Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	16
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Rosia Montana, 24.07.2006
RMGC internal unique code	MMGA_0081

Proposal

What will happen when blasting procedures will be conducted at Rosia Montana by using between 20 and 60 tons of explosives? If 20 tons of explosives will be used for blasting through a network of drill holes or through galleries, which are provided with blasting chambers, the seismic wave will propagate around it on a distance of 8Km.

Solution

The quantity of TNT mentioned in the question is over-exaggerated, and the tendentious wording of the question is misleading, since the EIA does not indicate such quantities. All details related to the blasting technologies can be found in Chapter 2 – *Technological Processes*, Section 4.1.1.2 *Mining Works*.

In reality, during a blasting phase, up to 1,296 kg AM will be detonated, resulting in a mining mass of 8,000 – 10,000 t. In order to obtain the daily production (tailings and ore), the movement of the rock of approx. 28 - 32 exploitation panels is necessary, respectively the detonation of a quantity of approx. 10 t of explosive AM-type, as presented in Chapter 2 – *Technological Processes*, Section 4.1.1.2, p. 60 *et seq.*

The priming will be of sequential type and NONEL-type non-electric fuses (non-electric) and detonating wire will be used, technology that assures a mining mass crushing degree compatible to the loading machines capacity and determines the reduction of the exploded rock spreading area.

For the definitive outlining of the pit sides, bore holes similar to those used for mining will be used, having though a smaller explosive quantity with approx. 20% compared to the production holes, the start being given by dynamite cartridges.

For the detonation the NONEL technology will be used.

The load blasting order will be performed with micro delay, from the hole center to the base part and to the upper one, and from the center hole of the first row to the side extremities and to the following rows, technology that assures the significant decrease of the seismic intensity and an increased effectiveness of the rock movement explosions.

The environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorized equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate *Best Management Practices/Best Available Techniques* for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see Tables 4.3.8 through 4.3.16 and Exhibits 4.3.1 through 4.3.9. All these details related to the applied assessment methodology, the input data of the dispersion model, the modeling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 *Noise and Vibrations of the EIA Report.*

Project Years 0, 9, 10, 12, 14 and 19 were selected for modeling because they are considered to be representative of the most significant levels of noise-generating activity. They are also the same years used for air impact modeling purposes in Section 4.2, as air and noise impacts share many of the same sources or are otherwise closely correlated. In order to more accurately reflect potential receptor impacts, all of these exhibits integrate the background traffic estimates discussed in Section 4.3.6.1.

The Project site plan and process plant area and facility drawings were used to establish the position of the noise sources and other relevant physical characteristics of the site. Receptor locations were established using background reports and project engineering and environmental documentation provided by RMGC. With this information, the source locations and receptor locations were translated into input (x, y, and z) co-ordinates for the noise-modeling program.

The calculations account for classical sound wave divergence (i.e., spherical spreading loss with adjustments for source directivity from point sources) plus attenuation factors due to air absorption, minimal ground effects, and barriers/shielding.

This model has been validated by AAC (Acoustic Aliance Consulting) over a number of years via noise measurements at several operating industrial sites that had been previously modeled during the engineering design phases. The comparison of modeled predictions versus actual measurements has consistently shown close agreement; typically in the range of 1 to 3 dB (A).

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Millisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 milliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 milliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly executed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of small intensity explosions will propagate the rock crushing wave.

In conclusion, the special technologies used (within various perimeters) will not produce adverse effects on the constructions from Roșia Montană commune; however, due to the state of advanced deterioration, and in the absence of rapid intervention from the competent bodies, these constructions will become impossible to recover.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project.

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	16
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Rosia Montana, 24.07.2006
RMGC internal unique code	MMGA_0083

Proposal

How can the project state that at Rosia Montana there is no chance for an earthquake to occur except once at 100 years, without taking into account that for each blasting performed at Rosia Montana an earthquake will be produced? The tailings management facility will be shaken with every occasion; the city of Abrud is located downstream of the TMF: what will happen with those people?

Solution

The environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorised equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate Best Management Practices/Best Available Techniques for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see **Tables 4.3.8** through **4.3.16** and **Exhibits 4.3.1** through **4.3.9**. All these details related to the applied assessment methodology, the input data of the dispersion model, the modelling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 Noise and Vibrations of the EIA Report.

The analysis of the data included in Ipromin's study, entitled „Geo-mechanical study for the measurement of the effects of quarrying operations on the constructions located inside the protected area" indicates that, in the case of the excavation technologies to be used in the Roşia Montană mining perimeter, the oscillation velocity (the most important parameter of the seismic wave generated by the blasting) is significantly reduced as we move away from the centre of the explosion.

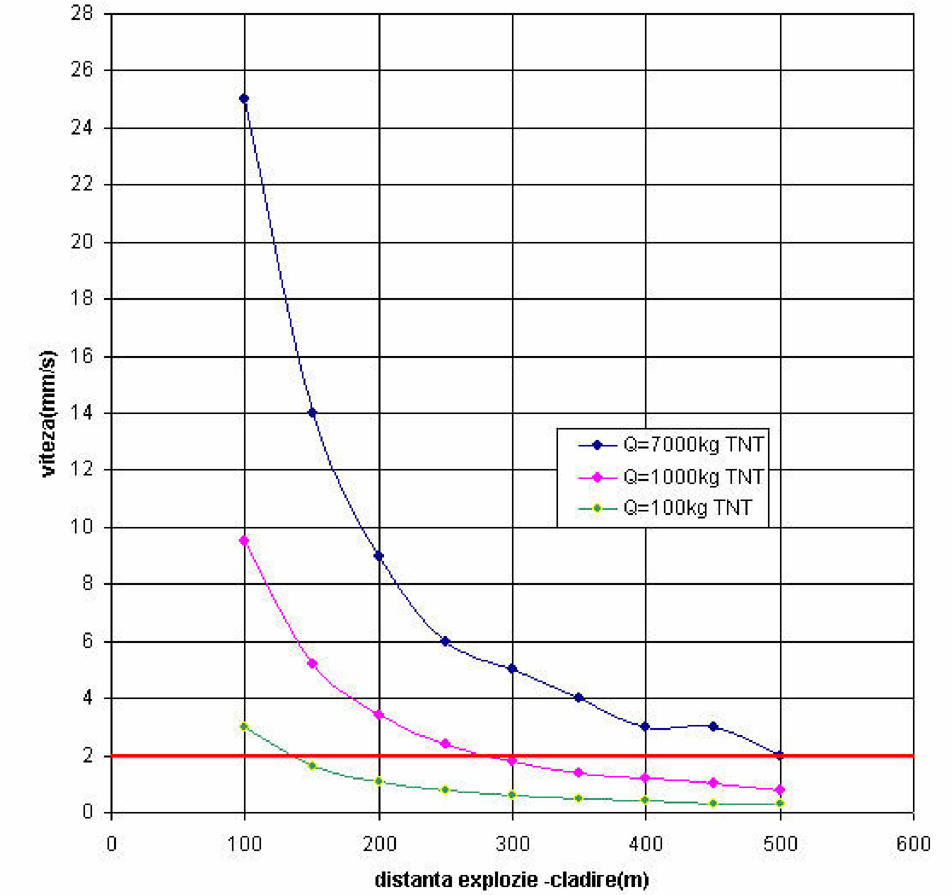
Values of the oscillation velocity of the material particle, table no. 2

Table no. 2

Blasting Type	Distance from the explosion centre				
	100 m	200 m	300 m	400 m	500 m
	Oscillation velocity [mm/s]				
Instantaneous	24,8	9,1	4,7	3,0	2,2
n∆t = 0,140 s micro-delay	17,6	6,5	3,3	2,2	1,6
n∆t = 0,600 s micro-delay	14,6	5,4	2,8	1,7	1,3

As shown in Table no. 2 and Figure no. 1, the oscillation velocity at a distance of 500 meters from the centre of the explosion corresponds, on the MKS scale, to natural earthquakes of 1st and 2nd degree. The dam of the Corna tailings management facility (TMF) is located approximately 2.5 km away from the Cetate open pit and approximately 3 km away from the Cârnic open pit. The further we move from the centre of the explosion, the lower the oscillation velocity and it can be stated that this velocity will be very low in the TMF area.

