Explanatory Note for Chapter 7 – Risk cases

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25 October 2010 | **OCONECORISC**

1. Assessment of the impact on the Project and/or EIA Report due to the alteration of the relevant legal framework

In accordance with the requests raised by the Technical Analysis Committee, we started an analysis of the legislative evolution of all regulations relevant to the Chapter 7 of the Environmental Impact Assessment Report (EIA Report). The aim of this operation is to identify the alterations of the legal framework occurred after the submission date of the EIA Report so as to assess how the legislative evolutions impact the conclusions of the EIA Report.

The Governmental Decision no. 95/2003 on the control of activities which may generate major-accident hazards involving dangerous substances has been altered and replaced by Governmental Decision no. 804/2007 on the control of major accident hazards involving dangerous substances. On its turn, this final regulation has been altered by Governmental Decision no. 79/2009 on the alteration of Governmental Decision no. 804/2007 on the control of major accident hazards involving dangerous substances. Governmental Decision no. 804/2007 – as it was altered – it is applicable to sites where certain relevant hazardous substances are present, as detailed under Annex 1 of this regulation. Among the new aspects presented by this Governmental Decision no. 804/2007, the most important ones are considering the followings: the additions to be made to the contents of the letter that is to be sent by the operator to the local environmental protection agency; the regulation of the terms for sending the letter; the establishment of the duty to inform the environmental protection agencies in case a site or an installation is altered that would result in an increase of the hazards of a major accident; the establishment of the duty to appoint of an onsite safety management responsible individual for the purpose of observing the provisions under Governmental Decision no. 804/2007; the alteration of the of the contents of the Annexes listing the hazardous substances.

Government Emergency Ordinance no. 68/2007 on environmental liability with regard to the prevention and remedying of environmental damage. This regulation implements into the Romanian legislation the provisions under Directive no. 2004/35/EC on environmental liability with regard to the prevention and remedying of environmental damage, as amended by art. 15 of Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC. The regulation regulating the preventing and remedying measures that can be taken to prevent/remove environmental liabilities, as well as the payment and recovery of costs associated with the implementation of preventive and remediation measures, as the case may be.

Art. 33 and 34 of Governmental Emergency Ordinance no. 68/2007 stipulates the establishment of a system aimed at ensuring the creation of financial guarantees on environmental liability that will allow operators to use these in order to warrant the performance of the commitments assumed in accordance with this regulation. The establishment of this system is to be performed through a Decision issued by Romanian Government (the decision hasn't been issued yet). However, we believe that this guaranteeing system has a general character – aiming all fields of activity – by comparison with similar regulations enforced currently within mining industry (the guarantee established by Law no. 85/2003 and the one established by art. 50-53 of Governmental Decision no. 856/2008) that are having a special character. On this train of thoughts, we believe that the provisions under Governmental Emergency Ordinance no. 68/2007 – at least now when the enforcement decision hasn't been issued – are not additional guaranteeing duties for mining.

2. Updates of Chapter no. 7 – "Risk Cases"

2.1. Foreword

Following the transposition of Directive 2003/105/EC into domestic legislation, special implementation norms have been developed for SEVESO Directives – The guide on implementing the safety management system within the context of SEVESO Directives, the guideline for assessing the external emergency plan, the guideline for assessing the Safety Reports etc.[1] Therefore, in order to meet the legislative amendments occurred during this period and to observe the provisions under these special regulations, updated versions of Chapter 7 Risk Cases of EIA Report, Safety Report and Emergency Preparedness and Spill Contingency Plan have been developed.

2.2. Hazard and Risk

The qualitative analysis is aimed mainly at establishing a list of potential hazards, makes the ranking of events possible depending on the order of risk and it is the first step of the methodology used to conduct a risk quantitative analysis.

Following the concerns/observations raised during public consultation and disclosure stage, several accident scenarios have been assessed at a more detailed level, scenarios considered as being with major potential and consequences after conducting a qualitative analysis.

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[1] See: http://www.igsu.ro/seveso.htm

2.3. Technological Hazards and Risks

The Governmental Decision no. 804/2007 (transposing Directive 96/82/CE – Seveso II, amended by Directive 2003/105/CE on the control of major-accident hazards) is establishing measures for the control of activities presenting major-accident hazards where hazardous substances are involved, in order to prevent these accidental and to limit their consequences upon population health and safety, as well as on environmental quality. The provisions under this decision are applicable to activities where hazardous substances are present in quantities equal or higher that the quantities provided under Annex no. 1 of the abovementioned Decision, considering the legal provisions on the labor environment and, especially, the ones on the application of the measures of laborers health and safety at their workplaces.

Directive 2003/105/CE brings several amendments and alterations to Directive Seveso II, (transposed through Governmental Decision no. 804/2007) on extending the applicability also over the following:

- the chemical and thermal processing and storage operations that involves the use of hazardous substances, for the mining operations conducted on minerals within mines, open pits or through drillings;
- the operational tailings discharging facilities, to include tailings management facilities and tailings ponds containing hazardous substances and in particular when used in connection with mineral thermal and chemical processing.

