</td>
<td>Break of normal window panes</td>
<td>1500</td>
</tr>
</tbody>
</table>

Annex 4C13 shows extended effects on the area surrounding the storage facility.
Account should also be taken of the splinter effect compounding the effects of the shock wave, and occurring due to the fact that the explosive substance is located in a building that will be destroyed by the blast. Therefore, a minimum safety distance is required, as follows:

<table>
<thead>
<tr>
<th>Hypotheses 1,2,3 Distance (m)</th>
<th>Minimum safety distance required in case of an explosion</th>
<th>Hypothesis 4 Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1440</td>
<td>building protection</td>
<td>830</td>
</tr>
<tr>
<td>3845</td>
<td>people protection</td>
<td>2200</td>
</tr>
</tbody>
</table>

11. Road accident involving a vehicle providing on-site transportation of explosives

Such explosions are of lesser magnitude than those at the storage facility, therefore it is considered that the effects are similar to those of hypothesis 4 above. It should be noted, however, that in this case the effects will involve both the operating personnel (drivers, security) and people and goods potentially at the site of the explosion. Site routes for explosive transportation are so selected as to avoid the process plant location, which will greatly reduce the consequences of such an accident.

c. Assessment of Cumulated Health and Environmental Risks

Health and environmental risk assessment was seen as a priority by the European Conference for Environment and Health, London, 1999. The Executive Summary of the Proceedings states that there is an urgent need for methods and systems for the assessment of such risks with low costs, and one of the goals should be the assessment of specific susceptibility of individuals and populations to environmental and health risks. An improvement is recommended of the exposure and impact assessment methodologies and a further development of risk characterization by means of the quantity of chemicals.

After the industrial spills of toxic chemicals on the Lower Danube in early 2000, the Italian Ministry of the Environment and the World Health Organization (WHO/OMS in RO) developed a pilot project of rapid environmental and health risk assessment (REHRA) on secondary rivers of the Lower Danube Basin.

At the extraordinary meeting of the European Environment and Health Committee (EEHC) in Vienna, support was expressed for the association initiative of the Italian Government and the WHO in developing a proposal for the pilot project to create and trial a method based on the rapid environment and health risk assessment, with the following recommendations:
The Pilot Project should be open to any entrant and all the stakeholders, including the civil society, are invited to contribute to the formulation of the technical action plan and the actual implementation of the Project.

The Pilot Project is relevant for UN/ECE Convention on Protection and Use of Transboundary Waterways and International Lakes and for the Protocol on Water and Health as well as for UN/ECE Convention on Transboundary Impacts of Industrial Accidents, UN/ECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters and EU Seveso II Directive.

Industry should be directly involved in the Pilot Project, as it can contribute to various aspects such as risk and hazard assessment, management and control, prevention and emergency response, the health execs of chemicals and waste, and the best available technologies.

The Project methodology was developed by a team of experts selected by the IME and the WHO out of a pool of specialist organizations. The methods and technical documents consulted or used in developing this methodology include:

Aarhus and Espoo Convention - Annexes listing potentially hazardous industrial activities; Aarhus and Espoo Convention - Annexes listing potentially hazardous industrial activities;
UN/ECE Industrial Accidents Convention; UN/ECE Industrial Accidents Convention;
SEVESO II - EC Directive - Annex 1, concerning dangerous substances; SEVESO II - EC Directive - Annex 1, concerning dangerous substances;
EC/JRC - Major Accident Reporting System (MARS).

The Pilot Project proposes, implements and trials an integrated approach to rapid environment and health risk assessment in the case of major industrial accidents occurring in very hazardous or abandoned industrial facilities in selected geographical areas.

Risk assessment techniques for an adequate level for the accuracy required in the rapid approach are created for the identification of the most negative scenarios that might follow a serious accident and systematic and consecutive application, providing the countries involves with an active means of preventing, monitoring and managing predictable risks and associated emergencies in protecting health and the environment.

Hungary, Bulgaria and Romania have implemented and applied this methodology on selected areas. In Romania, implementation was provided in Ministerial Order 1406 of 3/3/2003 approving the Rapid Environmental and Health Risk Assessment Methodology, of the Ministry of Waters and the Environment.

1. Introduction to the Rapid Environmental and Health Risk Assessment (REHRA) Methodology

Rapid Environmental and Health Risk Assessment – REHRA refers to the immediate and acute consequences of an accident involving a spill of toxic chemicals on an industrial site. This method is applicable to both existing sites and those under development or in the design stage.

The basic structure of this methodology can be broken down into four principal elements:
1. Hazard indicator of the area and ranking thereof
2. Assessment of the area health and environmental risks and ranking
3. Environment and health vulnerability indicator
4. Major accident log

The first and the second items refer to rapid assessment. The third item is an additional information base for the verification of assessment results. The fourth element is considered secondary, but useful in the recording, analyzing and concluding on major accidents.

Hazard indicator of the area and ranking thereof
Site Hazard Indicator and ranking; is the probability of an accident occurring on the chemical site – the SHI indicator is calculated in relation to the following:
- Hazardous sites inventory
- Hazardous substance classification and inventory
- Natural hazard inventory
- Site Hazard Indicator and ranking

Assessment of the area health and environmental risks and ranking

Environment and Health Risk Assessment and ranking is the global risk for the area; it combines SHI probabilities and simplified consequence analysis. The calculation may be broken down into three steps:
- Environmental and health classification and inventory of the area
- Assessment of an accident’s consequences on the environment and health
- Rapid assessment of area-related risks and ranking
This procedure generates a final site risk indicator (SRI).

Environment and health vulnerability indicator

The Environment and Health Vulnerability Indicator is the estimated vulnerability of the site area. The GEHVI is based exclusively on environmental and health aspects of the general area and can be calculated in four steps:
- Population vulnerability indicator
- Environment vulnerability indicator
- Economic vulnerability indicator
- Environment and health vulnerability indicator
The global scheme of the REHRA approach is shown in Figure 4.6.
Figure 4.6 The global scheme of the REHRA approach
2. Assessment of the Site Health and Environmental Risks and Ranking

2.1. Hazard Assessment

Site General Indicator (SGI)

SGI represents the probability of something not working well on the industrial site, leading to a potential accident, due to the existence of two competing and simultaneous causes:

Process configuration, represented by the Site Technological Factor (STF), defined as the sum of values associated to each of the following elements:
- Site Age;
- Process Control;
- Type of Operations;
- Operating Conditions;
- Loading / Unloading Operations.

These are the key parameters influencing the accident probability of occurrence.

For each of these parameters a potential hazard level (category) is considered and a relevant numerical parameter is assigned (a number between 1 and 10). This parameter may involve an intermediate value in a certain range in order to take into account the site specific characteristics (Tables 4.10. A-E).

Table 4.10. Determination of the potential hazard level for the most representative elements for the rapid assessment of industrial risk

A) Element: Site age

<table>
<thead>
<tr>
<th>REFERENCE NO. OF INVENTORY</th>
<th>CATEGORY</th>
<th>VALUE OF PARAMETER A</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 1)</td>
<td>Between 1 and 5 years</td>
<td>1</td>
</tr>
<tr>
<td>a. 2)</td>
<td>Between 5 and 20 years</td>
<td>5</td>
</tr>
<tr>
<td>a. 3)</td>
<td>More than 20 years</td>
<td>10</td>
</tr>
</tbody>
</table>

B) Element: Process control

<table>
<thead>
<tr>
<th>REFERENCE NO. OF INVENTORY</th>
<th>CATEGORY</th>
<th>VALUE OF PARAMETER B</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. 1)</td>
<td>High level of technology</td>
<td>1</td>
</tr>
<tr>
<td>b. 2)</td>
<td>Average level of technology</td>
<td>5</td>
</tr>
<tr>
<td>b. 3)</td>
<td>Low level of technology</td>
<td>10</td>
</tr>
</tbody>
</table>

C) Element: Type of Operations

<table>
<thead>
<tr>
<th>REFERENCE NO. OF INVENTORY</th>
<th>CATEGORY</th>
<th>VALUE OF PARAMETER C</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 1)</td>
<td>Continuous production cycle</td>
<td>1</td>
</tr>
<tr>
<td>c. 2)</td>
<td>Semi-continuous production cycle</td>
<td>5</td>
</tr>
<tr>
<td>c. 3)</td>
<td>Discontinuous production cycle</td>
<td>10</td>
</tr>
</tbody>
</table>

D) Element: Operating Conditions

<table>
<thead>
<tr>
<th>REFERENCE NO. OF INVENTORY</th>
<th>CATEGORY</th>
<th>VALUE OF PARAMETER D</th>
</tr>
</thead>
<tbody>
<tr>
<td>d. 1)</td>
<td>Processes at low temperature and pressure</td>
<td>1</td>
</tr>
<tr>
<td>d. 2)</td>
<td>Processes using high pressures (&gt; 30 bar) or high temperatures (&gt; 200ºC)</td>
<td>5</td>
</tr>
<tr>
<td>d. 3)</td>
<td>Processes using very high pressures and temperatures</td>
<td>10</td>
</tr>
</tbody>
</table>
E) Element: Loading / Unloading Operations

<table>
<thead>
<tr>
<th>REFERENCE NO. OF INVENTORY</th>
<th>CATEGORY</th>
<th>VALUE OF PARAMETER E</th>
</tr>
</thead>
<tbody>
<tr>
<td>e. 1)</td>
<td>Number of loading/unloading operations below 50 per year</td>
<td>1</td>
</tr>
<tr>
<td>e. 2)</td>
<td>Number of loading/unloading operations between 50 and 300 per year</td>
<td>5</td>
</tr>
<tr>
<td>e. 3)</td>
<td>Number of loading/unloading operations over 300 per year</td>
<td>10</td>
</tr>
</tbody>
</table>

The Site Technological Factor (STF) is further defined as the sum of the values assigned to each element described in the above tables.

\[
STF = \frac{A + B + C + D + E}{50} \times 10
\]

The calculation for the project under review is summarized in Table 4.11:

**Table 4.11. Calculation of the Site Technological Factor (STF)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
</tr>
<tr>
<td>STF</td>
<td>2.6</td>
</tr>
</tbody>
</table>

- The level of organization of the environmental and health management, represented by the (SOF).

Three categories of potential hazards were defined in accordance with the available information and data, as well as corresponding hazard parameters.

This factor is calculated in accordance with Table 4.12:

**Table 4.12. Potential Hazard Categories**

<table>
<thead>
<tr>
<th>REFERENCE NO. OF INVENTORY</th>
<th>CATEGORY</th>
<th>VALUE OF PARAMETER F</th>
</tr>
</thead>
<tbody>
<tr>
<td>f.1)</td>
<td>Maximum reference level (implemented environmental and safety management systems)</td>
<td>1</td>
</tr>
<tr>
<td>f.2)</td>
<td>Average reference level</td>
<td>5</td>
</tr>
<tr>
<td>f.3)</td>
<td>Minimum</td>
<td>10</td>
</tr>
</tbody>
</table>

The site organisational factor is equal with the value of parameter F.

\[
SOF = F
\]

The calculation for the project under review is summarized in Table 4.13:

**Table 4.13. SOF Calculation**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOF</td>
<td>2</td>
</tr>
</tbody>
</table>
The two previous factors, STF and SOF are combined to define the Site General Indicator (SGI) using the formula:

$$SGI = \sqrt{STF \cdot SOF}$$

The calculation for the project under review is summarized in Table 4.14:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGI</td>
<td>2.28</td>
</tr>
</tbody>
</table>

**Dangerous substance indicator (DSI)**

The dangerous substance indicator (DSI) is calculated based on the total amount of hazardous substances handled and/or stored on the site, in correlation with the relevant quantity under Annex 1 of the Seveso Directive.

The dangerous substance indicator (DSI) is calculated based on the total amount of hazardous substances handled and/or stored on the site defined by the specific Dangerous Substance Factor (DSF), calculated as follows:

$$DSF = \sum \frac{q_i}{Q_i}$$

Where: $q_i$ is the amount of inventoried hazardous chemical substance/compound i (or category of hazardous substance) which falls within Part 1 or 2 of Annex 1 of the Seveso II Directive. $Q_i$ is the limit amount relevant for Parts 1 and 2 (column 2) of the above-mentioned Annex.

The DSI factor is calculated using the following formula (see Table 4.15):

<table>
<thead>
<tr>
<th>DSF</th>
<th>DSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0&lt;DSF≤10</td>
<td>DSI=1/5*(DSF)</td>
</tr>
<tr>
<td>DSF&gt;10</td>
<td>DSI=2*Log(DSF)</td>
</tr>
</tbody>
</table>

In this formula, the logarithm is calculated to the base 10.

The inventory of hazardous substances containing the $q_i$ amounts of substances used for calculation is described in section 3C of the Report.