Figure 1. Diagram of the oscillation velocity variation depending on the distance depending on the load detonated per blasting phase.



The size of the TMF dam has been designed such as to resist even an exceptional earthquake (8 degrees on the Richter scale); therefore the seismic waves generated by the open pit blasting are significantly reduced by the distance and do not impact the dam or endanger its resistance.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project.

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	16
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Roşia Montană, 24.07.2006
RMGC internal unique code	MMGA_0084

Proposal

What will happen with Rosia Montana churches? After two blasting operations, they will be demolished.

Solution

The environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorized equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate Best Management Practices/Best Available Techniques for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see Tables 4.3.8 through 4.3.16 and Exhibits 4.3.1 through 4.3.9. All these details related to the applied assessment methodology, the input data of the dispersion model, the modeling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 Noise and Vibrations of the EIA Report.

Through the use of modern technologies, adequate measures and actions, the vibrations (or earthquakes) generated by the open pit explosions will be maintained within certain limits, such as to ensure the protection of the constructions and other historical monuments existing in the area and proposed for conservation.

S.C. Ipromin S.A. has prepared a study entitled "Geo-mechanical study for measuring the effects of quarrying operations on the constructions located inside the protected area" for the purpose of analyzing the effects of the excavation technologies to be used in the Roşia Montană mining perimeter and identifying the technological solutions to ensure the protection of the constructions existing inside the protected area or other heritage constructions, therefore of the churches located in that area.

In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the effects of quarrying explosions the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction.

Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roşia Montană.

Due to the fact that România has not adopted any standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83 – the most exigent European standard (Table no. 1).

Limit values of the oscillation velocity (mm/s) according to DIN 4150/83.

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

One may notice that the value of 3 mm/s is the maximum velocity admitted for the protection of historical monuments.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	52
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Abrud, 25.07.2006
RMGC internal unique code	MMGA_0165

Proposal	The questioner makes the following remarks and comments:The vibrations resulted after blasting are grounds for concern with respect to the effects on the structure of houses and other buildings located within the protected area and on the tailings management facility.

Solution

The environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorized equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate *Best* Management Practices/Best Available Techniques for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see **Tables 4.3.8** through **4.3.16** and **Exhibits 4.3.1** through **4.3.9**. All these details related to the applied assessment methodology, the input data of the dispersion model, the modeling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 Noise and Vibrations of the EIA Report.

Through the use of modern technologies, adequate measures and actions, the vibrations (or earthquakes) generated by the open pit explosions will be maintained within certain limits, such as to ensure the protection of the constructions and other historical monuments existing in the area and proposed for conservation.

S.C. Ipromin S.A. has prepared a study entitled "Geo-mechanical study for measuring the effects of quarrying operations on the constructions located inside the protected area" for the purpose of analyzing the effects of the excavation technologies to be used in the Roşia Montană mining perimeter and identifying the technological solutions to ensure the protection of the constructions existing inside the protected area or other heritage constructions.

In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the effects of quarrying explosions the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction.

Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roşia Montană.

Due to the fact that România has not adopted any standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83 – the most exigent European standard (Table no. 1).

Limit values of the oscillation velocity (mm/s) according to DIN 4150/83.

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

One may notice that the value of 3 mm/s is the maximum velocity admitted for the protection of historical monuments.

The secondary effects of open pit explosions, such as the oscillation velocity and over-pressure of the shock wave can be kept under control and reduced by a number of technical and organizational measures.

The over-pressure of the shock wave depends on the amount of explosive load and blasting technique (electrical or non-electrical, instantaneous or micro delay). It implies a risk to human beings and to highly deteriorated constructions. The shock wave over-pressure impact can be reduced using the same methods used in the case of the blast radius (work fronts orientation and compliance with the geometrical parameters of load placement).

The seismic wave (material particle oscillation) represents the most important secondary effect on the soil and constructions. This effect is assessed by the velocity, acceleration or movement of the material particle. For the protection of constructions, velocity is the most widely used parameter.

The oscillation velocity of the material particle has been used as a parameter for the delimitation of the two large areas of the open pits, under the condition of a maximum velocity of 0.2 cm/s measured at the nearest construction from the explosion centre.

This velocity ensures the protection of the constructions, provided that the consolidation works are executed. This value of the maximum velocity (of 0.2 cm/s) has been adopted based on the relevant standards existing in other countries having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83.

It is important to emphasize that it is not the quarrying technologies using explosives that represent a real threat to the 42 historical buildings, but rather their advanced state of degradation. For this reason, if no measures are taken, these buildings will be inevitably lost.

In conclusion, the special technologies used (within various zones) will not generate any adverse impact on the constructions from the Roșia Montană commune.

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Millisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 milliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 milliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly executed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of small intensity explosions will propagate the rock crushing wave.

When the old technology was used – option b), the entire amount was placed in adequately selected mines, and the entire mass of explosive was detonated simultaneously.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	52
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Abrud, 25.07.2006
RMGC internal unique code	MMGA_0166

Proposal

The questioner hasn't been able to find within the EIA, namely in the volume where the impact on noises and vibrations is included, the necessary information related to the value of these vibrations. He would very much like to receive the figures of the maximum vibration that will be produced by open pit blasting as compared with the value of these vibrations that is not hazardous to the structure of buildings and tailings management facility.

Solution

This statement is ungrounded, because the environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorized equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate Best Management Practices/Best Available Techniques for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see Tables 4.3.8 through 4.3.16 and Exhibits 4.3.1 through 4.3.9. All these details related to the applied assessment methodology, the input data of the dispersion model, the modeling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 Noise and Vibrations of the EIA Report.

Project Years 0, 9, 10, 12, 14, and 19 were selected for modeling because they are considered to be representative of the most significant levels of noise-generating activity. They are also the same years used for air impact modeling purposes in Section 4.2, as air and noise impacts share many of the same sources or are otherwise closely correlated. In order to more accurately reflect potential receptor impacts, all of these exhibits integrate the background traffic estimates discussed in Section 4.3.6.1.

The Project site plan and process plant area and facility drawings were used to establish the position of the noise sources and other relevant physical characteristics of the site. Receptor locations were established using background reports and project engineering and environmental documentation provided by RMGC. With this information, the source locations and receptor locations were translated into input (x, y, and z) co-ordinates for the noise-modeling program.

Tables 4.3.8 through 4.3.16 and Exhibits 4.3.1 through 4.3.9 present the average maximum noise values likely to be experienced by the receptor community over all Project phases after incorporation of a variety of initial mitigation measures designed specifically to reduce the impacts associated with mobile and stationary machinery sources. The influence of non-mining related background (primarily traffic) noise is also included.

To evaluate the sound levels associated with haul trucks and other mobile sources crossing the site carrying excavated ore, waste rock, and topsoil, a noise analysis program based on the (U.S.) Federal Highway Administration's (FHWA) standard RD-77-108 [1] model was used to calculate reference noise emissions values for heavy trucks along the project roadways. The FHWA model predicts hourly Leq values for free-flowing traffic conditions and is generally considered to be accurate within 1.5 decibels (dB).

The model is based on the standardized noise emission factors for different types and weights of vehicles (e.g., automobiles, medium trucks, and heavy trucks), with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The emission levels of all three vehicle types increase as a function of the logarithm of their speed.