The relevant quantities that need to be considered for the enforcement of the provisions on control of major-accident hazards are the existing maximum quantities or that may exist at a particular moment within the site. The hazardous substances that are found within a site in quantities equal and/or lower than 2% of the relevant quantity are not considered upon calculating the total existing quantity if their placement within the site is conducted in such a manner that they are not in the position of initiating a major accident within another area of the site. Based on the data presented within the designing documentation, the substances quantities have been estimated for each installation from the Project and the calculation of the total quantity of hazardous substances and the hazardous substances categories present within the site has been performed. The status of the stocks of hazardous substances present within the entire Project site is presented as compared with the relevant quantities provided under the Directive, as follows:

Table 1. List of hazardous substances present within the site

No.	Name	CAS number	Location	Total storage capacity (t)	Physical status	Storage method	Storage conditions	Hazard Risk phrases *	Category in accordance with Governmental Decision no. 804/2007 (Annex no. 1)
1	Sodium Cyanide	143-33-9 Index number: 006-007-00-5	NaCN Storage	224	Solid, pellets	ISOtainers	Open air	Highly toxic, hazardous to environment	Part 2, point **1:** Highly toxic Part 2, point .**9i**: hazardous to environment
				260	Solution 20 %**	Metallic tanks + pipelines	-in open air, under a canopy -inside -in retention	Highly toxic, hazardous to environment R: 26/27/28-	Part 2, point **1:** Highly toxic Part 2. point .**9ii**: hazardous to environment
2	Hydrogen Chloride	7647-01-0 nr. index: 017-	HCl Storage	46	Solution 32 %	Tank	-in open air, under a canopy -in retention	Corrosive R: 34-37	Not ranked
3	Sodium Hydroxide	1310-73-2	Reagents Warehouse	50	Solid	Big-bag 1000 kg	-inside	Corrosive R 35	Not ranked
			NaOH Storage	72	Solution 20 %	Metallic tanks + pipelines	-inside -in retention sink		Not ranked
4	Cyanide slurry**		CIL Area	98000	Suspension having 300 mg/l CN	Metallic tanks + pipelines	-in open air -in retention	It is not ranked as hazardous in accordance	Not ranked

No.	Name	CAS number	Location	Total storage capacity (t)	Physical status	Storage method	Storage conditions	Hazard Risk phrases *	Category in accordance with Governmental Decision no. 804/2007 (Annex no. 1)
			TMF	5300	Suspension having 200 mg/l CN	Construction (concrete + metal) + pipelines	-in open air -in retention	with Governmental Decision no. 1408/2008	Not ranked
			DETOX	4930	Suspension having 10-180 mg/l CN	Metallic tanks + pipelines	-in open air -in retention		Not ranked
			Pipeline travelling from the Plant to	3800	Suspension having 10 mg/l CN	PEHD pipeline	-in open air		Not ranked
5	Solution rich in cyanides **		Elution Area	1460	Solution 2 % NaOH and 3 % NaCN	Metallic Tanks + electrowinning cells + pipelines	-in open air -inside -in retention	Toxic T, R: 23/24/25-36/38-52/53	Part 2, point **2:** Toxic
6	Process water *		Tank	12000	Solution 5 mg/l CN	Metallic Tanks + pipelines	-in open air -in retention	It is not ranked as hazardous in accordance with Governmental Decision no. 1408/2008	Not ranked
			Pipelines travelling from TMF to process tank and to SCD of	1000	Solution 5 mg/l CN	PEHD pipeline	-in open air		
			TMF	1000000	Solution 5 mg/l CN	TMF	-in open air		
7	Ammonium Nitrate	6448-52-2	Explosives Warehouse	100	Solid minim 28 % N	In silos	In special warehouse	It is not ranked as hazardous in accordance with Governmental	Part 1: oxidant
8	Initiation explosives - dynamite	6448-52-2 (azotat de	Explosives Warehouse	5	-	Original packing	In special warehouse	Explosive R: 2-6-44 ADR/RID: 1.1D	Part 2, point .5: explosive
9	Lime cream	1305-62-0	Limestone Warehouse	805	15 % CaO Suspension	Metallic tanks + pipelines	-in open air -in retention	Irritant R41	Not ranked
	Hydrated lime	1305-62-0	Limestone Warehouse	600	Dust	Silos	-in open air	Irritant R41	Not ranked
	Quicklime	1305-78-8		860	Bulks	Silos	-in open air		Not ranked
10	LPG	68476-85-7	Gas Boiler (elution area)	50	Liquefied Petroleum Gas	Metallic Tank	-in open air	Highly flammable R 12	Part 1: highly flammable
11	Oxygen	7782-44-7	Oxygen Station	2	Under-pressure gas	Metallic Tank	-in open air	Oxidant R 8	Part 1: oxidant
12	Diesel fuel	68476-34-6	Fuel Depot	520	Liquid	Metallic Tank	-in open air -in retention	Flammable R10-40-36/37	Part 1: flammable