The calculation for the project under review is summarized in Table 4.16:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSI</td>
<td>4.19</td>
</tr>
</tbody>
</table>

**Natural Hazard Indicator (NHI)**

The Natural Hazard Indicator (NHI) is a combination of independent factors that are relevant for one or more natural hazards (areas exposed to frequent flooding, high seismicity, frequent landslides, earth movements or high soil instability).
NHI is a combination of independent factors that are relevant for one or more natural hazards, as per Table 4.17:

**Table 4.17. Natural Hazard Indicator (NHI)**

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>NATURAL HAZARD FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood risk area</td>
<td>Yes: factor F = 1</td>
</tr>
<tr>
<td>High seismicity area</td>
<td>Yes: factor S = 1</td>
</tr>
<tr>
<td>Frequent landslides, earth movements or high soil instability affecting the area</td>
<td>Yes: factor L = 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>NATURAL HAZARD FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood risk area</td>
<td>No: factor F = 0</td>
</tr>
<tr>
<td>High seismicity area</td>
<td>No: factor S = 0</td>
</tr>
<tr>
<td>Frequent landslides, earth movements or high soil instability affecting the area</td>
<td>No: factor L = 0</td>
</tr>
</tbody>
</table>

The combination of these factors provide the NHI corresponding value, as follows:

\[ \text{NHI} = F + S + L \]

The calculation for the project under review is summarized in Table 4.18:

**Table 4.18. NHI Calculation**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>0</td>
</tr>
<tr>
<td>L</td>
<td>0</td>
</tr>
<tr>
<td>NHI</td>
<td>1</td>
</tr>
</tbody>
</table>

The site hazard indicator (SHI) is a composite parameter representing the potential hazard (probability of occurrence) of a major accident, without considering further environmental and health consequences.

The site hazard indicator (SHI) is calculated with the formula:

\[ \text{SHI} = \sqrt{\frac{|SGI| + NHI \times 10}{13}} \times DSI \]

where: \( SGI \) is the Site General Indicator  
NHI is the site hazard indicator  
DSI is the dangerous substance indicator

**Table 4.19** summarizes the calculated values for the above-mentioned indicators:

**Table 4.19. Hazard assessment indicators**

<table>
<thead>
<tr>
<th>Calculated Indicator</th>
<th>Intreg amplasamentul Site-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGI</td>
<td>2.28</td>
</tr>
<tr>
<td>DSI</td>
<td>4.19</td>
</tr>
<tr>
<td>NHI</td>
<td>1.00</td>
</tr>
<tr>
<td>SHI</td>
<td>2.25</td>
</tr>
</tbody>
</table>
2.2. Health and Environmental Risk Assessment

The components that are subject to assessment of seriousness classify into three broad categories:
- People
- Environmental media
- Economic resources

A general seriousness factor is calculated for each category, according to the estimated consequences for the area. These factors include:
CP – general seriousness factor for people
CE – general seriousness factor for the environmental media
CEC – general seriousness factor the economic resources

The general seriousness indicator
For each identified accident, an Environment and Population General Indicator (EPGI) is calculated as a sum of the three specific factors above.

Risk indicator for one accident
In terms of risk, for an identified accident, the relationship between frequency and seriousness is generally expressed as a product, hereinafter called the Accident Risk Indicator (ARI).

Site risk indicator
Representation of the final site risk indicator value is done based on the Site Risk Indicator (SRI), shown as the maximum value for each identified ARI. The final risk is the most negative situation possible, that might be caused by the investigated industrial activity.

Table 4.20 summarizes the calculated values for the above-mentioned indicators:

<table>
<thead>
<tr>
<th>Calculated Indicator</th>
<th>CP</th>
<th>CE</th>
<th>CEC</th>
<th>EPGI</th>
<th>ARI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HCN emission in the CIL area</td>
<td>1.33</td>
<td>0.83</td>
<td>1.25</td>
<td>1.22</td>
<td>1.82</td>
</tr>
<tr>
<td>2. TMF dam break</td>
<td>4.00</td>
<td>4.17</td>
<td>3.75</td>
<td>4.02</td>
<td>3.30</td>
</tr>
<tr>
<td>SRI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.30</td>
</tr>
</tbody>
</table>

2.3. General Environment and Health Vulnerability Assessment

Assessment of environmental and health vulnerability may provide additional information on how the external environment might be affected by a potential accident.

The General Environment and Health Vulnerability Indicator (GEHVI) is the weighted sum of:
- PVI - the population vulnerability indicator. PVI calculation will consider the potential effects of an accident on the surrounding population (residents and site workers).
- EVI - the environment vulnerability indicator. EVI is calculated considering the site-specific environmental media that might be endangered (rivers, lakes, soil and groundwater, fauna and vegetation).
- ECVI - the economic vulnerability indicator. ECVI is calculated considering the local economic components that might be endangered (livestock, agriculture, aquaculture, industry and business).

The values of specific weighting coefficients were established in terms of the impacts of each category of the general vulnerability indicator (the impact on population was established as the most critical, impact on economic activities as the lowest, while environmental impacts are considered medium).

Table 4.21 summarizes the calculated values for the above-mentioned indicators:
Table 4.21. Indicators of general environment and health vulnerability assessment

<table>
<thead>
<tr>
<th>Calculated Indicator</th>
<th>Site-wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVI</td>
<td>1.47</td>
</tr>
<tr>
<td>EVI</td>
<td>5.06</td>
</tr>
<tr>
<td>ECVI</td>
<td>3.75</td>
</tr>
<tr>
<td>GEHVI</td>
<td>2.40</td>
</tr>
</tbody>
</table>

For an assessment (in terms of risk) of the investigated site based on the indicators calculated as above, the following classification scale is used (summarized in Table 4.22)

Table 4.22. Classification scale of environment and health vulnerability assessment

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 0 to 1.6</td>
<td>Low</td>
</tr>
<tr>
<td>From 1.6 to 3.6</td>
<td>Moderate</td>
</tr>
<tr>
<td>From 3.6 to 6.4</td>
<td>High</td>
</tr>
<tr>
<td>From 6.4 to 10</td>
<td>Very high</td>
</tr>
</tbody>
</table>

The Figure 4.7 shows a comparison of seriousness and risk levels associated to potential major accidents

Figure 4.7. Probability, risk and vulnerability associated with the operation under review

Both the probabilities of occurrence and risks associated with the operation under review correspond to the moderate level. However, the probability has a lower level than the risk and vulnerability due to equipping with new facilities which meet the best available techniques (BAT) criteria and implemented operational management systems. The risk, although corresponding to the moderate level it is the highest level indicator due to the nature and characteristics of the chemicals

Prepared by S.C. OCON ECORISC S.R.L. Turda
used, i.e. sodium cyanide. There are protected species or areas or urban agglomerations in the region, which means that the environmental and health vulnerability associated with the activity under review also corresponds to the moderate level.

**d. Conclusion**

The analysis of hazards and risks associated to the Roșia Montană Project will point out the relatively high risk of the future activity due to its size and the presence of important quantities of dangerous substances.

The use of cyanide and the deposition of tailings into the TMF are the main risk factors.

Quantitative risk assessment was based on computing the level of risk as a product of the seriousness (consequence) and the probability of an event. Using the information obtained from the analysis, an event’s risk was placed in a probability/consequence type matrix.

Regardless of the existing situation, the risk of accident due to the non-performance of the TMF is extremely low. In case of a potential accident, the contaminated release is limited both in terms of quantity and duration. In most situations, even in case of such an accident, the water quality in the river is maintained at a level higher than the regulatory levels for the quality of surface water and drinking water, also at the point of discharge into the river. In all these situations, the safety conditions are restored hundreds of kilometres before the released water reaches the Hungarian border. The risk analysis establishes that the major accident scenario is unrealistic. Both the very low accident risk as well as the obvious benefits of the environmental rehabilitation operation indicate that the Project implementation might have a positive impact on some environmental components.

Analysis results suggest that the safety measures, prevention measures, implementation of the environmental and risk management systems, as provided by the Project, will reduce the identified risks to acceptable levels under the most restrictive norms, standards, the best practices and the relevant national and international recommendations.

**C. Description of technical parameters and equipment used for facility safety**

The description of the technical parameters and equipment used for facility safety is presented in **Section V point A** of the Report.
V. Protection and response measures to limit the consequences of an accident

A. Description of equipment installed on site to limit the consequences of major accidents

1. Tailings Management Facility

The TMF has an extremely robust design which includes numerous additional safety measures compared to the majority of such structures existing worldwide. These design features include:

- water storage capacity able to accommodate 2 PMF events;
- a spillway will be constructed with each dam raise that will discharge excess water from an exceptional event in a controlled way. Thus the downstream slopes of the dam will not be subject to erosion;
- starter dam made of rockfill with a central low permeability core, with gradients (2H:1V) downstream and (1.75H:1V) upstream;
- the main dam made of rockfill by centerline method of construction with 3H:1V gradient for downstream slope. The gradients for such structures are typically ranging between 1.5:1 and 1.75:1;
- A drainage system at the bottom of the TMF and a filter zone between tailings and rockfill aiming to facilitate reduction of moisture content and stabilization of deposited material;
- a monitoring system installed on the dam and in its proximity to give early warning on any likely instability situations, excessive increase of water table in the TMF body, excessive increase of water volume stored in the TMF;
- implementation of a quality assurance program during all TMF construction stages;
- Implementation of a rigorous monitoring program of the volume of water stored in the TMF.

2. Wastewater treatment plants

a. ARD treatment plant

Wastewater from the ore processing plant will be discharged depending on the TMF safety parameters and amount of precipitations (water balance) through the ARD plant (with non-permanent operation under continuous regime).

The ARD treatment plant will use a technology based on lime neutralization / precipitation method to reduce dissolved metal concentrations and pH.

The treatment plant design includes:
- design capacity: 400 m$^3$/h with allowance for increase;
- clarifier: capacity approx. 2000 m$^3$, diameter 28m
- air oxidation;
- lime neutralization/precipitation and pH control;
- pH adjustment at 8.5 with carbon dioxide (CO$_2$);
- flocculation with solids recycle;

The plant is provided with the following instrumentation:
- treated water flowmeter;
- pH sensor with transmitter installed on decant water pump suction;

When the wastewater plant is operating, discharges from the plant will be used primarily for dust suppression and in the process plant for dilution in the cyanide detoxification process. The releases from the wastewater treatment plant will be increased as required to dispose of the project surplus water and the design capacity of the conduits leading to the Rosia Stream will be increased accordingly. The treated effluent discharged to Rosia stream will have a flow of about 314 m$^3$/h (pipeline or open channel from the wastewater treatment plant in length of 2820m) and to Corna stream a flow of 20 m$^3$/h (pipeline from industrial wastewater treatment plant downstream of the secondary containment system in length of 4900m)
Some discharge water will be used to maintain biological baseflows in the Rosia valley creek during dry season.

b) DETOX treatment plant
To detoxify the cyanide in the process tailings the Project will employ the INCO SO₂/air detoxification process on the tailings discharge residue which allows reduction of WAD cyanide concentration below 10 mg/l before the detoxified tailings leave the confines of the process plant.

The cyanide detoxification facilities will consist of two tanks operating in parallel.

The control system allows for the design parameters to be reached via the following control systems:
- flowmeter to measure the air which is sparged in each tank - 9 Nm³/h
- Volume meter to measure the level of the Na₂S₂O₅ solution metered into each tank depending on the WAD cyanide concentration in the process tailings circuit.
- control system to adjust the CuSO₄ metering ratio through the solution flowrates entering the detoxification tank
- pH-meter to maintain pH at 8.5 by adding milk of lime through a close circuit pipeline system
- ion selective oxidation-reduction probes to measure to evaluate the oxidation potential of the detoxified slurry and ensure no free cyanide remains. The probes can also be used as a control element in the basic automated control system employed.

Analytical procedures will provide the operators with quick and accurate cyanide measurements, which will allow for set-point adjustment as required to maintain process control.

c) Cetate waste rock and mine drainage pond
Acid runoff from historical operation (including the Adit 714 runoff) and the new mine will be captured in the Cetate drainage pond, designed to collect a flow rate of 231 - 371 m³/h of ARD.

The base flow in the Rosia stream will be maintained primarily by constructing a diversion canal that will collect and divert water not impacted by the new mining operations around the Cetate dam and discharge it into Rosia Creek. Initially, the 3.9 km diversion canal will drain an area of about 7.5 km², which has not been impacted by recent mining. This represents about 70% of the Cetate pond catchment. Hence, initially the base flows of the Roșia Stream downstream of the Cetate dam will only be affected to a minor extent by the construction of the dam.

This dam will be breached as soon as it is found that the quality of the water stored in the dam complies with the standards laid down by NTPA 001 (approved by GD 352/2005) and based on the water management permit to be issued to RMGC for direct discharge in the Rosia stream. Any exposed areas would be re-graded to reduce the residual ponding effect and reinstate where possible the original stream course through this area.