To evaluate the sound sources from the proposed mine processing facility and the semistationary material handling equipment (at the ore extraction, rock and soil stockpiling areas), a proprietary computerised noise prediction program was used by AAC to simulate and model the future equipment noise emissions throughout the area. The modelling program uses industry-accepted propagation algorithms based on the following American National Standards Institute (ANSI) and International Organisation for Standardisation (ISO) standards:

- ANSI S1.26-1995 (R2004), Method for the Calculation of the Absorption of Sound by the Atmosphere;
- ISO 9613-1:1993, Acoustics -- Attenuation of sound during propagation outdoors-- Part 1: Calculation of the absorption of sound by the atmosphere;
- ISO 9613-2:1996, Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation;
- ISO 3891:1978, *Acoustics -- Procedure for describing aircraft noise heard on the ground.*

The calculations account for classical sound wave divergence (i.e., spherical spreading loss with adjustments for source directivity from point sources) plus attenuation factors due to air absorption, minimal ground effects, and barriers/shielding.

This model has been validated by AAC over a number of years via noise measurements at several operating industrial sites that had been previously modeled during the engineering design phases. The comparison of modeled predictions versus actual measurements has consistently shown close agreement; typically in the range of 1 to 3 dB (A).

Through the use of modern technologies, adequate measures and actions, the vibrations (or earthquakes) generated by the open pit explosions will be maintained within certain limits, such as to ensure the protection of the constructions and other historical monuments existing in the area and proposed for conservation.

S.C. Ipromin S.A. has prepared a study entitled "Geo-mechanical study for measuring the effects of quarrying operations on the constructions located inside the protected area" for the purpose of analyzing the effects of the excavation technologies to be used in the Roşia Montană mining perimeter and identifying the technological solutions to ensure the protection of the constructions existing inside the protected area or other heritage constructions.

In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the effects of quarrying explosions the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction.

Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roşia Montană.

Due to the fact that România, at the time of preparation of the EIA, had not adopted any specific standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83 – the most exigent European standard (Table no. 1).

Limit values of the oscillation velocity (mm/s) according to *DIN 4150/83*:

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

historical monuments.

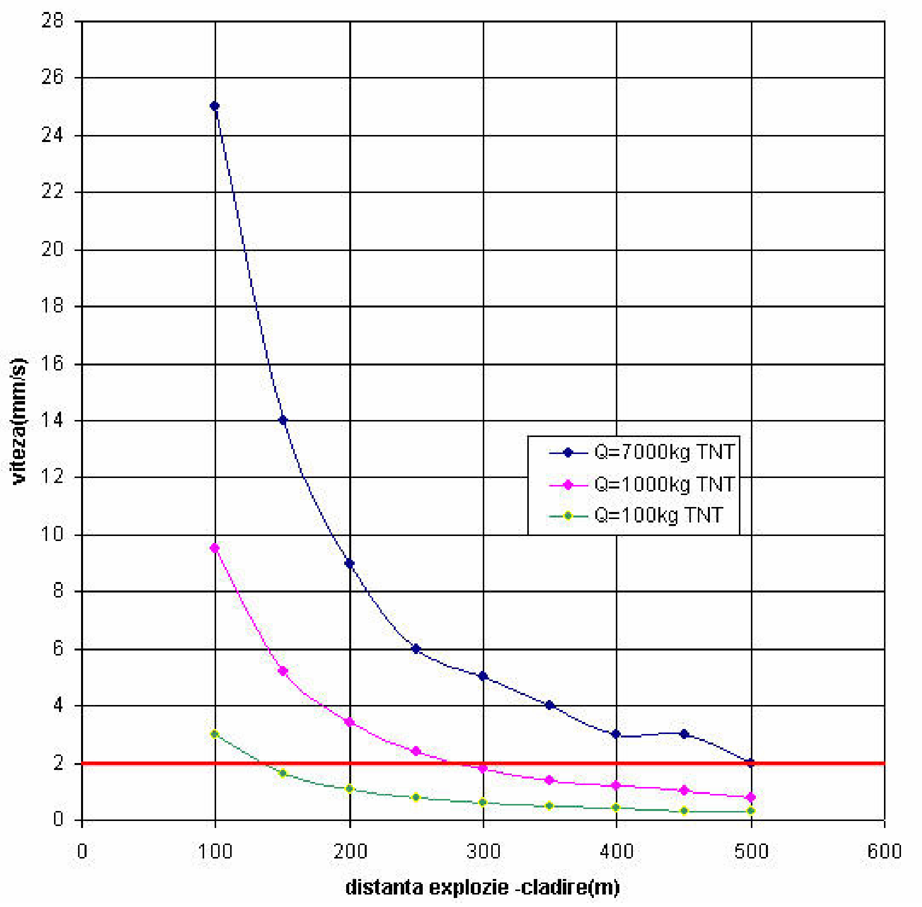
Using the formulas provided in the specialized literature, the values of the oscillation velocity at a distance of 100 m, 200 m and 300 m from the protected constructions have been determined, in case of blasting 6,860 kg per blasting phase.

The following values of the oscillation velocity of the material particle are determined (Table no. 2 and Figure 1).

Table no. 2

Blasting Type	Distance from the explosion centre				
	100 m	200 m	300 m	400 m	500 m
	Oscillation velocity [mm/s]				
Instantaneous	24,8	9,1	4,7	3,0	2,2
nΔt = 0,140 s micro-delay	17,6	6,5	3,3	2,2	1,6
nΔt = 0,600 s micro-delay	14,6	5,4	2,8	1,7	1,3

Figure 1. Diagram of the oscillation velocity variation depending on the distance depending on the load detonated per blasting phase.



According to the data presented in Table no. 2, the load can be used at distances of more than 300 m from the protected constructions, with micro delay.

This technology can be used for an area representing approximately 85% of the open pits area. At smaller distances, in order to ensure an oscillation velocity of maximum 0.2 cm/s next to the construction, *i.e.* to ensure a negligible seismic impact, some special technological options of the quarrying technology are required. Such technological options consist in the reduction of the bore hole diameter and depth, reduction of the amount of explosive detonated per blasting phase, etc.

This area covers approximately 15%, containing small amounts of ore to be blasted. Zone 2 extends to maximum 300 m from the nearest construction. In its turn, this zone is divided into three sub-zones of application of the technological options for ore blasting.

A maximum load of explosive/blasting phase corresponds to each sub-zone.

You can notice that the oscillation velocity at a distance of 500 meters from the centre of the explosion corresponds, on the MKS scale, to natural earthquakes of 1st and 2nd degree. The dam of the Corna tailings management facility (TMF) is located approximately 2.5 km away from the Cetate open pit and approximately 3 km away from the Cârnic open pit. The further we move from the centre of the explosion, the lower the oscillation speed and it can be stated that this speed will be very low in the TMF area.

The size of the TMF dam has been designed such as to resist even an exceptional earthquake; therefore the seismic waves generated by the open pit blasting are significantly reduced by the distance and do not impact the dam or endanger its resistance.

In order to measure the quarrying explosions impact on the constructions located inside the protected area and other historical buildings, a monitoring system will be implemented, consisting in a stationary network of digital seismographs, with three components installed at the main constructions to be protected, and a mobile network composed of three mobile seismographs installed on a longitudinal profile between the protected construction and the centre of the explosions. The processing of the monitoring data obtained during the operation of the Roşia Montană open pits will also determine the variation of the dynamic parameters of the seismic oscillations (seismic impact mitigation coefficient).

The secondary effects of open pit explosions, such as the oscillation velocity and over-pressure of the shock wave can be kept under control and reduced by a number of technical and organizational measures.