No.	Name	CAS number	Location	Total storage capacity (t)	Physical status	Storage method	Storage conditions	Hazard Risk phrases *	Category in accordance with Governmental Decision no. 804/2007 (Annex no. 1)
	Petrol	86290-81-5		15	Liquid	Metallic Tank	-buried	Highly flammable, cancerigenous R12-38-45-65	Part 1: flammable
13	Sodium hypochlorite	7681-52-9	Waters treatment station	5	Liquid	Plastic barrels	-in open air, under a canopy	Corrosive R31-34	Not ranked
14	Metabisulfite	7681-57-4	Reagents Warehouse	120	Solid	Big-bag 1000 kg	-inside	Toxic R: 22-31-41	Not ranked
			DETOX	300	20 % Solution	Metallic tanks + pipelines	-in open air -in retention		Not ranked
15	Copper Sulphate	7758-99-8	Reagents Warehouse	10	Solid	Big-bag 1000 kg	-inside	Toxic, hazardous to environment R: 22-36/38-	Part 2, point **9i**: hazardous to environment
		7758-99-7	DETOX	72	15 % Solution*	Metallic tanks + pipelines	-in open air -in retention	Toxic, hazardous to environment R22-51/53	Part 2, point **9ii**: hazardous to environment
16	Acid Waters**		Cetate Dam	500000	Acid Waters	Collection Pond	-in open air	It is not ranked as hazardous in accordance with Governmental Decision no. 1408/2008	Not ranked
			Pipeline from Cetate Dam to Plant	140	Acid Waters	PEHD pipeline	-buried		Not ranked
17	Mercury	7439-97-6	Reagents Warehouse	1	Liquid	Special packaging	-inside	Toxic, hazardous to environment R: 23-33-50/53	Part 2 point **2**: Toxic Part 2, point **9i**: Hazardous to environment
18	Flocculent		Reagents Warehouse	10	Solid	Big-bag 1000 kg	-inside	It is not ranked as hazardous in accordance with Governmental Decision no. 1408/2008	Not ranked
			DETOX	68	Solution 0,25 %	Metallic tanks + pipelines	-in open air -in retention		Not ranked

Note: ** Risk phrases have been stipulated in accordance with Safety Technical Sheets*

*** In order to establish the risk phrases of all mixtures (considered as being chemical preparations), the methodology presented under Governmental Decision no. HG 1408/2008 referencing the Governmental Decision no. 92/2003 : Annex 1 – health hazards and Annex 2 – environmental hazards, has been used*

Table 2. List of hazardous substances present on site, exceeding the relevant specific quantities in accordance with Seveso Directive (Governmental Decision no. 804/2007)

No.	Name	Category in accordance with Governmental Decision no. 804/2007(Annex no. 1)	Relevant Quantity (t)		Total Storage Capacity (t)	Physical Status
			art. 7 and 8	art. 10		
1	Solid Sodium Cyanide	Part 2, point **1:** Highly toxic	5	20	224	Solid, pellets
		Part 2, point **9i**: hazardous to environment	100	200		
2	Sodium Cyanide in solution	Part 2, point **1:** Highly toxic	5	20	260	20 % Solution
		Part 2. point **9ii**: hazardous to environment	200	500		
3	Solution rich in cyanides	Part 2, point **2:** Toxic	50	200	1460	2 % NaCN Solution
4	LPG	Part 1: highly flammable	50	200	50	Liquefied Petroleum Gas

Considering the fact that several stocked hazardous substances are exceeding both the lower and the upper value of the specific relevant quantities provided under Governmental Decision no. 804/2007 - Annex no. 1, the site is framed within the upper value of the specific relevant quantities and therefore it is mandatory to send to the territorial public authority on environmental protection and to territorial authority on emergencies the Mine Safety Report on the prevention of major-accident hazards – see *Annex NE_Cap 7_03*.

2.4. Identification of the potential accident scenarios

Following the public consultation stage, certain accident scenarios have been closely analyzed. In the case of dam failure, two categories of conditions have been considered. Firstly, the extreme scenarios on dam failure presented within the EIA Report have been considered. However, as presented below, these scenarios have been considered to be too extreme to be plausible. The second category of scenarios that have been modeled are the ones with an extremely low probability of occurrence, but considered to be more plausible than the ones belonging to the first category. Each category is discussed in detailed in the following paragraphs.

To establish whether the dam provides acceptable safety against "uncontrolled" release of tailings and water during its life, an event tree approach was used to do the hazard analyses. This technique identifies potential failure mechanisms and follows how a series of events leading to non-performance of a dam might unfold. The probability of each scenario, given a triggering event, is quantified. The event tree hazard analyses considered the dam at different stages of its life and calculated the probability of non-performance. A non-satisfactory performance of the dam was defined as an uncontrolled release of tailings and water over a period of time. The release could be due to a breach of the crest of the dam or overtopping without breach of the dam.
The analyses looked at critical scenarios, including all potential modes of non-performance for the Corna dam under extreme triggers such as a rare, unusually strong earthquake and extreme rainfall in a 24-hour period.
The detailed event tree analyses replace the earlier extreme scenarios of dam breach, which were established in a more arbitrarily manner than the scenarios in the present report. These earlier extreme scenarios were presented in the Report on Environmental Impact Assessment Study (EIA Report, Chapter 7 "Risks", May 2006). The probability of occurrence for the extreme dam break scenarios presented earlier by RMGC was found to be too small to be considered realistic for the present analyses, given the design and characteristics of the TMF. Therefore, other scenarios with higher probability of occurrence were considered in the event tree analyses.
The key factors considered in the analyses included: dam configuration (Starter dam, dam during construction (9-12 years) and dam at completion (16 years); triggers, including earthquake shaking, extreme rainfall and/or snowmelt, natural terrain landslide in the valley and failure of the Carnic waste stockpile into the tailings reservoir; "failure" modes included failure of the foundation, dam slope instability downstream or upstream, unravelling of downstream toe and slope, piping, internal erosion, dam abutment failure followed by breach, and liquefaction of the tailings; and conditions such construction deficiencies, inadequate response of the field control team and construction schedule changes. These factors were integrated in the event tree analyses.