Strategic revegetation will be employed aiming to have the area covered naturally with local species.

The water treatment lagoons to be constructed downstream of the dam will be kept after closure too in order to ensure continuous semi-passive treatment of the runoff.
3. Structures for collecting and impounding accidental spills of fluids containing dangerous substances

a) Secondary Containment System

Minor seepage through the main dam is expected, which is normal for any dam. Seepage through the dam will be collected directly in the secondary containment system (SCS), located at the final downstream toe of the embankment.

The SCS will consist of a 10 to 15 m deep sump excavated into weathered rock in conjunction with a zoned rockfill dam and pumping system to pump water over the TMF embankment and back into the tailings impoundment.

The materials used to construct the SCS will be chemically inert, and non-acid generating.

b) Processing plant collection and retention system

All areas within the plant site where dangerous materials are handled are provided with concrete berms and runoff ditches towards concrete basins fitted with sump pumps. The 7 leaching tanks are installed in a containment basin fitted with sump and sump pump which allows for any accidental spillage to be returned to the process circuit. The cyanide storage tanks, pregnant solution tanks, HCl tank, detox plant are also fitted with impermeable containment berms fitted with sump pumps.

In the southern part of the plant there is an emergency pond where all industrial wastewater from the plant site (including storm water) is collected which can then be reused in process or discharged onto the TMF together with the slurry.

c) Other safety systems or facilities

The process plant site and explosives storage facility are fenced in, access being permitted only to authorized people and vehicles. Security is ensured on permanent basis by company’s own personnel.

Work places posing hazard for release of toxic gas or vapors are fitted with systems to capture, treat, discharge and disperse contaminants and with automatic hydrogen cyanide detectors with continuous operation.

Lockable gates and appropriate signage will restrict use of the roads within the plant site.

B. Alert and response

Alert and response are organized in accordance with the Internal Emergency Plan and Accidental Pollution Prevention and Control Plan.

1. Definitions

- major accident means an occurrence on site in the course of an operation involving the management of extractive waste in any establishment covered by this Directive, leading to a serious danger to human health and/or the environment, whether immediately or over time, on-site or off-site;
- site means the area which is under the control of the same operator where, in one or several facilities, including in the joint activities and infrastructure, dangerous substances are present;
- emergency / accident means an event that does not generate major consequences to human health and/or environment but which has potential to cause a major accident;
- emergency – exceptional event of non-military nature which by scale and intensity threatens human life and health, environment, important material and cultural assets and to reinstate normality requires urgent measures and actions, allocation of additional resources and unitary management of the involved forces and resources;
- scale of emergency – size of the area of impact in which human life, functioning of the institutions of the democratic state, values and interests of the community are threatened or affected;
- **intensity of emergency** - speed of evolution of the destructive events and degree of disturbance of normality status;

- **potential emergency generating condition** – complex of risk factors which by their uncontrolled evolution and imminence of threat may negatively impact on human life and health, important material and cultural assets and environment;

- **imminence of threat** – status and time parameters which determine inevitable generation of an emergency situation;

- **alert state** – means immediate implementation of the prevention actions and measures plan, warning of population, limitation and removal of the consequences of the emergency situation;

- **management of emergency** – all the activities carried out and procedures employed by the decision makers, public institutions and services competent to identify and monitor risk sources, evaluate information and analyze situation, prepare forecasts, determine action options and implement the same in order to reinstate the normality situation;

- **monitoring of emergency** – supervision process required to systematically evaluate the dynamics of the parameters of the occurred situation, know the type, scale and intensity of the event, the evolution and social implications thereof as well as the way to carry out the measures established in order to manage the emergency situation;

- **risk factor** – event, process or complex of congruent circumstances, at the same time and in the same space, which may determine or facilitate the occurrence of certain risk types;

- **risk types** – force majeure cases generated by fires, earthquakes, floods, accidents, explosions, failures, land slides, mass epidemics, collapses of constructions, facilities or plants, wreckage or sinking of ships, fall of objects from the air or space, tornadoes, avalanches, failure of public utility services or other natural calamities, severe catastrophes or large scale public events generated or facilitated by specific risk factors.

- **management of emergency** – identify, record and assess the risk types and their causing factors, notify the stakeholders, warn population, limit, remove and control risk factors and adverse effects and impact generated by the respective exceptional events;

- **operative response** - actions carried out in due time by specialized units in order to prevent the emergency to become worse or remove, as the case may be, its consequences.

- **evacuation** – protection measure taken in case of imminent threat, alert state or occurrence of an emergency which consists of removing in an organized way from the affected or potentially affected areas public institutions, businesses, categories or groups of people or property to areas and towns that ensure safety for people, property and assets and operating conditions for public institutions and businesses;

- **disaster** - event generated by certain risk types, natural causes or by man, that leads to loss of human life, property or to environmental changes and which by its scale, intensity and consequences reaches or exceeds the specific severity levels established in the regulations on the management of emergencies, developed and approved according to the law;

- **civil protection situation** – situation generated by the imminence of occurrence or the occurrence of disasters, military conflicts and/or other unconventional situations which by their severity level jeopardizes or affects life, environment, property, cultural and heritage assets;

- **notification** - transmission of authorized information on the imminence or occurrence of disasters and/or military conflicts to the central or local public administration authorities in order to avoid surprise and be able to take safety actions;

- **warning** - providing the people with the required information on the imminence or occurrence of disasters;

- **pre-alarming** – transmission of warning messages / signals regarding the potential for occurrence of disasters or an air attack to the authorities;

- **alarming** – transmission of warning messages / signals regarding the potential for occurrence of disasters or an air attack to the authorities;

- **sheltering** – specific safety measure for people, property, cultural and heritage assets during military conflicts against the effects of the enemy’s air raids. The civil protection shelters are areas set up to the specific purpose to protect the personnel in emergency situations, which are designed, constructed and equipped according to the technical standards and instructions prepared by the
General Inspectorate for Emergencies and approved by the Minister of Administration and Internal Affairs;

- **storage facility** – presence of a quantity of dangerous substances for storage purposes, kept under safety conditions or maintained in stock;

- **“Domino” effect** – the result of a series of events in which the consequences of an accident occurring to a Seveso type facility or site are amplified by the next accident at another facility / site as a result of the distances and properties of the substances that are present and which ultimately leads to a major accident;

- **facility** – technical unit within a site where dangerous substances are produces, used, handled and/or stored. The facility includes all equipment, structures, pipeline system, machinery, devices, internal railways, docks, unloading quays that serve the facility, piers, warehouses or similar structures, floating or of other nature required to operate the facility;

- **operator** - any legal or natural person that operates or owns under any title a site or a facility;

- **hazard / danger** – intrinsic property of a dangerous substance or physical situation with potential to induce adverse effects on human health and / or environment;

- **risk** – probability of occurrence of a specific effect in a certain period of time or under certain circumstances, residual risk refers to the risk that remains after some of the risk-causing factors are removed;

- **dangerous substance** – a substance, mixture or solution provided in GD 804/2007 – Appendix no. 1 - Part 1, or which meet the criteria in Appendix no. 1 – Section 2 and which are present as raw materials, products, secondary products, residual or intermediate, including those substances which may be generated during an accident.
2. Emergency Organization Chart

Figure 5.1. Emergency Organization Chart at S.C. Roșia Montană Gold Corporation S.A.

2.1. Emergency Cell

The emergency cell is a management structure for emergencies and carries out its activities according to the provisions of the “REGULATION REGARDING THE ORGANIZATION, TASKS AND OPERATION OF THE EMERGENCY CELLS”. The membership of the emergency cell is established by decision of the site manager who is also the head of the emergency cell.

Tasks:
- Identifies and manages the disaster generating risks within the unit.
- Carries out civil protection training (general and specialized theoretical and practical and by participation in public alarm exercises). Civil protection training of the employees is done together with the fire prevention and extinguishing training. Preventive training of the employees will have the following objectives: information regarding the hazards they are exposed to, self-protection measures to be carried out, safety equipment provided, rights and obligations according to the civil protection law as well as obligations and way of action during the emergency. Employee participation in training is a job duty.
- Ensures initiation, training, improvement or specialization of the civil protection inspector, emergency cell members, head of emergency division and other people with civil protection duties.
through courses, exercises, training, etc initiated by the National Training Centre for Management of Emergencies through its regional centers.
- Establishes specific protection methods and procedures of the employees and population (where there is a daily massive influx of people) as well as of the own material assets.
- Ensures financial and material resources required to construct, develop, maintain, upgrade: The control points, civil protection shelters, notification – alarm system, protection, response resources, training process resources, organizing the records, storage, conservation and maintenance of the same.
- Sets up the financial and technical – material reserves specific in emergency or armed conflict situations.
- Ensures implementation of light and heat sources concealment and camouflage.
- Reviews and determines the ways to adapt and use own technical resources and equipment for civil protection requirements.
- Organizes and ensures the efficiency and optimum response capacity of the private (volunteer) emergency service by limiting and removing the effects of disasters and air attacks during armed conflicts, reducing loss of human lives and reestablishing the affected units.
- Informs the County Inspectorate for Emergencies (operational center) and the other bodies with competences in emergency management about conditions that could potentially generate emergency situations or about the occurrence of an emergency situation within the unit.
- Assesses the occurred emergencies establishing specific measures and actions for their management and supervises their implementation.
- Organizes and ensures the evacuation of the employees and own material assets in special situations, in accordance with the provisions of the plans developed in this purpose.
- Develops “Action plans and measures for employee (population) prevention and warning and emergency management specific to the types of risks the unit may be exposed to and within the radius of the locality / county”.
- Also fulfills other civil protection tasks, according to the legislation in force.

Activities:
The Emergency Cell is mobilized and gets in action after an event of a nature to produce an emergency is reported.
- Decides on the determination of the nature of the accident and response of the teams;
- Establishes the characteristics of the hot spot and severity of the occurred situation:
  - Exact location of the failure or accident;
  - Quantity of dangerous substance involved;
  - Size of affected areas;
  - Predictable evolution of accident.
- Reviews the created situation and decides on launching the alarm subject to the emergency class;
- Decides on and brings in the response teams; Where required, decides on supplementing the response teams to eliminate the consequences of the occurred situation;
- In cooperation with specialized companies ensures additional response machinery and equipment;
- Coordinates, through the Emergency Cell members, the action of all teams that respond in the hot spot and affected areas in order to eliminate the failure and limit its effects.
- Establishes the evacuation directions and decides where required the evacuation of personnel from affected areas.
- Ensures, by company’s available vehicles, the evacuation of personnel and transportation of injured people to the nearest healthcare facility. Requests additional vehicles through the Inspectorate for Emergencies.
- Decides on partial or total shutdown of facilities in extremely severe cases, when delays in remediation of accident are anticipated.
- Advises and notifies the occurrence of the emergency (failure / incident or accident) to the authorities with competences for emergencies;
- Alarms population and nearby businesses, the localities within which radius the accident occurred or which may be affected by the accident, cooperating with the local bodies (Town Hall, Police Department, Prefecture, Ranger Division, Fire Brigade, etc).
- Participates together with the authorities in investigating the areas affected offsite in order to establish measures to limit the generated effects.
- Supervises the rescue and medical teams on site, asks for and ensures additional first aid measures and transport of the injured or intoxicated people.
- Alarms, organizes and coordinates the activity of the security personnel responsible for blocking the access ways, restricting the access in the affected area and guarding the area.
- Coordinates the activity of company's own teams with the external teams to remediate the effects of the accident.
- Decides on the return of the personnel to the workplaces, resuming normal work program and bringing the facilities to normal operating parameters after the emergency is remediated and when the concentration of toxic substances dropped below maximum permissible values.
- Provides in own budget funds for expenses required to conduct emergency activities.

In case of occurrence of emergencies of whose effects exceed / may exceed the site boundaries, informs and notifies of the occurrence within maximum 2 hours the territorial public authorities with responsibilities in terms of civil protection, environmental protection, labor safety, public administration and health, in accordance with GD 804 / 2007 art. 15 and MAI Order 1084/2003. Successive reports and notifications will be sent during the course of the events. After cessation of the emergency the final version of the notification will be drafted up.