The over-pressure of the shock wave depends on the amount of explosive load and blasting technique (electrical or non-electrical, instantaneous or micro delay). It implies a risk to human beings and to highly deteriorated constructions. The shock wave over-pressure impact can be reduced using the same methods used in the case of the blast radius (work fronts orientation and compliance with the geometrical parameters of load placement).

The seismic wave (material particle oscillation) represents the most important secondary effect on the soil and constructions. This effect is assessed by the velocity, acceleration or movement of the material particle. For the protection of constructions, velocity is the most widely used parameter.

The oscillation velocity of the material particle has been used as a parameter for the delimitation of the two large areas of the open pits, under the condition of a maximum velocity of 0.2 cm/s measured at the nearest construction from the explosion centre.

This velocity ensures the protection of the constructions, provided that the consolidation works are performed. This value of the maximum velocity (of 0.2 cm/s) has been adopted based on the relevant standards existing in other countries having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83.

It is important to emphasize that it is not the quarrying technologies using explosives that represent a real threat to the 42 historical buildings, but rather their advanced state of degradation. For this reason, if no measures are taken, these buildings will be inevitably lost.

In conclusion, the special technologies used (within various zones) will not generate any adverse impact on the constructions from the Roşia Montană commune.

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Millisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 milliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 milliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly executed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of small intensity explosions will propagate the rock crushing wave.

When the old technology was used – option b), the entire amount was placed in adequately selected galleries, and the entire mass of explosive was detonated simultaneously.

RESTRICTIONS

Romanian Standard SR 12025: **Vibration effects produced by road traffic on buildings or building parts (Measurement methods)**: establishes the methods of measurement for the traffic vibration propagated through streets and affecting buildings or building components.

Romanian Standard SR 12025/2-94: **Vibration effects on buildings or building parts. (Permissible limits).** Establishes the admissible limits for dwellings and socio-cultural buildings as well as occupants who may be affected by vibration, either from internal/external machinery or from propagated vibration from street traffic. The data are presented in Table 5.1 and Figure 5.2 in the *Noise and Vibrations Management Plan*. For the least resistant type of buildings, C3 curve for admissible limits is recommended (measured in vibrars).

The conversion of **vibrars** in the measurement units used by standard DIN 4150/83, *i.e.* ***mm/s,*** indicates the comparable maximum admissible limits.

Perceived vibration level [2]

Vibration Level [mm/s]	Degree of Perception
0,10	Not felt
0,15	Threshold of perception
0,35	Barely noticeable
1,0	Noticeable
2,2	Easily noticeable
6,0	Strongly noticeable
14,0	Very strongly noticeable

The Noise and Vibration Management Plan implies the following (p. 17):
- conduct blasting tests in pits;
- evaluate results;
- prepare site-specific blasting plans;
- monitoring.

References:
[1] FHWA Highway Traffic Noise Prediction Model; see Federal Highway Administration Report Number FHWA-RD-77-108, USA, Washington, D.C., 1978;
[2] S.C. Roșia Montană Gold Corporation S.A. - Report on Environmental Impact Assessment Study, Noise and Vibration Management Plan, p. 8, table 4-1, 2006.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	52
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Abrud, 25.07.2006
RMGC internal unique code	MMGA_0167

Proposal

The questioner would like to receive an answer by the end of the public debate, because for vibrations there is a management plan that should be based on several actual figures.

Solution

Through the use of modern technologies, adequate measures and actions, the vibrations (or earthquakes) generated by the open pit explosions will be maintained within certain limits, such as to ensure the protection of the constructions and other historical monuments existing in the area and proposed for conservation.

S.C. Ipromin S.A. has prepared a study entitled "Geo-mechanical study for measuring the effects of quarrying operations on the constructions located inside the protected area" for the purpose of analyzing the effects of the excavation technologies to be used in the Roşia Montană mining perimeter and identifying the technological solutions to ensure the protection of the constructions existing inside the protected area or other heritage constructions.

In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the effects of quarrying explosions the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction.

Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roşia Montană.

Due to the fact that România has not adopted any standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83 – the most exigent European standard (Table no. 1).

Limit values of the oscillation velocity (mm/s) according to DIN 4150/83.

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

One may notice that the value of 3 mm/s is the maximum velocity admitted for the protection of historical monuments.

The secondary effects of open pit explosions, such as the oscillation velocity and over-pressure of the shock wave can be kept under control and reduced by a number of technical and organizational measures.

The over-pressure of the shock wave depends on the amount of explosive load and blasting technique (electrical or non-electrical, instantaneous or micro delay). It implies a risk to human beings and to highly deteriorated constructions. The shock wave over-pressure impact can be reduced using the same methods used in the case of the blast radius (work fronts orientation and compliance with the geometrical

The seismic wave (material particle oscillation) represents the most important secondary effect on the soil and constructions. This effect is assessed by the velocity, acceleration or movement of the material particle. For the protection of constructions, velocity is the most widely used parameter.

The oscillation velocity of the material particle has been used as a parameter for the delimitation of the two large areas of the open pits, under the condition of a maximum velocity of 0.2 cm/s measured at the nearest construction from the explosion centre.

This velocity ensures the protection of the constructions, provided that the consolidation works are executed. This value of the maximum velocity (of 0.2 cm/s) has been adopted based on the relevant standards existing in other countries having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83.

It is important to emphasize that it is not the quarrying technologies using explosives that represent a real threat to the 42 historical buildings, but rather their advanced state of degradation. For this reason, if no measures are taken, these buildings will be inevitably lost.

In conclusion, the special technologies used (within various zones) will not generate any adverse impact on the constructions from the Roşia Montană commune.

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Millisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 milliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 milliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly performed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of small intensity explosions will propagate the rock crushing wave.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	80
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Câmpeni, 26.07.2006
RMGC internal unique code	MMGA_0196

Proposal

The questioner makes the following remarks and comments:He would like to receive guarantees that he may live a quiet life in Rosia Montana, that he won't be affected by pollution, noise and dust.

Solution

Atmospheric pollutants occur everywhere in the ambient air, with less or higher concentrations, their emission sources being both anthropic (human activities) and natural.

As regards the atmospheric pollutants generated by the mining activities proposed by Roşia Montană Project, we specify that the area from the vicinity of the industrial perimeter, although relatively close to industrial site, is a part of its external areas and is exposed at the lowest extent to these pollutants. The sole pollutant which could influence, at a certain extent, the air quality from area is represented by particles. The Maximum concentrations of particles in the air neighboring the industrial perimeter will be of 4 up to more than 20 times lower than the standard value for the protection of the population's health. The concentrations of other pollutants to be generated by future mining activities in the area neighboring the industrial perimeter will be insignificant.

It is mentioned that any locality, irrespective of the existence of industrial activity, the quality of the air is given by the local sources inherent for day-to-day life of the residents, namely: heating, cooking, traffic, etc.

The levels of pollution by particles of the air neighboring the industrial perimeter, due to the effect of the local sources together with the future mining activities, will be lower than the limit values for population's health protection.

The atmospheric dispersion modeling has been performed using the best available techniques in order to simulate the transport of the pollutants generated by the mining activities outside the Project area. AERMOD incorporates through a new and simple approach the current concepts regarding flow and dispersion in complex terrains. If needed, the plume is modeled either with a trajectory impacting the terrain or with a trajectory following the terrain topography.

AERMOD may forecast concentrations of pollutants from multiple sources for a wide variety of sites, meteorological conditions, types of pollutants and mediation periods. For this project, the concentrations on short term have been calculated using the maximum hourly rates of emission for activities developed simultaneously and for the averages calculated for intervals of 1 hour, 8 hours and 24 hours. The annual concentrations have been calculated using all active sources during the respective year.