Dam failure conditions considered within EIA Study

For the cases presented within the EIA Study, part 7, Risks, (page 120 of 205), discharges of 7.8 million m^3 of tailings and 3.8 million m^3 are; and 27.7 million m^3 of tailings and 5.9 million m^3 of water during a 24 hour period. These discharges would assume a 60 m in height and 390 m in width movement of the dam and that has been considered as impossible for a rock-filled dam with 3H:1V downstream slopes.
The Hazard Assessment conducted with the assistance of experts on dams and hazard assessment, which were present within a workshop (Bucharest, January 2009) and due to the use of event tree analysis, the extreme dam failure scenarios mentioned earlier within the EIA Report are replaced. *It has been concluded that the probability of occurrence for the dam failure scenarios presented earlier it is too low (less than one in 100 million years) to represent realistic scenarios.* Therefore, other scenarios with higher probability of occurrence were considered in the event tree analyses

Low-probability of occurrence scenarios, but more plausible
The Norwegian Geotechnical Institute has considered the hazards associated with the scenarios more plausible to result in environmental impacts. The highest hazard (the probability of occurrence) established as being associated with a plausible non-performance of the dam has been determined to have a 1 to 1 million years probability of occurrence. *The event tree analysis shows that the estimated probability of non-performance is about 100 times lower than what is used as criteria for secondary containment structures around the world, based on the performances observed at dams around the world.*
The experts present at the workshop have estimated the fact that the physical impact of these scenarios is a deformation of dam crest of 5 to 8 m on a centerline length that may vary between 100 and 200 m. A conservative estimation of the tailings volume discharged has been established between 125,000 m^3 and 250,000 m^3 and of water of 13,000 m^3 and 26,000 m^3 of contaminated water during a 24 hour period. Following this event it will result a tailings and water discharge 100 times lower than the one resulted after the two extreme scenarios considered within the EIA Report.
The dam failure scenario has been considered to occur within the final operating years, when the Tailings Management Facility (TMF) holds a maximum volume of tailings. The hazard analyses conducted for the first operating years showed that any water discharged from the TMF (again, a very low probability of occurrence) would be retained within the area between the Secondary Contingency Dam (SCD) and the TMF toe and would not enter the river.

Modeled scenarios presented in the NGI Report – the most plausible scenarios

Following the analysis, it resulted that the probability of occurrence for these scenarios during the first 21 years of life of the tailings installation is one in one million years. This means a probability of 1 to 1 million for a major breach to occur in the dam that would result in damages during the first 17 years. After that, the stability of the dam shall improve. Moreover, as the different construction stages of the main dam advance, the monitoring results and the knowledge obtained provided that the structure behaves satisfactory shall lower the calculated probability of the failure, i.e. the 1 to 1 million-year probability. Additionally, except for the production of an earthquake, the hazards are slow processes, and RMGC shall be able to respond to any hazard detected by its monitoring and emergency preparedness programs so as to counteract any hazard in development.
The group of experts present within the hazard workshop held in Bucharest, on January 2009 considered the following natural disasters: lightning, forest fires, heavy rainfall, avalanches, floods, earthquakes, strong winds, landslides, etc. The conclusion was that the most probable triggers of failures at TMF are earthquakes, heavy rainfalls (followed by floods) and landslide. The most probable scenarios resulted from a combination of these phenomena (due to the fact that they may occur simultaneously) present a probability of occurrence of one to one million years.

Dam breach of over 60 m in its centerline
Following the analysis it resulted that an over 60-m deep breach in a rock-filled dam that has the slopes designed in accordance with the current proposal has been considered as fully unrealistic and presenting a probability of occurrence lower than one to a billion or even trillion of years, and the analysis did not continue on this issue. The probability of occurrence of such a scenario during the first 17 years of life of the tailings management facility is consequently lower than one to a billion years.
As presented above, as the different construction stages of the main dam advance, the monitoring results and the knowledge obtained provided that the structure behaves satisfactory shall lower even more the calculated probability of the failure. After completing the construction, the stability of the dam shall improve and the probability of occurrence of adverse impacts shall lower even more.