2.2. Coordinator of emergency response (Safety Management Officer).

Tasks
- Ensures permanent coordination of planning and performance of activities and of emergency protection and preparedness measures, participates in the training of the emergency divisions, employees and ensures coordination of emergency cells.
- Ensures identification, monitoring and assessment of the specific risk factors that can generate dangerous events;
- Organizes and equips, based on the performance criteria prepared by the General Inspectorate for Emergencies, the company’s own emergency units;
- Participates in civil protection exercises and applications and leads the actions related to alarm, evacuation, response, limitation and removal of the consequences of the emergency situations carried out by the company's own units;
- Organizes training of the emergency personnel;
- Provides in own annual budget funds for expenses required to conduct civil protection activities;
- Notifies the competent persons and bodies of the risk factors and informs them immediately of the imminence of occurrence or occurrence of a civil emergency;
- Develops and forwards to sub-contractors specific protection measures correlated with the risks predictable in the use, handling, transport and storage;
- Signs contracts, agreements or cooperation protocols with other emergency divisions, professional or volunteer;
- Maintains in operating condition the transmission – alarm equipment, shelter areas and own shelter or response technical resources, keeps record of and checks the same periodically;
- Representation and cooperation relationships; establishes cooperation relationships with the local public administration authorities from the relocation area, professional response units in whose area of competence the activity is carried out, other institutions and bodies involved in emergency prevention, preparation and response.

Specific duties:
- to know in detail the provisions of this document and of all standard and specific operating plans, emergency preparedness and response plans.
- to know the equipment, forces and means and any other type of resources that may be used for emergency response as well as the location and operation of the same;
- to know all chemical substances, materials, wastes, their circuit and storage place, incidents that may occur during transport, handling, storage or during production as well as immediate measures to be taken in case of accident;
- to know all operations to be carried out in the production area, ancillary areas, extraction area or in areas where the site is developed;
- to know the membership of the response team and resources available to them;
- to know the maintenance and production personnel involved in the critical operating processes of the activities carried out on site;
- to know the external emergency response resources: businesses, local, regional, national private or public organizations, professional, volunteer or private emergency divisions within the responsibility area;
- to know the location of the personnel in the areas that may be affected by accidents.

Activities:
- Ensures permanent coordination of planning and performance of activities and of emergency protection and preparedness measures, ensures coordination of emergency cells.
- Establishes and ensures fulfillment of prevention actions and emergency response;
- Provides free of charge the equipment, substances, resources and antidotes suitable for the specific risks to the response forces called in for emergency help;
- Alarms the people within the risk area created as a result of the own activities carried out;
- Organizes and prepares personnel to ensure emergency response within the site;
- Is responsible for making the initial decisions on the type of response to be given to the specific emergency created, thus rating it in the appropriate emergency level and evaluating the response resources required.
- Appoints the leader of the emergency action subject to the created situation from among the persons trained specifically for this activity.

2.3. Action Leader

Tasks

The action leader is the person responsible for the actions carried out at the accident site, unitary coordination of the action of all response forces, makes decisions on the resources required and communicated with those present at the accident site. The action leader position is temporary and held only during emergencies.

The action leader will be appointed by the emergency cell, upon the proposal of the emergency response coordinator depending on the emergency response personnel present on site and on the type and scale of the occurred situation. Special training regarding the organization of the emergency response is required to fulfill the tasks of this position. This training is done centralized under direct coordination by the emergency response coordinator, based on a training program. This training will be completed with specific training depending on the activity site and type of incident that may occur within that site. The potential incident leaders will be selected from within the engineers, technicians, section, workshop, plant, warehouse, work place, etc supervisors as well as own response team leaders.

The emergency coordinator must keep records of the trained personnel in order to fill in the incident leader position depending on the type and location of the incident.

The action leader ensures unitary coordination of the action of all response forces and is responsible, along with the emergency response team leaders, for the adequate and efficient execution of the response, i.e. stop and containment of spills, ensure medical services, fire extinguishing and rescue operations.

During the execution of the tasks, the action leader shall be subordinated to the emergency coordinator. Will be in permanent contact with them and will supply data on the real situation occurred, completed response actions, damages, number of victims, forces required and additional...
response resources. Also, during the response will cooperate with all categories of forces that are helping with the limitation and remediation of the adverse consequences of the emergency and provide them with all the information and resources necessary for the response.

The action leader is usually the leader of the Private Emergency Division organized by decision of the site manager.

In certain situations the incident leader may be a different person, selected by the Head of the Emergency Cell, depending on the emergency response personnel present on site, usually the supervisors of the sectors where the accident occurs.

Activities

During emergencies, the action leader is responsible, along with the response team leaders, for: responding, stopping emissions and containing spills, ensuring medical services, extinguishing fires and undertaking rescue operations.

The action leader, after having been appointed, will go to the accident site together with the response team. The action Leader will:
- contact the persons who ensured the first emergency response in order to get accurate information on the incident;
- in cooperation with the head of the emergency cell decide if the incident was adequately rated;
- ensure double check regarding setting off the appropriate alarm and initiating the adequate alarm systems, if this had not been already done;
- control all emergency response forces managing the employees and response teams;
- cooperate closely and communicate with the response teams on and off site (police, fire brigade, other external emergency response organizations or contractors that arrive at the incident site);
- assess the risk for occurrence or spreading of fires, explosions or chemical substance spills, etc;
- ensures monitoring of spills, toxic gas generation, equipment pressure balance, failure of valves, pipes or other equipment;
- stay on to control the area until the emergency is deemed finished at which point control will be taken over by the head of the emergency cell;
- continue to communicate only with the head of the emergency cell, in addition to the communication with the people who respond to emergencies and local employees; Communication with other persons should be avoided until emergency is declared finished;
- initiate the evacuation of the facilities and decide if local evacuation, evacuation of the entire site or of neighboring population is required;
- decide which emergency response equipment, either on or off site and which operating equipment is required to adequately respond to the emergency;
- control the use of equipment by those who respond to the emergency;

The action leader and those who respond to emergencies shall be responsible only for the response during the emergency, that is stopping emissions and containing spills, providing medical services, extinguishing fires and undertaking rescue operations. Post-emergency clean-up and decontamination operations shall be the responsibility of other departments, organizations or contractors.

After the emergency starts, the action leader will help the head of the emergency cell with:
- Documenting the incident;
- Starting emergency investigation, reporting and recording;
- Starting clean-up;
- Treatment, storage or disposing of salvaged waste, contaminated soil or surface water or any materials resulting from the incident.

2.4. Private Emergency Division

Tasks

In accordance with MAI Order 158/2007 for the approval of the performance criteria on the set up, rating and equipping of private emergency divisions, a category V division shall be set up within SC Rosia Montana Gold Corporation of whose response, rescue and first aid unit will include
teams specialized according to the types of risks, including in supervision and commissioning of special fire prevention and extinguishing equipment.

In case of failure / accident involving dangerous substances the response team members will be available on site and will take action according to the instructions given by the action leader in situations that involve: dangerous substance spills, fires – explosions and natural disasters. They will be trained with regard to the handling and properties of the dangerous substances and their compounds that may be formed in various reactions on site and in terms of the emergency response.

The main duties of the private emergency division members include periodical inspection and testing of emergency response equipment involving dangerous substances and keeping the response equipment operational according to the relevant regulation.

The Private Emergency Division (PED) works together with the response teams and has the following main duties:

- Ensures training of personnel in emergency response;
- Periodical inspection and testing of emergency response equipment involving dangerous substances and keeping the response equipment operational according to the relevant regulation.

The response teams will take action according to the emergency plan and instructions given by the emergency cell in situations involving fires and/or explosions, chemical substance overflow or spills, natural or man-made disasters. The response teams will also be trained with regard to the handling and properties of the dangerous substances and of those that may be formed in case of accident.

PED will be subordinated to the Emergency Cell.

a) Fire prevention and Extinguishing (FPE) Team

The FPE team members will be available on site and will take action according to the instructions given by the action leader in situations involving: fire and/or explosions, accidents involving dangerous chemical substances, overflow or spill of dangerous substances, materials or wastes.

They will be trained with regard to the handling and properties of the dangerous substances and their compounds that may be formed in various reactions that may occur on site.

The FPE team members will be trained to respond on site in case of fire and/or explosions and of accidents involving dangerous substances.

The FPE team members should know the action and response method for the hazards that may occur following accidents on site and be able to fulfill several duties during an emergency in extremely complex situations.

The FPE response team may take action together with the other response units or independently in all types of emergencies that may occur on site.
The FPE response team will be subordinated to the Emergency Response Coordinator and during emergency responses to the Action Leader.

In case of an emergency, the FPE teams will take action according to the instructions and plans available at the activity site under the command of the sector supervisors.

Upon hearing the alarm signal, the response unit members will:
- get equipped, get the safety and response materials and equipment ready and wait for the dispatcher’s order;
- take action to eliminate the incident and evacuate people from affected area and limit negative effects;
- participates in the investigation of the affected area, delineation, marking and isolation of the affected area, estimation of the number of affected people and determination of the response requirements.

Depending on the received order, the fire brigade responds to limit the propagation of the toxic cloud or to put out the fire occurred following the failure.

The unit leader will advise the team leaders from each response vehicle of the hot spot data, access ways and location of each equipment at the response location.

Depending on the situations and orders received, it may carry out other missions such as:
- Participate in rescue actions, first aid and transport of injured or in other activities in the affected area;
- Participate in removal of the consequences of the disasters and rehabilitation of the area;
- Participate in the limitation and elimination of the created hot spot and upon order in the decontamination of the response and protection equipment and vehicles.

b) Duties of release – rescue team

Upon reporting a failure, the release – rescue team gets equipped and goes to the failure site. Depending on the duties, the first to react will be the work place operators and then as mobilization progresses, maintenance personnel and other members of the team will also get involved in the response. The response team will have the following duties:
- acts in the affected area and on the access roads to determine the situation on site and sends information in order to set off the alarm;
- controls the affected sector to locate the injured people and take them out of the dangerous area, provides first aid to the injured until they are taken over by medical staff.
- helps with the evacuation of the personnel that is present at the failure site and is not involved in the response effort;
- uses first response resources, i.e. fire extinguishers, shovels, sand, buckets, etc;
- uses response resources, i.e. water hydrants and foam, water guns and fixed fire extinguishing equipment;
- operates the equipment to stop the fuel streams that feed the failure, i.e. shut down pumps, close valves, change seals, blinding off, cut off electrical power, etc;
- remove combustible materials from affected areas;
- after removing the immediate causes and effects of the failure investigates the site to assess the damages and requests cessation of emergency.

Once alarms (emergency) stops, the team leader checks the personnel, equipment, materials and writes a report on the response action. Response materials and equipment are cleaned and put away in storage areas.

c) Duties of CBRN (HAZMAT) protection team

In case of accident involving dangerous substances, the response team members will be available on site and will take action according to the instructions given by the action leader in situations involving: overflow or spill of dangerous substances, materials or wastes.

They will be trained with regard to the handling and properties of the dangerous substances and their compounds that may be formed in various reactions that may occur on site.

CBRN team acts within the response team and has the following main duties:
ensures immediate response at incident site;
- takes action to limit and remove the effects of the incident and evacuates personnel from contaminated area;
- does the investigation to determine contamination degree, delineate affected area and estimate number of affected people;
- delineates, marks-up and isolates contaminated site;
Depending on the situations and orders received, it may carry out other missions such as:
- participate in rescue actions, first aid and transport of injured or in other activities in the affected area;
- participates in the removal of the consequences of the disasters and decontamination of the area;
- participates in taking samples from the contaminated area (water, animal products, vegetal products);
- participates in the limitation and elimination of the created hot spot and upon order in the decontamination of the response and protection equipment and vehicles.
- responds in order to limit and eliminate the adverse effect of the emergency on the environment.

Emergencies that involve response are: technical accidents that result in releases of toxic gases; spill of dangerous or combustible chemical substances; fires or explosions followed by massive exhaust gas and smoke releases, collapse of buildings, facilities or plants; earthquakes followed by release of dangerous chemical substances.

The response involves: removal of dangerous substances from the area, depollution and decontamination of the area in case spills of dangerous products occurred (clean up spills); clean up dangerous substances from storm water ditches, use neutralizing substances. The response effort is carried out with the employees of the sector where the event occurs.

The team also is prepared to carry out the following activities:
- land and building decontamination in the area where the response team carries out the action;
- decontamination of personnel, equipment, vehicles, machinery, facilities, etc;
- qualitative and quantitative analysis of contaminated samples;
- Carry out chemical and radiation investigation on land, buildings, etc.

Depending on the situations and orders received, it may carry out other missions such as:
- participate in rescue actions, first aid and transport of injured, supply water, food or other goods required in the affected area;

The sector where the action is carried out may be left only when the mission is completed and the team was not given other orders or when personnel security is directly threatened and there is no other solution.

Once the alarm stops, the investigation team members will put the protection and detection equipment away in the response cabinet and will write the response report.

b) Duties of investigation – observation team

Upon commencement of emergency, the investigation team is mobilized and available to the emergency cell. Upon order, the investigation team equipped with individual safety equipment and devices goes to the emergency site where they undertake specific duties to measure the contaminants.
- Investigates the affected area to establish the emergency impact limits (air, soil, water analysis to determine pollutant concentrations, etc).
- Investigates the area adjacent to the affected site to establish any likely impact in these areas. On conducting measurements in areas adjacent to affected site, the response vehicle is normally used.
- Conducts pollutant measurements to establish the area posing intoxication, fire or explosion hazard;
- Conducts analytical tests in case of leaks in the sewage system.
The investigation team members make observations, measurements, assessments until the hazard is gone and advise the response leader and emergency cell, by all means possible, of the progress of the events and created situations.