For the dust emission control from open pits and haulage roads of ore and waste rock, the following measures have been taken:

- Utilization of a new blasting technology, namely the sequential blasting technology which reduces drastically the height of the dust plume and dispersion area;
- Ceasing of the activities generating dust during the periods with intense winds or when the automatic monitor for particles installed in the Roşia Montană protection area indicates an alert situation;
- Implementation of a program for dust control on the unpaved roads during the drought seasons by means of watering trucks and inert substances for dust restraining. These measures will reduce the dust emissions with 90%;
- Minimizing of the unloading height at manipulation/discharge of materials;
- Prescribing and application of speed limitation on traffic;

- Implementation of a program of periodically maintenance of vehicles and motorized equipments;
- Automatic monitoring of the air quality and meteorological parameters;
- Implementation of additional measures for dust emission control: ore and waste rock watering at the loading into trucks.

The noise and vibration management plan, Air quality management plan as well as the other management plans propose measures which proved their efficiency in similar projects and maintain the parameters of noise and vibration phenomena as well as the air quality within normal limits. These plans provide also the monitoring system of these parameters which will be implemented by the project as well as the potential proposed measures for their mitigation.

The blasting activities in open pits as well as the displacement of heavy equipments are allowed only if the parameters of the generated vibrations are maintained within the limits imposed by legislation.

The EIA study presents the admissible maximum limits regarding the security of buildings and the procedures keeping the vibration parameters within these limits. The pertinent blasting designs combined with blasting tests and step by step optimization corrections as well as the utilization of specific control and prevention measures and actions will assure the vibration, noise and dust parameters below the admissible limits.

Heavy equipments may produce ground vibrations. For this reason the measures stipulate roads design at great enough distances so that the vibrations will imply low amplitudes. Also, the transport speed in critical areas is reduced so that the vibration parameters will have values below the admissible limits stipulated by the standards in force for residential areas.

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	104
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Câmpeni, 26.07.2006
RMGC internal unique code	MMGA_0236

Proposal

Why the walls of the houses are cracked due to explosions, if they are not impacting anyone?

Solution

It is possible that the former pit blasting from Roşia Montană affected some of the buildings located in the nearby area, causing cracks in the walls. It should be mentioned that the cracking of the plastering or walls of the buildings may have other causes, too, such as land sinking or sliding, aging of the constructions without taking any consolidation and maintenance measures; these causes also appear within areas where no mining activities are carried out.

The new Roşia Montană project will use modern blasting technologies, and the adaptation thereof, depending on the monitoring results, such as to minimize the impact upon constructions.

S.C. Ipromin S.A. has prepared a study entitled "Geo-mechanical study for measuring the effects of quarrying operations on the constructions located inside the protected area" for the purpose of analyzing the effects of the excavation technologies to be used in the Roşia Montană mining perimeter and identifying the technological solutions to ensure the protection of the constructions existing inside the protected area or other heritage constructions.

In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the effects of quarrying explosions the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction.

Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roşia Montană.

Due to the fact that România, by the time of preparation of the EIA study, had not adopted any specific standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83 – the most exigent European standard (Table no. 1).

Limit values of the oscillation velocity (mm/s) according to *DIN 4150/83.*

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

One may notice that the value of 3 mm/s is the maximum velocity admitted for the protection of historical monuments.

Using the formulas provided in the specialized literature, the values of the oscillation velocity at a distance of 100 m, 200 m and 300 m from the protected constructions have been determined, in case of blasting

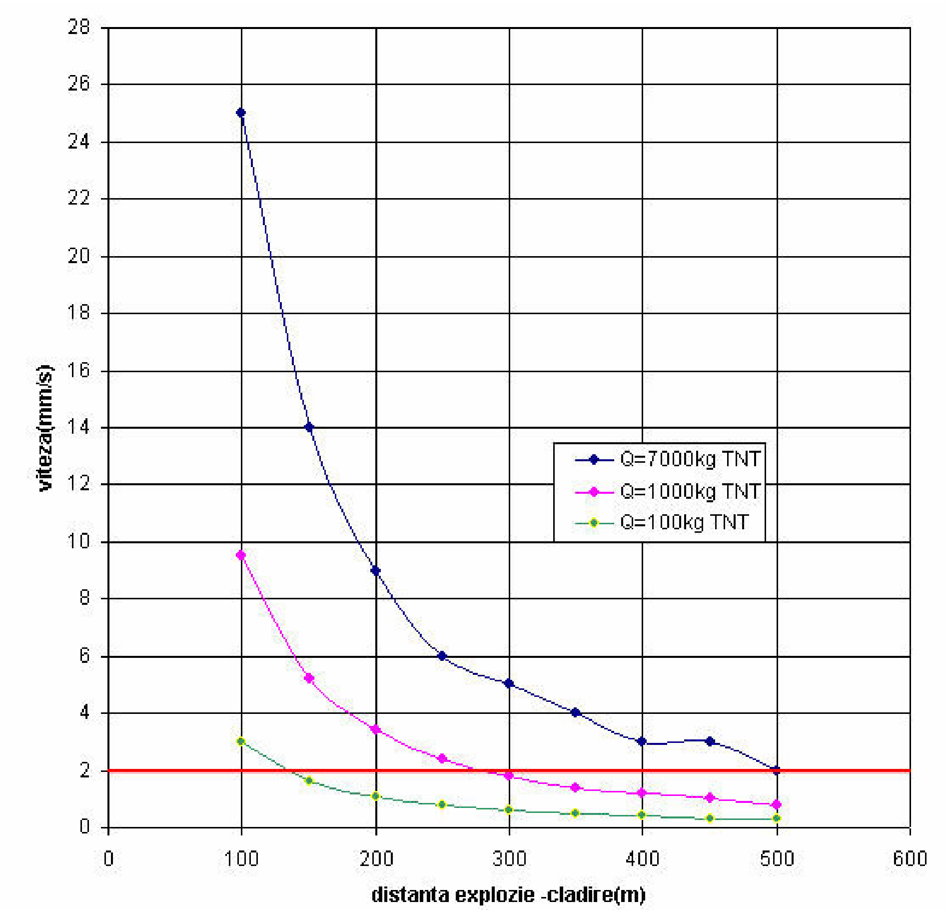
6,860 kg per blasting phase.

The following values of the oscillation velocity of the material particle are determined (Table no. 2 and Figure 1).

Table no. 2

Blasting Type	Distance from the explosion centre				
	100 m	200 m	300 m	400 m	500 m
	Oscillation velocity [mm/s]				
Instantaneous	24,8	9,1	4,7	3,0	2,2
nΔt = 0,140 s micro-delay	17,6	6,5	3,3	2,2	1,6
nΔt = 0,600 s micro-delay	14,6	5,4	2,8	1,7	1,3

Figure 1. Diagram of the oscillation velocity variation depending on the distance depending on the load detonated per blasting phase.



This technology can be used for an area representing approximately 85% of the open pits area.

At smaller distances, in order to ensure an oscillation velocity of maximum 0.2 cm/s next to the construction, *i.e.* to ensure a negligible seismic impact, some special technological variants of the quarrying technology are required. Such technological variants consist in the reduction of the auger hole diameter and depth, reduction of the amount of explosive detonated per blasting phase, etc.

This area covers approximately 15%, containing small amounts of ore to be blasted. Zone 2 extends to maximum 300 m from the nearest construction. In its turn, this zone is divided into three sub-zones of application of the technological variants for ore blasting.

A maximum load of explosive/blasting phase corresponds to each sub-zone.

In order to measure the quarrying explosions impact on the constructions located inside the protected area and other historical buildings, a monitoring system will be implemented, consisting in a stationary network of digital seismographs, with three components installed at the main constructions to be protected, and a mobile network composed of three mobile seismographs installed on a longitudinal profile between the protected construction and the centre of the explosions. The processing of the monitoring data obtained during the operation of the Roşia Montană open pits will also determine the variation of the dynamic parameters of the seismic oscillations (seismic impact mitigation coefficient).