Other scenarios and other triggers

Under any circumstance, the hazard, the risk and the probability of occurrence are never 0. There is always a possibility as low as it can be of occurrence of a phenomenon, with low or unrealistic probability of occurrence, like for instance one in a billion or trillion years, etc. The probabilities that are lower than one to several millions are so low than they are not entering the realistic calculation domain.
It is true that certain threats like terrorist attacks, the crashing of a 747 plane in the dam, illegal weapons, bomb attacks, vandalism, sabotage or a war have probability of occurrence higher than 0. These triggers have been discussed during the workshop organized in Bucharest in January 2009 within the analysis of "framing the failure modes" through which priority was given to the analyzed scenarios as chains of events.
Considering the location of the dam, the current political status, and what can be expected in the region during the next 20 years (when the TMF is no longer a retaining structure for tailings and water), the probability of occurrence is much lower than one to one million, maybe one to one billion or trillion. Right now there is a probability higher than 0 for such events to occur today in Rosia Montana without the presence of the TMF.
The probability of occurrence of such triggers that would result in the release of large volumes of tailings and water during the first 17 years of the life of the tailings installation is lower than one to one billion or trillion of years. The probability of occurrence of such an event, due to the fact that it not depends on the installation itself, shall not lower after the first 17 years.
The impact forms caused by the dam breach discussed above are not referring to some of the Project characteristics that may mitigate that impact. Specifically, the model does not consider the possibility of capturing some of these discharges behind the secondary containment dam or in the semi-passive treatment lagoons that are to be built immediately after the second dam. The SCD, after the completion of the dam, shall have a capacity of 53,000 m^3 (with a larger capacity during the first years of construction). The lagoons have been designed to cover an area of approx. 500 de m downstream of the SCD and have an additional capacity of approx. 33,000 m^3 over their operating capacity. These two installations shall not be full under normal operating conditions and may reduce or even fully retain the impact of tailings and water discharges. Moreover, the possibility to use close accumulation basins located downstream is also provided in the study, having a capacity of 10 million m^3 of water to rapidly dilute any discharge, as a response measure in case of an emergency, removing any exceeds of the standard values, even in the close vicinity of the site.

2.5. Major accidents and potential consequences

Based on the Hazard Assessment conducted by Norwegian Geotechnical Institute together with several international dam and hazard experts, the dam failure scenarios and the tailings discharge scenarios occurring during the last years of the TMF life would result, and we quote from the report prepared by the hazard experts, "in some material damage and some contamination, but only in the vicinity downstream of the dam", but nothing more than that. The river bed shall not be crossed. The tailings may travel a distance of several hundred of meters from the TMF dam, on a distance sufficiently low to impose a risk on the adjacent properties and people.

The following table summarizes the key conclusions:

Event	**High Flow river conditions**	**Low Flow river conditions**
Overtopping of the dam due to extreme rain or snow melt - two 1 in 10,000 yr rainfall in 24 hours followed by 1 in 10 yr flood (probability of occurrence less than 1 in 100 million years)	No breach of water standards	Not considered. Extreme rainfall and low flow condition in river would not occur at same time.
Dam breach caused by large earthquake or other triggers (probability of occurrence 1 in 1 million years)	No breach of water standards	Standards exceeded for 80 km downstream, only for extreme concurrence of events (probability of occurrence of 1 in 4 million years). • Temporary and limited consequences • Potentially mitigated
Environmental Impact Assessment (EIA) hypothetical dam breach cases – unrealistic. (probability of occurrence 1 in 100 million years or less)	Not realistic Theoretically exceeds standards	Not realistic Theoretically exceeds standards

For both cases, high and low river flow conditions, modeling results indicate that the downstream water quality criteria will be met for river standards and for drinking water standards, even at the immediate vicinity of the site. Under low flow conditions, there may be a short term exceedence of standards for a distance of 80 km from the site. It should be emphasized that these simultaneous conditions of a dam breach and low flow have a considerably lower probability of occurrence, being one chance in four million years. The lower probability is due to the low flow conditions having been observed to occur statistically during 3 out of 12 months in a year. The small risk of this impact is again of a limited extent and is temporary. The impact should be weighed against the benefit of the immediate and assured clean-up of the current actual and constant heavy metals pollution.

The conditions present after the accident, under worst case scenario, may threaten the fish that is most vulnerable from the most sensible species – but the low concentration and the temporary exposure are in such a manner than only the weakest shall die. Of course that there will be no full depletion of the specie, not even in the case of the most sensitive ones, and thus these shall continue to be represented within water courses.

An accidental pollution could occur if unusually intense rainfall and/or a large earthquake caused an overtopping or a breach in the dam at Rosia Montana. A massive rainfall event of two 1 in 10,000 year rainfall occurring within 24 hours followed by a 1 in 10 year flood that could result in discharge from the TMF facility, was determined to have an extremely low probability of occurrence (less than 1 in 100 million years). This is considered an unrealistic scenario. However, an analysis of the water quality impacts from such an extreme rainfall scenario was conducted. The dispersion analysis indicated that there would be no exceedence of water quality standards at the Hungarian border and an upstream exceedence only in the case of a low water flow conditions, an even less realistic combination of adverse conditions.

The physical impacts of even a once in a million year type of event were considerably smaller than assumed in the EIA. Given the much smaller volumes of material released (approximately 100 times less than the EIA cases), the results of the analyses indicated that there will be either no damage, if the tailing and water are contained in the semi-passive containment ponds; or that there may be some limited impacts for a temporary period in the vicinity downstream of the Corna valley, but only for the scenario under low flow conditions. In no case will there be adverse impacts anywhere close to the Hungarian border.

The sub-chapter on the assessment of environmental and health hazard for Rosia Montana Project presents additional information for the clarification of the analysis results.