The sector where the action is carried out may be left only when the mission is completed and the team was not given other orders or when personnel security is directly threatened and there is no other solution.

Once the chemical alarm stops, the investigation team members will put away in the response cabinet the protection and detection equipment and will write the response report.

e) Duties of paramedics team

The paramedics team will be available on site to respond to emergencies involving injuries, sickness or death of employees, visitors or contractors that are on site.

In case of alarm, the paramedics are mobilized and upon instruction from the emergency cell, organize the first aid center outside the area affected by the emergency. They will take action according to the instructions given by the action leader.

- put the safety equipment on and go to the emergency site equipped with first aid and rescue equipment (stretcher, first aid kit) in order to take over any likely injured people;
- organizes and sets up locations for gathering up injured and intoxicated people (outside the toxic area);
- takes over injured people from the rescue teams and gives first aid until they are passed on to the medical stuff;
- transports the injured people to the first aid center, gives first aid where necessary;
- transports the injured people to the meeting point with the rescue team;
- ensures, where necessary, transport of the more severely injured people (requiring specialized treatment) to the health clinic or hospital;
- gives first aid to the injured people until doctor’s arrival;
- upon order from the action leader and depending on the equipment available, participates in the search for injured people;
- upon order from the emergency cell goes outside the site to give first aid to potential injured people;
- once alarms stops the team leader checks the equipment and writes a response report.
- reports the existing situation to the action leader and asks for help in case the number of injured people is high.

Depending on the situation and orders received they may also undertake other missions or activities in the affected area, i.e.
- participate in providing food, water and medication;
- participate in removal of the consequences of the disasters and rehabilitation of the area;
- help in taking samples from the contaminated area;
- participate in the limitation and elimination of the created hot spot and upon order in the decontamination of the response and protection equipment and vehicles and in establishing the usage conditions of the products in the contaminated area.

Once the alarm stops, the materials used are put away in the response storage and any problems encountered during the alarm are reported.

b) Duties of telecommunication – alarm team

The telecommunication - alarm team is meant to develop, operate and maintain operational the telecommunication and alarm systems in order to notify and alarm the population.

Acts within the response unit fulfilling the following missions:
- ensures communication with the response team and private emergency division taking measures to protect the forces, equipment and connections;
- undertakes telecommunications investigation;
- takes from the regional telecommunications systems the means, ways and lines planned to be included in own telecommunication system;
- ensures priority receipt and transmission of signals notifying and alarming the employees and population from adjacent areas regarding the imminence of occurrence of emergencies on site using the existing alarm system or other means that are available;
- upon order, gets the alarm signals on site and notifies the neighboring residents and businesses;
- fixes the telecommunication and alarm systems should they be damaged as a result of air attacks, calamities and catastrophes;
- Maintains and repairs the alarm – telecommunication equipment and ensures correct operation of the same.

g) Duties of logistics team
The logistics team has the following main missions:
- supply food to the response team;
- supply spare equipment in summer or winter;
- provide transportation for injured people;
- ensure supplies to the response units;
- provide additional equipment as needed to the response units;

In addition to the above mentioned activities and subject to the concrete situation on site, all teams will undertake other activities depending on the nature of the events and dynamics over time of the events.

h) Dispatcher`s duties
Centralizes the information on emergencies or which require setting off the alarm within the company's site. Where required, he notifies and mobilizes the emergency cell and, in all shifts, takes over the duties of the general headquarters until the arrival on site of its members.
Points out any special hazardous situations occurred which involve chemical alarm and writes them down in the job report. On receipt of the notification about emissions or spills of dangerous substances or emergencies he asks by phone and writes down in record book the following:
- Name of released substance or dangerous event;
- Size of emergency, quantity of substance stored in the facility, tanks on the failed route, TMF, etc.
- the place with exact location of the substance release / spill source (chemical hot spot) and identification of the toxic source, fire or explosion;
- causes of the release or accident (if known);
- name, position and workplace of the person who does the notification.

Until the arrival of the emergency cell members he alarms, mobilizes and coordinates the activity of all response teams set up at company level.
He informs the emergency cell leader or deputy of the same about the occurred situation, urgent measures taken and ensures they are brought over.
He carefully analyses the situation occurred, decides if it’s necessary to set off the alarm and determines the type of alarm (local or general). In support of his decision he will take into consideration:
- Exact location of the hot spot and toxic source;
- Amount of substance present in the failed facility;
- Amount of discharged substance (approximately);
- Propagation direction of toxic cloud or pollution wave;
- Facilities affected or which may be affected subject to distance and location.

Keeps in touch by any means with the response teams in order to learn the status of the emergency limitation and elimination.
Determines the sectors on site, adjacent facilities and towns that may be affected and alarms them directly and/or via civil protection bodies in order to take the required measures according to the company’s internal emergency plan.

Ensures that the affected site is marked up and access is restricted.

Alarms the security personnel and through the security posts orders that access in the affected area be restricted (available only for response personnel equipped with adequate safety equipment) as well as traffic on the roads outside the site located in the affected or likely to be affected area.

In case of expansion of products that generate fire or explosion hazard instructs the local headquarters to:
- immediately turn off all fire sources;
- cut the electricity supply to the machinery in the area;
- stop the vehicles that drive in the area;
- rapid evacuation of personnel towards the assembly locations.

In case of severe failures, when delays in the remediation of the emergency with own means are anticipated, he may give instructions:
- for the intervention of Fire Brigade on site;
- Partial or total shutdown of facilities;
- informs the Inspectorate for Emergency Situations of the occurred situation and as required asks for their help.

Ensures mobilization of all available company vehicles and via the Sanitary Department asks for additional vehicles in order to transport the injured people to medical units and via the Inspectorate for Emergency Situations the evacuation of personnel to shelter areas.

If required, he asks the local headquarters from unaffected areas to provide additional response forces in the hotspot.

According to the order of the emergency cell leader, once the emergency is remediated he announces the cessation of the alert state and return of personnel to the workplaces to continue their activities.

Upon cessation of the alarm state, he prepares an activity report describing the dangerous event that generated the chemical alarm and all the actions and interventions completed until the state of hazard was eliminated.

2.5. Duties of technological response team

The technological response teams are set up by work units and/or fabrication stages from the personnel on duty by care of the site manager.

Each person selected as member of the response team will get familiar with the provisions and duties outlined in the alarm plan.

Participation in response teams is mandatory for each appointed employee.

In case of chemical alarm, the technological response teams continue to supervise the operation of the facilities and shuts them down according to the operating instructions and orders of the incident leader.

The technological team members must know in detail the technological equipment they operate, the actions required in case of emergency and the correct order for partial or total shutdown of the equipment.

The technological response team members must know in detail, from a construction and use perspective, the protection and response means the section is equipped with and be familiar with the use of the individual rescue equipment and individual safety equipment.

The technological team members must participate in chemical alarm exercises and be aware of the correct way to act in case of alarm.

Where failure occurs in another activity sector, the technological response teams ensure that the equipment is kept operational or shuts it down partially or fully, according to the instructions received.
Where failure occurs in their own activity sector, the technological response teams, in cooperation with the special response teams, led by the local headquarters will undertake the following operations:
- Isolate the dangerous source by closing valves, blinding off or even shutdown equipment;
- Drain the failed equipment, machinery, pipeline or tank;
- Cut off electricity (by pressing the switches, removing fuses, inter-blocking, etc);
- Remediate failures.

The team members will be in permanent contact with the section, shift or unit supervisor reporting any abnormality occurred.

The sector is left only in extreme cases when personal safety is directly threatened and only after the duties outlined in the alarm plan are fulfilled. The technological response teams will not leave the impact area for reasons of fear, panic, etc.

After total shutdown of the equipment and after having ensured the safety of the equipment, upon the incident leader’s instructions they leave the area to go to the specified assembly place or, according to the instructions, to participate in supporting the other teams that deal with the alarm.

Once the alarm state stops, they will put away in the response cabinet all the equipment and resources used and will write the response report.

2.6. Duties of special response team

The special response team is formed of the specialized assistance, service and maintenance personnel on site.

The team will take action according to the instructions given by the emergency cell leader, in situations involving fire and/or explosions, accidents involving dangerous chemical substances, overflow or spill of dangerous substances, materials or wastes.

The special response team may take action together with the other response units or independently in all types of emergencies that may occur on site.

In case of alarm, the response team takes action to isolate, limit and remediate the failure.

All through the response action, they will keep in permanent contact with the emergency cell, reporting on the progress of the response, approximate duration of response action, difficulties encountered and, where required, will request additional resources and equipment.

The team members must advise, through all means possible, if they found injured or intoxicated people along the route towards the hotspot or in the incident hotspot area.

Response actions for failure remediation are undertaken in cooperation with the other response teams and operations personnel at the emergency site.

Prior to the actual response action, they carefully check the hotspot area and subject to the size of the emergency and way of cooperation with the response teams take the following measures:
- Isolate the dangerous source by employing specific measures or even shutdown the facility that generated the incident;
- Deactivate the equipment which if operational may create a dangerous situation;
- Provide materials, tools or support devices for prompt response;
- Stop the vehicle traffic in the area in case of release of flammable or explosive products;
- Cut off electricity (by pressing the switches, removing fuses, inter-blocking, etc);
- Turn off the fire sources;
- For sources located in closed spaces, either natural ventilation is ensured (by opening doors or windows) or mechanical ventilation but the latter only if they are sure it is adequate and does not generate a bigger hazard;
- Response by using neutralizing substances or water, if they are close to the hotspot and if they can easily be brought over to the emergency site.
When carrying out response actions in the hotspot, the health and safety standards will be strictly complied with, by:
- Using adequate tools (anti-explosion, properly wedged and kept in easy to transport kits);
- Using only strong ladders and well anchored life lines when working at heights;
- Wearing and correctly using the individual safety equipment which will be well tightened around the body;
- Avoid blocking access ways.

The completion of the response will be reported to the emergency cell and based on its instructions response actions will be carried out in other sectors too.

The place where the action is carried out may be left only when the failure is remediated and the team was not given other orders or when personnel security is directly threatened and there is no other solution.
2.7. Security personnel

Duties

Security personnel should be familiar with the organization of the company and alarm and notification methods in case of emergency.

They should participate in theoretical and practical training organized by the company and in alarm exercises and should learn the correct actions to be taken in case of emergency.

Depending on the specifics of the situations described in the Plan, notification should be sent to the site manager, company’s executives, section, workshop, warehouse supervisors as well as special units (FPE unit, health and safety unit, mechanics and electricians on duty, Police, rangers, Fire Brigade, ambulance service, civil protection) and other institutions or forces depending on their competence in relation to the event.

All activities related to security, supervision and protection of the facility, goods and assets will be managed by the site manager in joint agreement with the relevant company's executive personnel.

To achieve management and cooperation with the bodies, forces and institutions involved in security of facilities, goods and assets, emergency response and public order in special situations, the site manager will use company’s own security, surveillance, communication and alarm equipment, in joint agreement with the company’s executives.

Activities

In case of occurrence of emergency situations takes action to:

- Secure the site and prevent people from entering the affected area (except for the response personnel);
- If need be, they may participate in evacuation of people, goods and assets as well as in ensuring their security;
- Manage traffic on the roads outside the site or forbid access of vehicles on these roads by installing barriers and providing security (except for response vehicles);
- Clear the internal roads and access ways or create passages, depending on the situation;
- Assist in the transport of injured, rescue of material assets or human life, normally outside the impact area of the toxic cloud;
- Reports through any means of communication possible, any special problems occurred during the alarm;
- Withdraw of personnel is done in case personal safety is directly at risk and there is no other way, informing to this effect through any means of communication possible; Withdrawal is done by any means of transport possible towards the established refuge area;
- Once the alarm stops, the way in which the mission was fulfilled and any problems encountered during the alarm should be reported.

2.8. Individual persons not included in the emergency management system

Duties

By individual person is meant any person who entered the company’s site and who in case of chemical alarm is found in a dangerous area, is exposed to toxic factors and does not participate directly in the alarm plan actions.

The persons caught by the incident on site and who do not carry out response activities specific for the situation shall have the following obligations:

- Any person entering the site should be informed of the risk they expose themselves to and of the actions to be taken in case of chemical alarm; Information is done by:
  - Brief training upon entering for external people, delegates, etc;
  - General introductory training at the health and safety office for students or personnel of companies providing services or doing works on site;
Specific training at the workplace for the other people within the company.
- Any individual person must recognize the chemical alarm signal and the way in which the assembly places are marked and located.