The secondary effects of open pit explosions, such as the oscillation velocity and over-pressure of the shock wave can be kept under control and reduced by a number of technical and organizational measures.

The over-pressure of the shock wave depends on the amount of explosive load and blasting technique (electrical or non-electrical, instantaneous or micro delay). It implies a risk to human beings and to highly deteriorated constructions. The shock wave over-pressure impact can be reduced using the same methods used in the case of the blast radius (work fronts orientation and compliance with the geometrical parameters of load placement).

The seismic wave (material particle oscillation) represents the most important secondary effect on the soil and constructions. This effect is assessed by the velocity, acceleration or movement of the material particle. For the protection of constructions, velocity is the most widely used parameter.

The oscillation velocity of the material particle has been used as a parameter for the delimitation of the two large areas of the open pits, under the condition of a maximum velocity of 0.2 cm/s measured at the nearest construction from the explosion centre.

This velocity ensures the protection of the constructions, provided that the consolidation works are executed. This value of the maximum velocity (of 0.2 cm/s) has been adopted based on the relevant standards existing in other countries having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83.

It is important to emphasize that it is not the quarrying technologies using explosives that represent a real threat to the 42 historical buildings, but rather their advanced state of degradation. For this reason, if no measures are taken, these buildings will be inevitably lost.

In conclusion, the special technologies used (within various zones) will not generate any adverse impact on the constructions from the Roşia Montană commune.

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Millisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 milliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 milliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly performed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of small intensity explosions will propagate the rock crushing wave.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	125
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Alba Iulia, 31.07.2006
RMGC internal unique code	MMGA_0289

Proposal

How are the monument houses, that are located within the mining area, going to be protected? Out of those 41, only 6 are located within this area, but how are they going to be protected when bulldozers and haul trucks will produce vibrations that could demolish a house built yesterday not to mention one built 100 years ago?

Solution

Of the 41 historical houses, 35 are located inside the protected area and 6 outside this area. None of them will be destroyed due to the project implementation. Both the pit explosions and the use of heavy equipment may produce vibrations; however, the use of adequate technologies, measures and actions, such as those indicated in the Noise and Vibration Management Plan (Volume 24) can maintain these vibrations within certain limits, such as to ensure the protection of all constructions.

Heavy equipment may produce land vibrations, which are transmitted to the weak buildings located near the roads. For this reason, the measures provide the execution of roads at a sufficient distance from the buildings, such as to reduce the impact of vibrations; also, the traveling speed inside the critical areas is reduced to the point that the values of vibration parameters are below the admissible limits stipulated by the Romanian Standard 12025 -94.

In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the vibrations generated by the specific operations the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction.

Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roșia Montană.

Due to the fact that România, by the time of preparation of the EIA study, had not adopted any specific standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83 – the most exigent European standard (Table no. 1)

Limit values of the oscillation velocity (mm/s) according to *DIN 4150/83*

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

One may notice that the value of 3 mm/s is the maximum velocity admitted for the protection of historical monuments.

This technology can be used for an area representing approximately 85% of the open pits area. At smaller distances, in order to ensure an oscillation velocity of maximum 0.2 cm/s next to the construction, *i.e.* to ensure a negligible seismic impact, some special technological variants of the quarrying technology are required. Such technological variants consist in the reduction of the auger hole diameter and depth, This area covers approximately 15%, containing small amounts of ore to be blasted. Zone 2 extends to maximum 300 m from the nearest construction. In its turn, this zone is divided into three sub-zones of application of the technological variants for ore blasting.

A maximum load of explosive/blasting phase corresponds to each sub-zone.

In order to measure the quarrying explosions impact on the constructions located inside the protected area and other historical buildings, a monitoring system will be implemented, consisting in a fixed network of digital seismographs, with three components installed at the main constructions to be protected, and a mobile network composed of three mobile seismographs installed on a longitudinal profile between the protected construction and the centre of the explosions. The processing of the monitoring data obtained during the operation of the Roşia Montană open pits will also determine the variation of the dynamic parameters of the seismic oscillations (seismic impact mitigation coefficient).

The secondary effects of open pit explosions, such as the oscillation velocity and over-pressure of the shock wave can be kept under control and reduced by a number of technical and organizational measures.

The over-pressure of the shock wave depends on the amount of explosive load and blasting technique (electrical or non-electrical, instantaneous or micro delay). It implies a risk to human beings and to highly deteriorated constructions. The shock wave over-pressure impact can be reduced using the same methods used in the case of the blast radius (work fronts orientation and compliance with the geometrical parameters of load placement).

The seismic wave (material particle oscillation) represents the most important secondary effect on the soil and constructions. This effect is assessed by the velocity, acceleration or movement of the material particle. For the protection of constructions, velocity is the most widely used parameter.

The oscillation velocity of the material particle has been used as a parameter for the delimitation of the two large areas of the open pits, under the condition of a maximum velocity of 0.2 cm/s measured at the nearest construction from the explosion centre.

This velocity ensures the protection of the constructions, provided that the consolidation works are executed. This value of the maximum velocity (of 0.2 cm/s) has been adopted based on the relevant standards existing in other countries having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83.

It is important to emphasize that it is not the quarrying technologies using explosives that represent a real threat to the 42 historical buildings, but rather their advanced state of degradation. For this reason, if no measures are taken, these buildings will be inevitably lost.

In conclusion, the special technologies used (within various zones) will not generate any adverse impact on the constructions from the Roşia Montană commune.

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Millisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 milliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 milliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly executed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of *small intensity explosions will propagate the rock crushing wave.*

RESTRICTIONS

Romanian Standard SR 12025: **Vibration effects produced by road traffic on buildings or building parts (Measurement methods)**: establishes the methods of measurement for the traffic vibration propagated through streets and affecting buildings or building components.

Romanian Standard SR 12025/2-94: **Vibration effects on buildings or building parts. (Permissible limits).** Establishes the admissible limits for dwellings and cultural buildings as well as occupants who may be affected by vibration, either from internal/external machinery or from propagated vibration from street traffic. The data are presented in Table 5.1 and Figure 5.2 in the Noise and Vibrations Management Plan. For the least resistant type of buildings, C3 curve for admissible limits is recommended (measured in vibrars).

The conversion of **vibrars** in the measurement units used by standard *DIN 4150/83*, *i.e.* ***mm/s,*** indicates the comparable maximum admissible limits.

Perceived vibration level [1]

Vibration Level [mm/s]	Degree of Perception
0,10	Not felt
0,15	Threshold of perception
0,35	Barely noticeable
1,0	Noticeable
2,2	Easily noticeable
6,0	Strongly noticeable
14,0	Very strongly noticeable

The Noise and Vibration Management Plan implies the following (p. 17):
- conduct blasting tests in pits;
- evaluate results;
- prepare site-specific blasting plans;
- monitoring.

References:
[1] S.C. Roşia Montană Gold Corporation S.A. - Report on Environmental Impact Assessment Study, Noise and Vibration Management Plan, p. 8, table 4-1, 2006.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	160
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Zlatna, 02.08.2006
RMGC internal unique code	MMGA_0343
Proposal	How can the civic Centre, Roman Galleries, cemeteries, churches, archaeological evidences be preserved among so many tons of explosives that will generate earthquakes?
Solution	The environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorized equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate Best Management Practices/Best Available Techniques for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see **Tables 4.3.8** through **4.3.16** and **Exhibits 4.3.1** through **4.3.9**. All these details related to the applied assessment methodology, the input data of the dispersion model, the modeling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 Noise and Vibrations of the EIA Report. Through the use of modern technologies, adequate measures and actions, the vibrations (or earthquakes) generated by the open pit explosions will be maintained within certain limits, such as to ensure the protection of the constructions and other historical monuments existing in the area and proposed for conservation. S.C. Ipromin S.A. has prepared a study entitled "Geo-mechanical study for measuring the effects of quarrying operations on the constructions located inside the protected area" for the purpose of analyzing the effects of the excavation technologies to be used in the Roşia Montană mining perimeter and identifying the technological solutions to ensure the protection of the constructions existing inside the protected area or other heritage constructions. In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the effects of quarrying explosions, the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction. Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roşia Montană. Due to the fact that România, at the time of preparation of the EIA, had not adopted any specific standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83 – the most exigent European standard (Table no. 1). Limit values of the oscillation velocity (mm/s) according to DIN 4150/83.