Both the probabilities of occurrence and the hazards associated with this activity are meeting the moderate level. However, the probability has a lower level on hazard and vulnerability due to the use of new installations that are compliant with the Best Available Techniques (BAT) and due to the use of management systems within the proposed activity. The hazard, although it is framed in a moderate level, is the indicator of the highest level, due to the nature and properties of the involved chemical substances, i.e. sodium cyanide. Within this area, there are no protected species or areas, no urban agglomerations, and that makes the environmental vulnerability and the health associated with this activity to be framed as moderate level. Additional details are presented in *Annex NE_Cap 7_01, Annex NE_Cap 10_01 and Annex NE_Cap 10_02.*

Potential impacts on human life and aquatic ecosystems

Based on the Hazard Assessment conducted by Norwegian Geotechnical Institute together with several international dam and hazard experts, the dam failure scenarios and the tailings discharge scenarios occurring during the last years of the TMF life would result, and we quote from the report prepared by the hazard experts, "in some material damage and some contamination, but only in the vicinity downstream of the dam", but nothing more than that. The river bed shall not be crossed. The tailings may travel a distance of several hundred of meters from the TMF dam, on a distance sufficiently low to impose a risk on the adjacent properties and people."

The highest cyanide levels (established by considering worst case scenarios occurring in the most inappropriate location, i.e. close to the site) occurring due to tailings/water discharge at the size and duration caused by the accident conditions assessed as being well below the concentration levels and/or exposure duration that may impact the human life forms, birds or non-aquatic life forms.

These levels are safe for the aquatic flora that is capable of facing exposure to concentration levels and time duration higher than the levels and durations provided for the cyanide levels in river water, even in the case when a model is prepared for the worst case discharge.

The concentrations may impact the most sensitive invertebrates present in the aquatic environment, but the exposure time is so low than if an impact is produced, than that impact is an insignificant one.

Fish is the most vulnerable life forms due to their acute sensibility to contaminated waters, considering the fact that they live in that environment. However, the fish and even the most vulnerable species (river trout) need a minimum level of cyanide and a minimum exposure before the most vulnerable specimens of the least resistant species to lose their life. The post accident conditions, at most, may threaten the most vulnerable fish from the

most sensitive species, but the low concentration and temporary exposure are in such a manner, then only the weakest fish is going to die. Of course, there will be no full depletion of the respective specie, not even in the case of the most sensitive ones, and they shall continue to be represented within the respective water courses.
It must be underlined the fact that while the pollution mitigation in the case of ARD production is aimed to allow rehabilitation of aquatic life, currently there is no aquatic life capable of surviving within acid water and heavy metals contamination conditions present now in the water courses on a 40 Km distance downstream of the site.

To conclude, the risk of ecologic impact is mitigated due to the limited and temporary impact. The impact should be reported against the immediate benefits brought by the remediation activities proposed to be developed so as to remove existing and continuous heavy metals pollution.

Potential Transboundary Impacts
Considering the technical features of the Rosia Montana TMF, as well as the technical design and the operation criteria established for this mine site, the plausible failure and tailings overtopping scenarios do not involve water quality impacts at the Hungarian border.

Conclusions
Regardless of the current situation, the risk of an accident is extremely low. In the case of an accident, the contaminated discharged is so low from quantitative point of view, as well as from its duration point of view. In most of the cases, even in case of an accident, the river water quality is maintained at a higher level both for the surface water quality standards and the drinking water standards, even at its river discharge point. Within all these conditions, the safe conditions are restored hundred of Kms before the contaminated water reaches the Hungarian border. The Hazard Assessment establishes the fact that the case in which a more serious accident would occur is not real. Both the very low risk associated with accident production and the clear benefits of the environmental rehabilitation operation indicate the fact that project implementation is beneficial on several environmental components.

Environmental and Health Hazard Assessment in the case of Rosia Montana Project
For each of these elements, it is assumed a potential level (a category) of hazard and a relevant numeric parameter is assigned (a value between 1 and 10). This parameter may assume an intermediate value from a certain interval so as to consider the specific status of the assessed site (*tables 7.34. A-E*).

Table 7.34. Establishing the potential hazard level for the most representative elements for the rapid assessment of the industrial hazard

A) Element: site age

INVENTORY REFERENCE NUMBER	CATEGORY	VALUE OF PARAMETER **A**
a. 1)	Between 1 and 5 years	1
a. 2)	Between 5 and 20 years	5
a. 3)	More than 20 years	10

B) Element: process control

INVENTORY REFERENCE NUMBER	CATEGORY	VALUE OF PARAMETER **B**
b. 1)	State-of-the-art Technology	1
b. 2)	Average level of the Technology	5
b. 3)	Low level of the Technology	10

C) Element: type of operation

INVENTORY REFERENCE NUMBER	CATEGORY	VALUE OF PARAMETER **C**
c. 1)	Continuous operation	1
c. 2)	Semi-continuous operation	5
c. 3)	Discontinuous operation	10

D) Element: operating conditions of the industrial installation

INVENTORY REFERENCE NUMBER	CATEGORY	VALUE OF PARAMETER **D**
d. 1)	Processes developed at low temperatures and pressures	1
d. 2)	Processes developed at elevated pressures (> 30 bars) or high temperatures (> 200º C)	5
d. 3)	Processes developed at extremely elevated pressures and extremely high temperatures	10