**Activities**

The following steps will be taken in alarm situations that involve sound alarm signal
- The local or general chemical alarm signal is carefully listened to and the alarm type is identified;
- They go towards the nearest assembly place (away from affected or dangerous areas), where people are already gathering;
- The instructions and orders of the assembly place manager is listened to and complied with and/or evacuation is done towards areas indicated by the assembly place manager;
- The personnel of other companies carrying out works within S.C. Rosia Montana Gold Corporation S.A. site based on service contracts and other categories of people who are temporarily on site (delegates, students, visitors, etc) group up and follow the instructions of the Emergency Unit from the sector they are in;
- In case of toxic emissions, the predominant wind direction and the direction from which the toxic hazard comes from should be determined (according to the orientation of the wind flags, vapor, smoke direction, etc);
- Put the gas mask on and walk perpendicular to the wind direction towards the nearest assembly place;
- Personnel caught by the toxic cloud without mask will try to get out of the affected area, walking and taking slower breaths;
- Do not run or leave the area towards unknown directions.

2.9. Specific duties of contractors carrying out activities on site

Any sub-contractor carrying out activities inside or around the site who sees or is warned of an emergency situation will have to act immediately.

The first action to be taken is to notify the dispatcher by using any means of communication possible. Then, the person in question will notify his/her direct boss.

Personnel onsite should:
- Remain at the workplace until instructed by way of a communication or alarm system;
- Not get near the area affected by the emergency unless instructed clearly in this sense;
- Prepare and evacuate the area and follow the evacuation procedure;
- Be prepared to support the efforts of the others upon request by the action leader or other response personnel.

The contract relationships with service providers are described in contracts meant to achieve the safety targets in all construction phases and then during operation.

2.10. Specific duties of other departments

**a) Security department**

The security department has the most important role in emergencies that occur on site. The main duties of the department are:
- Receive all emergency calls, direct phone or radio calls;
- Ensure informational flow and data required by the emergency coordinator to make decisions;
- Participate in delineation, marking and isolation of contaminated site - gates, doors are closed, temporary barriers are fitted, lights are flashing, temporary post signs are installed, etc;
- People that are inside the safety area will be informed of the emergency and moved to a safe location;
People responsible for site safety will control traffic in affected area according to the instructions received from the emergency coordinator or incident leader; All persons that passed through the affected area will be recorded in a log;

- Measures are taken to strengthen site security, organize control, access, coordination and people and vehicle evacuation points; Traffic is managed through these points, giving priority to the response vehicles and equipment;

- Safety personnel will help with the evacuation and control the crowd of people in order to maintain order.

- Personnel will escort the representatives of the institutions and authorities in their visit on the site where emergency occurred.

a) Maintenance department

Maintenance department may play an important role in emergencies. Specific duties include:

- Shutdown the equipment and utilities on site, if required;

- Maintenance department has the means of localization, access and protection of all control equipment for utilities such as gas, water and electricity; Prepares and updates on permanent basis the pipeline maps or flowsheets to ensure utilities and work flow and locate control equipment;

- Communicates with utility providers;

- Emergencies causing power failures, broken power lines, damaged sewage or water pipes will be immediately reported to the supplying company by the maintenance department;

- Maintenance department prepares and updates the list of utility suppliers, contact persons and details of the same;

- Inspects / approves the occupation of the buildings with resources available (technical equipment and specialists), ensures technical review on buildings and structures, conducts measurements and works required to safely occupy the buildings;

- Ensures additional utilities / facilities. Maintenance department will determine alternative solutions to ensure utilities required on site; various resources will be provided to support the needs of the personnel and those involved during an emergency;

  - auxiliary gensets;
  - gas for emergencies and water reserves;
  - telecommunications / video / fax;
  - response and protection equipment;
  - decontamination, depollution and neutralization solutions and substances
  - rest facilities and food;
  - lighting, torches;

- Supporting production. Maintenance department will help with re-establishing production operations fixing problems related to electrical power, ventilation, gas, water, communication, cranes, walls, roofs, lighting, flooring, channels or windows. Support given to external contractors may help with resuming production;

- Protect the area to keep all unauthorized personnel outside the affected area and isolate dangers or hazards; Access on site will be allowed only to maintenance and response personnel;

- Construction according to requirements; Will provide construction services according to the instructions of the emergency coordinator or action leader and depending on available materials;

- Identifies repair resources, i.e.

  ▪ Determines equipment, materials, personnel and actions required to fully reestablish the operational state of the affected areas;

  ▪ Thoroughly reviews the available equipment, materials and personnel and determines additional resources required to complete their duties;

  ▪ By coordinating with internal departments and external contractors they may also determine availability of external resources;
- Repairs:
  - The department will coordinate the action plans together with the emergency coordinator and will initiate the required salvage actions;
  - Provide ancillary utilities (air, electricity and lighting);
  - Manage subcontractors, material resources and operations by liaising with maintenance department, other departments and external equipment and service providers;
  - Repairs will be managed by controlling methods, personnel, resources, approach and time required to repair equipment or facilities.

c) Operations - process department
This department may play an important role in emergencies and has the following specific duties:
- Shutdown operations (according to re-established shutdown procedures);
- Ensure additional emergency response equipment;
- Bring to normal operating parameters the treatment plant, TMF and other facilities, according to pre-established procedures;
- Undertakes and coordinates clean-up activities.

a) Environmental department
The environmental department shall have the following specific duties:
- Assist the emergency coordinator in determining the nature and cause of the incident:
  - The department will evaluate the nature and causes of the emergency and its ramifications and will determine the range of consequences potentially damaging to human life and environment with focus on preventing damaging consequences;
  - Will take immediate action to mitigate existing adverse impacts and will design control strategies and tactics to prevent and mitigate the risk for future environmental consequences;
- Ensure immediate technical support on site:
  - Will ensure technical review and interpretation of available information for the emergency coordinator and action leader in identifying the problem and will assist the emergency response team in preparing an efficient answer;
  - Will provide the communications coordinator with the interpretation of the information for the management of the situation, preparation of press releases or other communication-related activities.
- Notification of emergencies:
  - Will immediately notify RMGC’s manager should events requiring reporting occur;
  - Release of dangerous wastes that exceed the established maximum permissible concentrations (MPC) requires notification of relevant authorities (external notification). The environmental department will initiate and lead this notification procedure. This communication with the agencies will be documented in the Notification Report;
  - Will liaise with the local Environmental Agencies to prove that the situation is managed according to law provisions;
- Take environmental samples and ensures analytical evaluation of the results of the laboratory analyses, i.e.
  - Will manage the collection of samples from materials that may be dangerous for human health and/or environment;
  - The basic analysis of the samples will be conducted through authorized laboratories. Will ensure transport of samples to the laboratory and will be responsible for quality assurance and control;
  - Information received on the results of initial analysis and subsequent laboratory analysis will be used to determine the suitable control measures and corrective actions.

3. Declaration of emergency situation and implementation of alert state
3.1. Declaration of emergency situation

During the emergency situations or states that are likely to generate emergency situations actions and measures are undertaken under the law for the declaration of the emergency situation in case of immediate threat or occurrence of the emergency situation.

The leader of the emergency cell on site has the authority to declare the emergency situation. The structure that implements the specific emergency measures on site includes:
- Person who reports the occurrence of an emergency;
- Shift supervisor who receives the information, checks it and forwards it to the dispatcher;
- Response teams leader who rates the emergency and leads the response teams (action leader);
- Emergency cell leader who makes the decision to declare emergency situation and decides on transmitting the alarm message.

The events requiring a decision to declare emergency situation are:
- Occurrence of a technological accident which results in release of dangerous substances to air, soil or water;
- Action of unauthorized persons which results in impacts similar to the occurrence of a technological accident;
- Receipt of a notification on the proximity of occurrence of a terrorist attack or air attack (war situation) or its occurrence;
- Extreme weather events or natural disasters with effects that are likely to generate a technological accident;
- Earthquake with effects that are likely to generate a technological accident;
- Any other events with effects that are likely to generate a technological accident.

3.2. Declaration and institution of alert state

Alert state is declared according to Emergency Ordinance No. 21/2004 and refers to immediate implementation of the prevention actions and measures plan, warning of population, limitation and removal of the consequences of the emergency situation. Under art. 53 of the Constitution of Romania, republished, during the alert state there may be implemented measures to restrict some fundamental rights or liberties regarding free circulation, inviolability of residence, forced labor banning, private property right or social labor protection right, that are in close causality relationship with the occurred situation and specific management methods of the same.

The measures to restrict some rights or liberties should be proportionate to the situations that generated the measures and should be applied in compliance with the conditions and limits provided by the law.

The leader of the emergency cell on site has the authority to declare the alert state.

Declaration of alert state at local level (within the administrative – territorial unit) shall be done by the Local Committee for Emergency Situations, with the prefect’s approval, and at county level or in several localities of the county by the County Committee for Emergency Situations with the approval of the Minister of Administration and Internal Affairs. Accordingly, the County Committee for Emergency Situations is competent to propose the implementation of the emergency state.

The emergency state is the ensemble of measures of political, economic, social nature and of public origin, instituted in the entire country or in certain areas or administrative – territorial units in the following situations:
  a) presence of threats to national safety or constitutional democracy which requires protection of the democratic institutions and maintenance or reestablishment of the legality state;
  b) imminence of or occurrence of disasters requiring prevention, limitation and removal of their effects.
The emergency state shall be instituted by the President of Romania by decree, countersigned by the prime-minister and published in the Official Gazette of Romania.

3.3. Cessation of alert state

The alert state shall cease once the causes of occurrence and effects of the emergency situation are removed throughout the site and adjacent areas. In case the alarm was issued by the Inspectorate for Emergency Situations within the general alarm, the alert state cessation signal given by the Inspectorate is awaited and then the emergency cell on site will order cessation of the situation, provided the situation on site has returned to normal.

After cessation of alert state, the emergency cell leader will order, through all means of information possible, the return of personnel to workplaces.

Since during the emergency situation the response teams will only carry out emergency response works, after the emergency state is lifted, definitive remediation works will be undertaken, i.e.

- Cleanup spill wastes;
- Decontaminate areas affected by toxic products;
- Repair constructions and equipment damaged during the accident;
- Service the safety equipment and response machinery;
- Fill up the response material stock: neutralization products, tailings bags, pipes, medical materials, etc according to the standards;
- Neutralize and/or destroy dangerous wastes resulting after the accident;
- Decontaminate soil affected by accident.

After cessation of alert state, each leader of participating units will prepare a detailed report on completed activity. Based on these reports and subject to the emergency degree, the emergency leader on site will decide on the final format of the notification to be sent to the authorities.

4. Information – alarm - notification

The notification – alarm system includes all forces and resources belonging to the Project operator.

The notification – alarm system is organized at two independent levels, as follows:

- First level is the risk source Project operator;
- Second level is organized and controlled by the County Inspectorate for Emergency Situations.

In case of occurrence of an event of whose effects may exceed the Project boundaries, the company must notify the local Environmental Protection Authority and Civil Protection Authority within the County Inspectorate for Emergency Situations which, subject to the severity of the situation and required measures, notifies the local committees for emergency situations and alarms the local population that is likely to be affected.

The authorities and population will be notified and alarmed by:

- acoustic means: electronic, electric sirens, acoustic signals;
- radio means: fixed and portable radios;
- telephone, fax lines and email;
- other means.

In case of special events, notifications are doubled through mass-media. It is important that the population and employees to apply prevention and safety measures and comply with the behavior rules and restrictions laid down by the authorities in such situations.

Notification - alarm diagram is presented in Figure 5.2:

Figure 5.2. Notification - alarm diagram at S.C. Rosia Montana Gold Corporation S.A.
Upon occurrence of an emergency (accident or failure / incident likely to generate an accident) the emergency cell leader orders that the emergency authorities be notified within maximum 2 hours of the occurrence.

- County Environmental Protection Agency;
- Alba County Inspectorate for Emergency Situations;
- Alba County Office of the National Environmental Guard.

The telephone notification will be complemented by a written notification. The contents of the notification and information sent will be according to Appendix No. 2.1 and MAI Order 1084/2003. Successive reports and notifications will be sent during the course of the events.

Where there are victims following the accident the information and notification will also be sent to the Regional Labor Inspectorate (RLI).

In case of occurrence of a major accident, the emergency cell leader immediately informs and notifies (according to the alarm – notification diagram) of the occurrence the territorial public authorities with responsibilities in terms of civil protection, environmental protection, labor safety, public administration and health, in accordance with MAPAM Order 1084 / 2003.
4.1. Alarm by emergency classes

Subject to the severity class, alarm is done as follows:

- Alarm in case of **class A** emergency – being a low severity emergency it shall be limited to notification / alarm of the emergency cell, security department and private emergency unit. Where the emergency is not immediately eliminated based on own resources, the emergency is rated into class B.