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

One may notice that the value of 3 mm/s is the maximum velocity admitted for the protection of historical monuments.

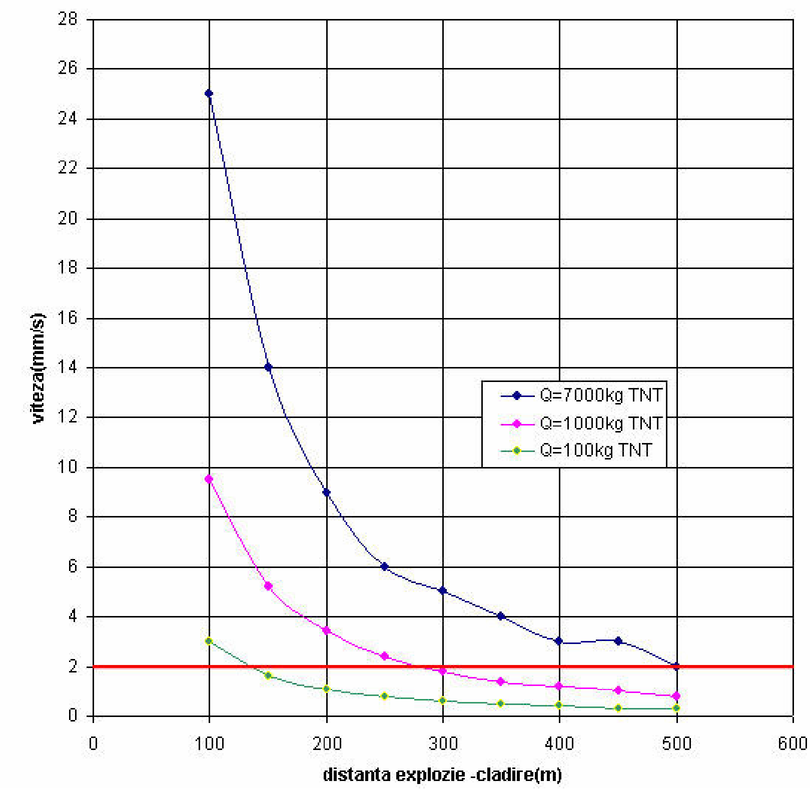
Using the formulas provided in the specialized literature, the values of the oscillation velocity at a distance of 100 m, 200 m and 300 m from the protected constructions have been determined, in case of blasting 6,860 kg per blasting phase.

The following values of the oscillation velocity of the material particle are determined (Table no. 2 and Figure 1).

Table no. 2

Blasting Type	Distance from the explosion centre				
	100 m	200 m	300 m	400 m	500 m
	Oscillation velocity [mm/s]				
Instantaneous	24,8	9,1	4,7	3,0	2,2
nΔt = 0,140 s micro-delay	17,6	6,5	3,3	2,2	1,6
nΔt = 0,600 s micro-delay	14,6	5,4	2,8	1,7	1,3

Figure 1. Diagram of the oscillation velocity variation depending on the distance depending on the load detonated per blasting phase.



This technology can be used for an area representing approximately 85% of the open pits area. At smaller distances, in order to ensure an oscillation velocity of maximum 0.2 cm/s next to the construction, *i.e.* to ensure a negligible seismic impact, some special technological variants of the quarrying technology are required. Such technological variants consist in the reduction of the auger hole diameter and depth, reduction of the amount of explosive detonated per blasting phase, etc.

This area covers approximately 15%, containing small amounts of ore to be blasted. Zone 2 extends to maximum 300 m from the nearest construction. In its turn, this zone is divided into three sub-zones of application of the technological variants for ore blasting.

A maximum load of explosive/blasting phase corresponds to each sub-zone.

In order to measure the quarrying explosions impact on the constructions located inside the protected area and other historical buildings, a monitoring system will be implemented, consisting in a fixed network of digital seismographs, with three components installed at the main constructions to be protected, and a mobile network composed of three mobile seismographs installed on a longitudinal profile between the protected construction and the centre of the explosions. The processing of the monitoring data obtained during the operation of the Roşia Montană open pits will also determine the variation of the dynamic parameters of the seismic oscillations (seismic impact mitigation coefficient).

The secondary effects of open pit explosions, such as the oscillation velocity and over-pressure of the shock wave can be kept under control and reduced by a number of technical and organizational measures.

The over-pressure of the shock wave depends on the amount of explosive load and blasting technique (electrical or non-electrical, instantaneous or micro delay). It implies a risk to human beings and to highly deteriorated constructions. The shock wave over-pressure impact can be reduced using the same methods used in the case of the blast radius (work fronts orientation and compliance with the geometrical parameters of load placement).

The seismic wave (material particle oscillation) represents the most important secondary effect on the soil and constructions. This effect is assessed by the velocity, acceleration or movement of the material particle. For the protection of constructions, velocity is the most widely used parameter.

The oscillation velocity of the material particle has been used as a parameter for the delimitation of the two large areas of the open pits, under the condition of a maximum velocity of 0.2 cm/s measured at the nearest construction from the explosion centre.

This velocity ensures the protection of the constructions, provided that the consolidation works are executed. This value of the maximum velocity (of 0.2 cm/s) has been adopted based on the relevant standards existing in other countries having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83.

It is important to emphasize that it is not the quarrying technologies using explosives that represent a real threat to the 42 historical buildings, but rather their advanced state of degradation. For this reason, if no measures are taken, these buildings will be inevitably lost.

In conclusion, the special technologies used (within various zones) will not generate any adverse impact on the constructions from the Roşia Montană commune.

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Milisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 miliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 miliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly executed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of *small intensity explosions will propagate the rock crushing wave.*

When the old technology was used – variant b), the entire amount was placed in adequately selected galleries, and the entire mass of explosive was detonated simultaneously.

A detailed presentation of blasting technology can be found in the annex 7.1 - proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	202
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Cluj Napoca, 07.08.2006
RMGC internal unique code	MMGA_0410

Proposal

How will the historical centre be protected against earthquakes generated by mining operations?

Solution

The environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorized equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate Best Management Practices/Best Available Techniques for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see **Tables 4.3.8** through **4.3.16** and **Exhibits 4.3.1** through **4.3.9**. All these details related to the applied assessment methodology, the input data of the dispersion model, the modeling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 Noise and Vibrations of the EIA Report.

Through the use of modern technologies, adequate measures and actions, the vibrations (or earthquakes) generated by the open pit explosions will be maintained within certain limits, such as to ensure the protection of the constructions and other historical monuments existing in the area and proposed for conservation.

S.C. Ipromin S.A. has prepared a study entitled "Geo-mechanical study for measuring the effects of quarrying operations on the constructions located inside the protected area" for the purpose of analyzing the effects of the excavation technologies to be used in the Roşia Montană mining perimeter and identifying the technological solutions to ensure the protection of the constructions existing inside the protected area or other heritage constructions.

In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the effects of quarrying explosions the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction.

Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roşia Montană.

Due to the fact that România, at the time of preparation of the EIA, had not adopted any specific standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83 – the most exigent European standard (Table no. 1).