E) Element: loading/unloading operations

INVENTORY REFERENCE	CATEGORY	VALUE OF PARAMETER **E**

NUMBER		
e. 1)	Number of loading/unloading operations – below 50 per year	1
e. 2)	Number of loading/unloading operations – between 50 and 300 per year	5
e. 3)	Number of loading/unloading operations – over 300 per year	10

The Site Technological Factor (**STF**) is then defined as being the sum of the values associated with each of the elements defined within the previous tables.

$$STF = \frac{A+B+C+D+E}{50} x10$$

<u>The calculation for the assessed project is presented in table *7.27.*:</u>

*Table 7.27. Calculation of the site technological factor (**STF**)*

Parameter	*Index*
A	1
B	2
C	3
D	2
E	5
STF	***2.6***

The level of organization for Health and Environmental Management is represented by (**SOF)**.

Three categories of potential hazards have been defined in accordance with the existing information and data, as well as with the parameters of the corresponding hazard parameters.
This factor is calculated in accordance with *table 7.28*.

Table 7.28. Categories of potential hazards

INVENTORY REFERENCE NUMBER	CATEGORY	VALUE OF PARAMETER **F**
f.1)	**Maximum level of reference** *(implemented Health and Environmental Management Systems)*	1
f.2)	**Average level of reference**	5
f.3)	**Minimum**	10

The Site Organization Factor is equal with the value of parameter **F**.

$$\mathrm{SOF} = \mathrm{F}$$

<u>The calculation for the assessed project is presented in table *7.29.*:</u>

Table 7.29. SOF Calculation

Parameter	*Index*
SOF	*2*

The two previous factors, STF and SOF, are combined to define Site General Index **(SGI)** by using the following relation:

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

<u>The calculation for the assessed project is presented in table *7.30*:</u>

Table 7.30. SGI Calculation

Parameter	*Index*
SGI	*2.28*

Dangerous Substances Index (DSI)
It is calculated based on the total quantity of hazardous substances handled and/or stored onsite, correlated with the relevant quantity presented in Annex 1 of Seveso Directive.
Dangerous Substances Index (DSI) is based on the total quantity of hazardous substances handled and/or stored onsite, defined by the specific Dangerous Substances Factor (DSF), which is calculated as follows:

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

Where: **qi** is the quantity of the dangerous substance/chemical **i** (or hazardous substance category) inventoried and observing the Parts 1 or 2 of Annex 1 of Seveso II Directiva.

Qi is the standard value relevant for the Parts 1 or 2 (column 2) of the abovementioned Annex.

With the assistance of DSF, DSI is established by using the following equation (see *Table 7.31)*:

Table 7.31. Establishing the DSI value

DSF Value	*DSI Value*
0<DSF≤10	DSI=1/5*(DSF)
DSF>10	DSI=2*Log(DSF)

Within this equation, the logarithm is calculated with base 10.

The inventory of the hazardous substances that comprises the quantities of the respective substances **qi**, as used for the calculations, is presented under subchapter 7.1.6.3.

<u>The calculation for the assessed project is presented in table *7.32*:</u>

Table 7.32. DSI Calculation

Parameter	*Index*
DSI	*4.19*

Natural Hazards Index (NHI)

It is a combination of independent factors relevant for one or more natural hazards (zones predisposed to frequent floods, highly seismic areas, frequent landslides, or high ground instability).

NHI is a combination of individual factors relevant for one or several natural hazards, as per *Table 7.33.*:

Table 7.33. Natural Hazard Index (NHI)

CATEGORY	NATURAL HAZARD FACTOR
Area predisposed to flooding	Yes: factor F = 1
	No: factor F = 0
Area with high seismicity	Yes: factor S = 1
	No: factor S = 0
Frequent landslides, earth or soil movements, with elevated instability impacting the area	Yes: factor L = 1
	No: factor L = 0

A combination of these factors provides the value of NHI, as follows:

$$\mathbf{NHI} = F + S + L$$

<u>The calculation for the assessed project is presented in table *7.34*:</u>

Table 7.34. NHI Calculation

Parameter	*Index*
F	*1*
S	*0*
L	*0*
NHI	*1*

Site Hazard Index (SHI) is a composed parameter representing the potential hazard (the occurrence probability) of a major accident, without considering the subsequent consequences on environment and human health.

Site Hazard Index(SHI) is calculated as follows:

$$SHI = \sqrt{\left(\frac{[SGI + NHI] \times 10}{13}\right) \times DSI}$$

where: **SGI** Site General Index

NHI Natural Hazard Index

DSI Dangerous Substance Index

The values calculated for the above indexes are presented below inn Table 7-35:

Table 7-35. Hazard Assessment Indexes

Calculated Index	The entire site
SGI	2.28
DSI	4.19
NHI	1.00
SHI	2.25

Site Risk Index
The representation of the final value of hazard for a site is performed through the Site Risk Index (SRI), which is the maximum value of each ARI. The final risk is represented by the worst case scenario that may be caused by the assessed industrial activity.
The values calculated for the above indexes are presented in Table 7-36:

Table 7-36. Vlaues of the Health and Environment Risk Index

Calculated Index	CP	CE	CEC	EPGI	ARI
1. HCN emissions within CIL area	1.33	0.83	1.25	1.22	1.82
2. Break in the TMF dam	4.00	4.17	3.75	4.02	3.30
SRI		3.30			

General assessment of the environment and health vulnerability
The assessment of the environment and health vulnerability may provide additional information on how the environment may be impacted by a potential accident.
The General Environment and Health Vulnerability Index (GEHVI) is a value obtained by weighted sum of:
- PVI – Population Vulnerability Index . PVI Calculation considers the potential impacts of an accident on neighboring population (area locals and site workers).
- EVI – Environment Vulnerability Index. EVI Calculation considers the environmental components specific to this area, which may be endangered (rivers, lakes, soil, and underground waters, fauna and vegetation).
- ECVI – Economic Vulnerability Index. ECVI considers the economic components in the area that may be endangered (livestock, agriculture, aquaculture, industry and business).

The values of the specific weighted coefficients have been established within the terms of the impact of each category of general vulnerability index (the population impact has been established as being the most critical one, the business impact has been established as being the lowest and the environmental impact has been established as being at an intermediate value). The values calculated for the abovementioned indexes are presented in Table 7-37.

Table 7-37. The values of the Environment and Health Vulnerability Values

Calculated Index	The entire site
PVI	1.47
EVI	5.06
ECVI	3.75
GEHVI	2.40

The probability, the risk, and vulnerability associated with the assessed activity are presented in figure 7.25.

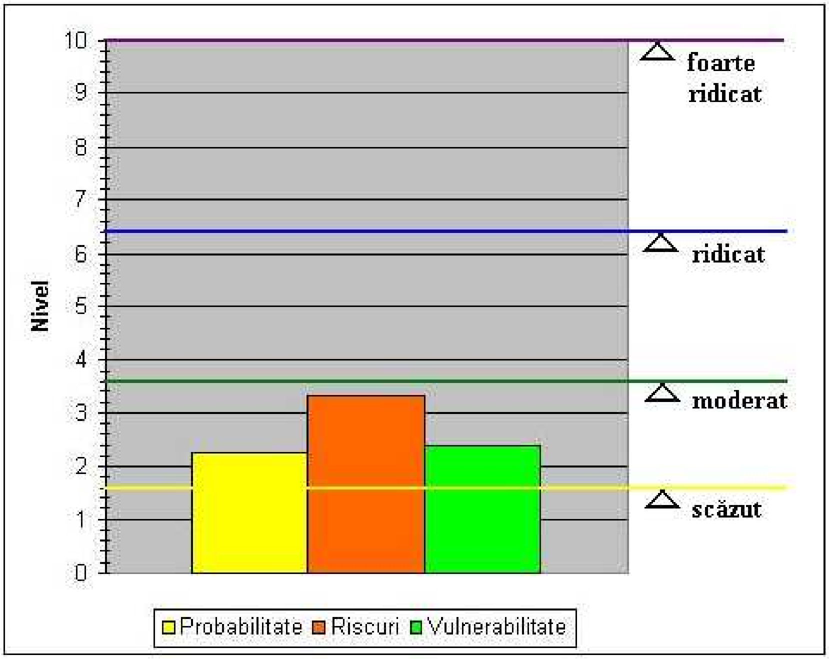

Figure 7.25. The probability, the risk, and vulnerability associated with the assessed activity.
Both the probability of occurrence and the associated risks are meeting the moderate level. However, the probability has a lower level to the risk and vulnerability due to the new installations that are in compliance with the Best Available Techniques (BAT) and with the management activities of the implemented activity. Risk, although moderate, is the highest level index, due to the nature and properties of the involved chemicals, i.e. sodium cyanide. There are no protected species or areas, or urban sites within this area and that makes the environmental and health vulnerability associated with the assessed activity to be also at a moderate level.

2.6. Scheduling emergencies

Following the legislative amendments, the organizational structure has been reviewed, amended and updated for the emergency situations management in accordance with the provision of current in force regulations: Governmental Decision no. 804/2007 on the control of major-accident hazards involving hazardous substances, Law no. 481/2004 on Civil Protection, Governmental Emergency Ordinance no. 21/2004 on the National System of Emergency Situations Management, Order of Minister of Administration and Internal Affairs no. 158 of 22 February 2007 on the approval of the performance criteria regarding the establishment, framing and endowment the private units for emergency situations. For additional details please read the Safety Report presented under *Annex NE_Cap 7_03.*

3. Updates of Chapter no. 7 – "Safety Report"

The Safety Report has been prepared in accordance with the legal requirements under Governmental Decision no. 804 of 25th of July 2007 on the control of major accident hazards involving hazardous substances, amended by Governmental Decision no. 79/2009, stipulated under art. 2 and art. 10 and materialized in Annex 2 of the above mentioned decision – Annex NE_Cap 7_03.

4. Updates of Chapter no.7 – "ANNEXES PREPARED AFTER PUBLIC INFORMATION AND DISCLOSURE MEETINGS – Volume 55 – Emergency Preparedness and Spill Contingency Plan"

The Emergency Preparedness and Spill Contingency Plan has been updated in accordance with the updates table presented at the end of chapter – A*nnex NE_Cap 7_02.*