- Alarm in case of **class B** emergency – being a higher severity emergency which may have limited effects (reduced and on small distances) outside the site, it involves mobilization of the Emergency Cell, alarming and bringing additional personnel within PED on site and notification / alarm of external emergency centers, i.e.
  - Public Emergency Service: Phone No: 112
  - Alba County Inspectorate for Emergency Situations – “Unirea”;
  - Alba Environmental Protection Agency;
  - Alba County Office of the National Environmental Guard;
  - Alba Regional Labor Inspectorate (if there are victims);
  - neighboring businesses and population, personnel that is occasionally in the area;

  The alarm message is sent by phone. Subject to the emergency location and outside effects, the neighboring businesses and population as well as the relevant municipalities are alarmed.
  Where there is a risk for polluting watercourses the Water Management Authority is alarmed.
  The neighboring population and businesses shall be alarmed by acoustic signals along with the personnel on site and by phone.

- Alarm in case of **class C** emergency – being an extreme severity emergency that may severely impact a large area outside the site, in addition to the alarm / notification of class A and B it also involves alarm / notification of the:
  - Alba County Prefecture;
  - Municipalities of affected localities;
  - Alba Public Health Authority.

Subject to the created situation, decision is made for additional response teams.
The alarm message shall be sent by the emergency cell leader by phone and shall mandatory include: place, time of occurrence and extent of the event, nature and quantity of hazardous substance and other data useful to ensure protection.

5. Action procedures by emergency classes

5.1. **Class A emergencies**

No acoustic alarm signals are used outside the site.
Emergencies that involve small areas onsite which pose no effects outside the site and may be remediated in a short time by company’s own resources (class A emergencies), require only alarm of the response team and reporting the incident.
The workplace personnel notifies the shift supervisor and takes the first technical measures specific to each workplace in case of emergency.
The response team goes to the emergency event site (fire, fuel spill), removes the causes and effects of the event using first response means. At the same time, the Fire Brigade is alerted.
Subject to the progress of the events, the supervisor of the sector where the emergency is located goes to the emergency place to coordinate the response actions, communicate additional data and if required ask for additional forces to complete the response action.

The occurred events and measures taken are reported to the emergency cell leader.

5.2. Class B emergencies

Acoustic alarm signals are used, i.e. 3 x 5 seconds short signals with 5 second breaks in between.

For emergencies that have impact on larger areas inside the site and cannot be remediated immediately using company's own resources (class B emergencies), the emergency cell is mobilized and the public emergency services 112 are called.

The workplace personnel notifies the shift supervisor and takes the first technical measures specific to each workplace in case of failure or accident.

The sector supervisor goes to the accident place, rates the emergency and subject to the situation asks for mobilization of special response, rescue, investigation and medical teams. If required, the external emergency service 112 is called. In obviously severe cases (when the sector supervisor is not present), in order not to lose time, these actions may be undertaken by the shift supervisor and then confirmed by the sector supervisor once he arrives on site.

The response teams go to the event place and initiate actions to remove the emergency.

Paramedics go to the incident place to evacuate and rescue injured and give first aid.

Access control team goes to the site gates to allow evacuation, restrict access and route the external response teams.

Personnel not participating in the emergency management will be evacuated. Personnel moves around in order, on the established evacuation ways.

Emergency Cell is mobilized. Under the coordination of the sector supervisor, the teams present eliminate the accident causes and effects and once he arrives, the management of the response action is taken over by the incident leader.

Subject to the nature of the emergency decision is made on implementing class B alarm signal, neighboring population and businesses are alarmed, the relevant emergency authorities are notified and alarmed according to the alarm diagram.

5.3. Class C emergencies

Acoustic signals are used, i.e. 5 x 16 seconds long signals with 5 seconds breaks in-between for 2 minutes.

Emergencies that get worse, may cover extended areas posing impact outside the site and/or show dangerous developments (class C emergencies) require alarming of the relevant emergency authorities, Regional Labor Inspectorate (if there are victims), neighboring businesses and population and local public authorities.

Under the management of the shift supervisor, actions are taken to evacuate personnel and assets from the area affected by the emergency. Where possible, urgent first measures are taken to shutdown and make safe the facilities and limit the accident impact. External emergency service 112 is called.

Emergency Cell is mobilized and arrives at the accident site as soon as possible. Response teams throughout the site are mobilized. The response team members take specific measures in case of fire or failure throughout the site.

After having established the parameters of the failure and rated the emergency, neighboring population and businesses are alarmed.

The neighboring businesses and population are alarmed by phone or via an agent.

The relevant emergency and local public authorities are informed and notified according to the alarm – notification diagram.

Personnel who don't participate in the management of the emergency shall leave the site immediately, according to the evacuation plans.
6. Specific response procedures

6.1. In case of hazardous substance spills

In case of hazardous substance spills the following measures will be taken:
- Isolate and stop or reduce the flow of hazardous substances by closing valves, blinding off or even shutting down pumps or the entire facility;
- Where required, when the flow of hazardous substance could not be stopped or when the presence of hazardous substance in the failed facility, plant, pipeline or tank creates a further hazard state, the same will be drained in a controlled manner into spare plants, containment bunds, emergency pond, containment zone;
- In case of hydrochloric acid spill care is taken for the acid not to reach the cyanide areas, i.e. CIL tank drainage channels and bunds, cyanide pumps area;
- Where toxic discharges occur following the spill, the response actions will be undertaken on the side opposite to the toxic cloud and by employing additional safety equipment, i.e. gas and insulating masks;
- The investigation team conducts pollutant measurements to determine the pollution level and limits of affected sector;
- The rescue team searches the emergency site, removes any likely injured people, gives first aid until the arrival of the specialized team (first aid team) or ambulance. Where required, the rescue team ensures transport of injured people to the first aid point or ambulance meeting point.
- Once spill is stopped, the affected area will be cleaned up by collecting the spills in designated containers and decontaminated with neutralizing substances until the concentration of the spilled hazardous substances goes down below maximum permissible limits. Collected spill will be transported and stored temporarily under safe environmental conditions in order to salvage or, as the case may be, neutralize or destroy the polluting substances;
- The investigation team measures the pollutants until the environmental parameters return to normal values;
- After the response action is completed, each team will write a report and submit it with the Emergency Cell.

6.2 In case of TMF dam breach development

In case of TMF dam breach development it is supposed according to the System for monitoring the performance of the construction (MPC) that the alert state is on. Where the alert state is on, the emergency cell takes the following measures:
- Intensifies the monitoring of the dam operating parameters and of the weather conditions;
- Cuts off TMF slurry supply;
- Pumps at maximum capacity the decant water to the wastewater treatment plant;
- Mobilizes additional response resources on site: tailing bags, filling material, drainage pipes, machinery i.e. excavators, cranes, loaders, bulldozers, pumps, etc.
- Supplements the machinery fuel stock;
- Ensures additional night lighting on dam crest;
- Ensures permanent observation points;
- Checks on the condition of the containment area, spillway and discharge pipes;
- Supplements and organizes the response teams, has them on site and working after-hours.
- Alarms population and local public authorities;
- Alarms the Alba Inspectorate for Emergency Situations, Alba Environmental Protection Agency and Alba Water Management Authority;
- Upon order of the Emergency Cell, the failure remediation is initiated (close the breach, for instance by installing controlled discharge pipes, rockfill and tailing bags sealing);
- After the breach is fully filled (up to dam crest) grading with fill material and compacting by bulldozer are undertaken;
- After breach is closed and hazard mitigated, the discharge pipes are turned off;
- During the entire breach closing effort, the dam surface is carefully monitored to detect any likely spills or anomalies in the dam behavior;
- Additional TMF monitoring and permanent presence of the response teams continues until the alert state is off;
- During the emergency and until full removal of its effects, the Emergency Cell organizes monitoring of soil, water table and surface water quality in order to establish the pollution level and footprint of the affected area. In cooperation with the authorities monitoring measures will also be taken outside the site;
- In cooperation with the local authorities, the population will be informed of the hazards present in the area;
- The emergency stops after the alert state is off. After the alert state is off and as the hazard degree goes down, the number of mobilized personnel is reduced;
- After the emergency situation stops, the Emergency Cell notifies the relevant authorities and demobilizes the teams.

6.3 In case of occurrence and release of hydrocyanic acid

a) Releases of hydrocyanic acid by accidental reaction of hydrochloric spills with cyanide
The person who detects a release of hydrocyanic acid will notify through any means available the shift supervisor and personnel present in the area in order to leave the hazardous area. When walking away from the release source (hotspot) wind should be blowing in front or sideways.

The shift supervisor mobilizes the response team members who quickly undertake the following operations:
- Put on with safety equipment (gas, insulating mask);
- Where people are affected (gassed), they will be immediately removed from the area and given antidote. The emergency services are notified for specialist treatment;
- Stop the flow of acid to the extent possible; Typically the acid generates emissions while cyanide solutions may be present in small quantities in open areas, i.e. CIL tank drainage channels and bunds, cyanide pumps area;
- Take action in the hotspot equipped with safety equipment (gas mask, insulating mask) with neutralizing substances, i.e. lime powder, milk of lime or other alkaline substances. The rapid reaction with hydrochloric acid and alakalinization of the area will stop the toxic release;
- People who carry out this action will be carefully monitored and if need be they will be quickly removed from the toxic area.

Notes: In such cases the success of the action depends largely on the rapidity of the response and on keeping one's calm and sense. Personnel selected for hotspot response should have these traits.

Where there are suspicions that areas outside the site may be affected, the people present go away and area is isolated.

After the release is neutralized and stopped, the area is ventilated (if it’s indoors), the pollutant concentration is measured and provided the concentration dropped below dangerous limits clean-up and detoxification is initiated.

b) Massive releases of hydrocyanic acid by reaction of hydrochloric acid with cyanide
Massive hydrocyanic releases may occur if large quantities of hydrochloric acid come in contact with cyanide. As shown, this may occur in case of terrorist or air attack. It is assumed that in this case the company and local population was alarmed by the personnel on site including by setting off chemical alarm signals or/and by the local authorities. Emergency is rated as class C and the alarm signals will correspond to this class.

In this situation, the following actions are taken:
- The Emergency Cell and the response teams that were not present on site when the emergency occurred (in reduced number as some of the people may be affected by the toxic emission) are mobilized. It is possible that movement around the site not to be possible because of the toxic cloud. In this case, assembly will take place in a location mutually agreed with the local authorities, in an area away from the hazard (located on the side opposite to the movement direction of the toxic gas cloud).

- The Emergency Cell establishes the potential accident parameters and forwards the following data to the authorities:
  - Number of personnel present on site at the time of the accident;
  - Exact location of the chemical hotspot;
  - Total amount of cyanide and hydrochloric acid present on site;
  - Amount of discharged toxic gas (approximately) and concentration;
  - Toxic cloud propagation direction and speed;
  - Amount and nature of required neutralization substances as well as their location on site;

- If possible, the response team members participate in the response action together with the specialized teams. The latter know best the situation on site.

It is assumed that the personnel present on site will be seriously affected by the toxic emission. Depending on weather conditions and toxic cloud movement direction, it is likely that some of the personnel will not be affected. i.e. in case of constant wind from a set direction, the personnel caught on the side opposite to the toxic cloud movement direction. The action taken by the people on site that are not affected by the toxic cloud to rescue the injured and undertake first response measures are essential to mitigate the effects of the accident. Making the entire personnel of the company aware about the way of acting in such situations is important.

Personnel on site, not affected by the effects of the accident, will:
- Put the gas mask on, or if possible the insulating mask, and remove the injured from the affected area, giving first aid;
- Contact the Emergency Cell and emergency services (tel. 112) and communicate data on the occurred accident, existing situation and measures taken;
- Will take action in the affected area by spreading neutralizing substances: lime powder, milk of lime or other alkaline substances;
- As new data is identified, it will be communicated to the Emergency Cell and authorities;
- Personnel caught inside buildings, if not sure that the outside area is not affected by the toxic cloud, will start sealing off the inside using any means available: cloths, towels, scotch tape, etc. If possible, will look at the outside situation, contact the authorities, communicate available data and await their instructions.

6.4. In case of combustible fluid leaks

Combustible fluid leaks are elements of emergency scenarios because they constitute vulnerable areas for fires and explosions, are dangerous for the environment since they pollute the soil and particularly the waters; if they get in the sewage system they are sources of VOC (Volatile Organic Compounds).

In case of combustible fluid spills measures are taken to stop their feed by:
- Isolating and draining the broken pipeline sections;
- Stopping, isolating and repairing the failed pumps, equipment and pipelines;
- Draining the broken tanks or reservoirs;
- Replacing the broken seals, hoses and valves.

Minor spills are remediated by absorption in sand or special absorbent materials with the formed mixture being stored and destroyed by incineration in authorized facilities.

In case of larger spills, the area is isolated by constructing berms (of sand, soil or other materials) with the fluids being collected and stored for future use. In case of major spills, the aim is
to contain them in retention ponds, use additional dams, close sewage systems and pump to tanks, reservoirs, drums, etc.

Discharge of oil products in the sewage system is not allowed, if required (overuse of oil separator), sewage system should be closed using any means available and the authorities notified.

During the interventions, personnel will work, as much as possible, on the side along the wind direction so as not to be exposed to intoxication hazard. In the area affected by spills and adjacent areas where flammable vapors may be present, vehicle traffic will be stopped (engines should be immediately turned off), area will be delineated, warning signs installed and any presence with open fire and vehicle access banned.

Generally, any spark generating activity is banned and only explosion-proof equipment (tools, devices) and antistatic clothing are used. Electricity is cut off remotely in areas not affected by the flammable vapor release.

6.5. In case of gas leaks

- In case of gas leaks from pipes, the gas flow is cut off by: shutting down pumps, closing valves, changing seals, blinding off, packing. The damaged pipeline sections will be isolated such that the remaining quantity of free gas to be minimum;
- In case of leaks from tanks, if it’s not possible to stop the leak by closing the valves on the connecting pipes, the tank will be drained into an empty tank. At the same time, the leaks will be reduced using any means available, i.e. wooden plugs, packing, blinding off, making sure they don't create additional hazard;
- Investigates the emergency area recording its parameters and together with the rescue team remove any injured people;
- Response work will be conducted on the side opposite to gas cloud movement to avoid intoxication of personnel. Insulating equipment will be used where there is intoxication hazard. The response personnel will be monitored during the entire response action and in case of hazard removed from the area;
- To stop the leaks, during the entire response action fire extinguishing materials will be prepared to be used immediately if required. The response equipment and materials will be placed on the side opposite to the movement of the gas cloud;
- While conducting response work in the gas cloud area operations that may create additional fire and explosion hazard will be avoided until the hazard is off, i.e. Starting up vehicles, switching power on or off, using spark generating equipment, tools or devices. Should such measures be absolutely required, they will be taken only when being sure they are no longer dangerous;
- Access of unauthorized personnel that is not involved in the emergency management in the impacted area will be banned. Open fire or spark sources in the hazard area both inside and outside the site will be detected and removed.
- Where the leak occurred in closed spaces, additional ventilation measures will be taken in compliance with the safety measures.

6.6. In case of gas fires

In case of fire, the effort is primarily focused on limiting the extent of the fire, controlling and putting it out in conjunction with the rescue and evacuation of people and material property.

- Investigates the emergency area recording its parameters and together with the rescue team removes any injured people;
- The gas flow feeding the fire will be cut off. Fire will never be fully put out if the gas flow was not cut off since this may lead to uncontrolled re-ignition of the fire;
- Water will be sprayed both onto storage tanks and adjacent areas as well as onto response personnel; water cooling leads to pressure drop. Water will not be sprayed directly onto liquefied gas since this may lead to spreading of fire;
• Carbon dioxide or powder material will be used to put out fires. Where there is no hazard for fire to spread and no additional damages occur, it is preferable for the leaked gas to burn in a controlled manner.

6.7. In case of gas explosions

In case of an explosion it is assumed that the impacts are severe both on personnel as well as on facilities and equipment.

• Investigate the emergency area and together with the rescue team remove any injured people; Due to the severity of the accident, it is required to call up all employees in order to make sure there are no missing people.
• Thoroughly investigate the facility area to detect and stop any gas flows resulting from failures. All storage tanks and facilities will be closed and any activity involving gas handling stopped. Where this activity is necessary (i.e. to drain out a failed tank), the operation will be conducted only after all fire hazards were removed and thorough checking was done.
• Electrical power supply will be cut off. Starting back up will be done gradually, on each circuit, only after thorough checking and under safety conditions;
• Storage tanks together with associated equipment will be cooled by water spray until temperature and pressure return to normal values;
• Personnel not participating in the emergency management will be evacuated;
• The affected area will be delineated and access of unauthorized people banned;
• Once the intervention is completed and emergency state is off, the response team supervisor will draft up a report writing down the completed activity.

6.8 In case of fire or explosion at fuel tanks

Response in case of fire is conducted in accordance with the “Fire Response Plan” developed by the company and approved by the Inspectorate for Emergency Situations.

In case of fire, the effort is primarily focused on limiting the extent of the fire, controlling and putting it out in conjunction with the rescue and evacuation of people and material property. In case of fire on a tank, if the fire inside the tank is not put out quickly using the fixed foam fire extinguisher, this may lead to damage of the tank top with fuel burning on the free surface of the tank. In severe cases when fire cannot be controlled and the outside of the tank is not cooled the tank lining may be damaged with outside release of burning fuel that may lead to an extremely violent fire. Outside burning of a large quantity of oil products is extremely dangerous because the fire affected area increases significantly causing huge extinguishing problems and the tanks in the retention bund are directly exposed which may lead to explosions and fire spreading to the other tanks.

Use of fixed fire extinguishers and rapid and efficient response including for protection of the tanks and adjacent areas significantly reduces the risk for such accidents to escalate.

C. Description of mobilized resources

To prevent and remove causes of emergencies, the company will organize / have in place (upon commissioning) a number of facilities and equipment, as follows:

• Emergency Cell organized within the site for management of emergencies, formed of the leaders of the company’s main functional departments and safety officers;
• Private Emergency Division organized within the site and formed of the operational personnel and professional firemen;
• Fire extinguishing equipment with hydrant networks and fire water tanks;
• First response resources;
• Neutralizing reagents.

The response teams of ISUJ Alba may also be mobilized in case an emergency occurs.
The list of response equipment required is shown in *Tables 5.1 – 5.4.*
### Table 5.1. Response equipment

<table>
<thead>
<tr>
<th>Equipment Category</th>
<th>Item</th>
<th>Emergency Regime</th>
<th>Location under Project normal operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire suppression</td>
<td>Fire suppression trucks</td>
<td>At least 1 truck permanently available that may be operated by trained personnel within Fire Brigade</td>
<td>When not used, these trucks will be parked in Safety Department building. <strong>Trucks are fitted with fire suppression equipment and response equipment for emergencies involving hazardous substances.</strong></td>
</tr>
<tr>
<td></td>
<td>Portable fire extinguishers</td>
<td>Located in individual buildings, warehouses and Project treatment areas Number and location are shown on evacuation maps displayed on the exit of each building and occupied area of the facility</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fire hydrants</td>
<td>To be used only by trained Fire Brigade personnel</td>
<td>Located in strategic points within the Project site</td>
</tr>
<tr>
<td></td>
<td>Sprinklers</td>
<td>Most buildings will be equipped with automatic sprinklers designed to detect a fire and set off to put it out.</td>
<td></td>
</tr>
<tr>
<td>Emergency Lighting</td>
<td>Ambulance</td>
<td>Fitted with medical emergency equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other equipment available during major emergency</td>
<td>Large haul trucks Bulldozers Excavators Wheel dozers Production loader Grading machines Utility loader Welding trucks Flat trucks Water trucks Vans Forklifts Cranes Telescopic loader Flat platforms Bobcats</td>
<td></td>
</tr>
</tbody>
</table>

**Cabinets with emergency response equipment (please see next tables)**

Prepared by S.C. OCON ECORISC S.R.L. Turda
Table 5.2. Cabinets with emergency response equipment

<table>
<thead>
<tr>
<th>Cabinet No.</th>
<th>Location</th>
<th>Main emergency response function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reagents building</td>
<td>Fires, hazardous substances spill, cyanide spill, first aid</td>
</tr>
<tr>
<td>2</td>
<td>Administration building / warehouses</td>
<td>Fires, chemical substances / fuel spills, first aid</td>
</tr>
<tr>
<td>3</td>
<td>Stormwater pond</td>
<td>Fires, chemical substances / fuel spills, first aid</td>
</tr>
<tr>
<td>4</td>
<td>Wastewater treatment plant</td>
<td>Fires, chemical substances / fuel spills, first aid</td>
</tr>
<tr>
<td>5</td>
<td>Fuel storage site</td>
<td>Fires, chemical substances / fuel spills, first aid</td>
</tr>
<tr>
<td>6</td>
<td>Primary crusher</td>
<td>Fires, chemical substances / fuel spills, first aid</td>
</tr>
<tr>
<td>7</td>
<td>Mining site</td>
<td>Fires, chemical substances / fuel spills, first aid</td>
</tr>
<tr>
<td>8</td>
<td>Pebble crusher</td>
<td>Fires, chemical substances / fuel spills, first aid</td>
</tr>
</tbody>
</table>

Table 5.3. Inventory of typical cabinet equipment

<table>
<thead>
<tr>
<th>Emergency response equipment</th>
<th>Inventory (minimum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber gloves</td>
<td>6 pairs</td>
</tr>
<tr>
<td>A level safety suit</td>
<td>4 pcs</td>
</tr>
<tr>
<td>B level safety suit</td>
<td>6 pcs</td>
</tr>
<tr>
<td>C level safety suit</td>
<td>6 pcs</td>
</tr>
<tr>
<td>SCBA with bottle and mask</td>
<td>6 pcs</td>
</tr>
<tr>
<td>Orange vest for emergency personnel</td>
<td>6 pcs</td>
</tr>
<tr>
<td>Waste containers (outside cabinet)</td>
<td>5 pcs</td>
</tr>
<tr>
<td>Absorbent material</td>
<td>1 roll</td>
</tr>
<tr>
<td>Push brooms</td>
<td>2 pcs</td>
</tr>
<tr>
<td>Shovel</td>
<td>2 pcs</td>
</tr>
<tr>
<td>Square shovel</td>
<td>2 pcs</td>
</tr>
<tr>
<td>Siren</td>
<td>1 pcs</td>
</tr>
<tr>
<td>First aid kit</td>
<td>1 pcs</td>
</tr>
<tr>
<td>Eye wash portable station</td>
<td>1 pcs</td>
</tr>
<tr>
<td>Stretcher</td>
<td>1 pcs</td>
</tr>
<tr>
<td>Portable torches and spare batteries</td>
<td>4 pcs</td>
</tr>
<tr>
<td>Rubber boots</td>
<td>6 pairs</td>
</tr>
<tr>
<td>Warning tape</td>
<td>4 roll</td>
</tr>
<tr>
<td>Tarpaulins or plastic sheets</td>
<td>2 pcs</td>
</tr>
<tr>
<td>Portable pumps</td>
<td>1 pcs</td>
</tr>
<tr>
<td>Emergency cones</td>
<td>6 pcs</td>
</tr>
</tbody>
</table>
Table 5.4. Inspections on emergency response equipment

<table>
<thead>
<tr>
<th>Emergency response equipment</th>
<th>Routine Inspections</th>
<th>Detailed Inspections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable fire extinguishers</td>
<td>Monthly</td>
<td>Annually</td>
</tr>
<tr>
<td>Fire hydrants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire trucks</td>
<td>Monthly</td>
<td>Annually</td>
</tr>
<tr>
<td>Emergency response equipment from the trucks</td>
<td>Monthly</td>
<td>Annually</td>
</tr>
<tr>
<td>Building sprinklers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabinets with emergency response equipment</td>
<td>Monthly</td>
<td>Annually</td>
</tr>
<tr>
<td>Ambulances</td>
<td>Monthly</td>
<td>Annually</td>
</tr>
<tr>
<td>Emergency response equipment from ambulance</td>
<td>Monthly</td>
<td>Annually</td>
</tr>
<tr>
<td>Emergency lighting</td>
<td>Monthly</td>
<td>Annually</td>
</tr>
</tbody>
</table>

Note:

Routine inspections check if equipment is at established location and may be used. Detailed inspections involve full checking of the integrity and capacity of equipment and is done by qualified persons.

Response and rescue materials are considered minimal safety stocks, are not to be used for routine activities and are permanently replenished, replaced or checked. They are stored in closed areas, however readily accessible, on stacks or sealed glass-door cabinets.

The response materials include the individual safety equipment each operator is provided with as well as the work tools and devices the locksmiths and electricians are provided with. Copy of all material safety data sheet will be kept with the health and Safety Department, in the administration and safety department building.

Once operations commence the above mentioned resources will be complemented according with the Framework Norms for equipping with materials and other means of protection against floods, ice and accidental pollution provided in Appendix 2 of the Rules on management of emergencies caused by floods, dangerous weather events, hydrotechnical construction accidents and accidental pollutions of 12.05.2005, approved by MAI Order 638/2005 and MEWM Order 420/2005.

D. Summary of elements described under letters A, B, C required to develop the Internal Emergency Plan

Internal Emergency Plan will be developed in accordance with MAI Order 647/2005 and GD 804/2007.

The Internal Emergency Plan will include data from the risk assessments presented within the Safety Report.

The Internal Emergency Plan will also include and elaborate on the chapters regarding: advise, notification, alarm and response.