Limit values of the oscillation velocity (mm/s) according to DIN 4150/83.

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

One may notice that the value of 3 mm/s is the maximum velocity admitted for the protection of historical monuments.

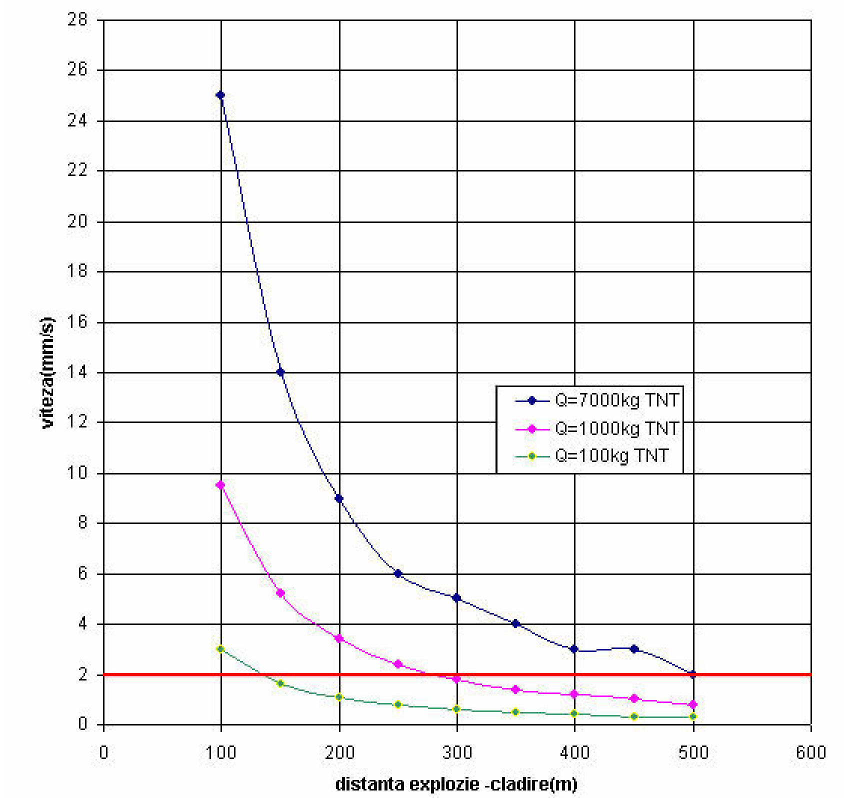
Using the formulas provided in the specialized literature, the values of the oscillation velocity at a distance of 100 m, 200 m and 300 m from the protected constructions have been determined, in case of blasting 6,860 kg per blasting phase.

The following values of the oscillation velocity of the material particle are determined (Table no. 2 and Figure 1)

Table no. 2

Blasting Type	Distance from the explosion centre				
	100 m	200 m	300 m	400 m	500 m
	Oscillation velocity [mm/s]				
Instantaneous	24,8	9,1	4,7	3,0	2,2
nΔt = 0,140 s micro-delay	17,6	6,5	3,3	2,2	1,6
nΔt = 0,600 s micro-delay	14,6	5,4	2,8	1,7	1,3

Figure 1. Diagram of the oscillation velocity variation depending on the distance depending on the load detonated per blasting phase.



This technology can be used for an area representing approximately 85% of the open pits area.

At smaller distances, in order to ensure an oscillation velocity of maximum 0.2 cm/s next to the construction, *i.e.* to ensure a negligible seismic impact, some special technological variants of the quarrying technology are required. Such technological variants consist in the reduction of the bore hole diameter and depth, reduction of the amount of explosive detonated per blasting phase, etc.

This area covers approximately 15%, containing small amounts of ore to be blasted. Zone 2 extends to maximum 300 m from the nearest construction. In its turn, this zone is divided into three sub-zones of application of the technological variants for ore blasting.

A maximum load of explosive/blasting phase corresponds to each sub-zone.

In order to measure the quarrying explosions impact on the constructions located inside the protected area and other historical buildings, a monitoring system will be implemented, consisting in a fixed network of digital seismographs, with three components installed at the main constructions to be protected, and a mobile network composed of three mobile seismographs installed on a longitudinal profile between the protected construction and the centre of the explosions. The processing of the monitoring data obtained during the operation of the Roşia Montană open pits will also determine the variation of the dynamic parameters of the seismic oscillations (seismic impact mitigation coefficient).

The secondary effects of open pit explosions, such as the oscillation velocity and over-pressure of the shock wave can be kept under control and reduced by a number of technical and organizational measures.

The over-pressure of the shock wave depends on the amount of explosive load and blasting technique (electrical or non-electrical, instantaneous or micro delay). It implies a risk to human beings and to highly deteriorated constructions. The shock wave over-pressure impact can be reduced using the same methods used in the case of the blast radius (work fronts orientation and compliance with the geometrical parameters of load placement).

The seismic wave (material particle oscillation) represents the most important secondary effect on the soil and constructions. This effect is assessed by the velocity, acceleration or movement of the material particle. For the protection of constructions, velocity is the most widely used parameter.

The oscillation velocity of the material particle has been used as a parameter for the delimitation of the two large areas of the open pits, under the condition of a maximum velocity of 0.2 cm/s measured at the nearest construction from the explosion centre.

This velocity ensures the protection of the constructions, provided that the consolidation works are executed. This value of the maximum velocity (of 0.2 cm/s) has been adopted based on the relevant standards existing in other countries having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83.

It is important to emphasize that it is not the quarrying technologies using explosives that represent a real threat to the 42 historical buildings, but rather their advanced state of degradation. For this reason, if no measures are taken, these buildings will be inevitably lost.

In conclusion, the special technologies used (within various zones) will not generate any adverse impact on the constructions from the Roșia Montană commune.

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Millisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 milliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 milliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly executed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of small intensity explosions will propagate the rock crushing wave.

When the old technology was used – option b), the entire amount was placed in adequately selected galleries, and the entire mass of explosive was detonated simultaneously.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	203
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Cluj Napoca, 07.08.2006
RMGC internal unique code	MMGA_0413
Proposal	What guarantee can the company offer for the impacts that blasting procedures may cause on the geological structure of the area, both throughout the development of mining operation and on long term, combined with the influence and action of other environmental factors, especially when temperature is higher and higher every year.
Solution	The environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorized equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate Best Management Practices/Best Available Techniques for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see **Tables** 4.3.8 through 4.3.16 and **Exhibits** 4.3.1 through 4.3.9. All these details related to the applied assessment methodology, the input data of the dispersion model, the modeling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 Noise and Vibrations of the EIA Report. Previous underground and massive surface blasting has been carried out in the area of the Roşia Montană deposit. The impact of these blasting operations on the geological structure has been limited to very small distances, such impact being insignificant on longer distances. A relevant example is represented by the underground galleries underneath the Cetate pit, which resisted the massive blasting carried out in this pit, although they were not reinforced. Only the works located 10-15 m underneath the pit floor have been impacted, several blocks falling due to the local increase of the rock cracking degree. Alternations of the geological structure of an area may occur only in case of natural disasters, involving huge energy releases, leading to temperature modifications and extremely high pressure, which does not happen in the case of pit explosions. The geological structure of the area neighboring the pits will not be altered, the vibrations transmitted to the areas near the pits having a low intensity and causing deformations only in the elastic range. "The temperature and other environmental factors" do not have any perceivable impact on the geological structure. *A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project*

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	213
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Cluj Napoca, 07.08.2006
RMGC internal unique code	MMGA_0433

Proposal	The destruction of the geological structures of lands at Rosia Montana represents a hazard by using those 150,000 tons of dynamite, or a blessing for the Apuseni Mountains locals?
Solution	The quantity of TNT mentioned in the question is over-exaggerated, and the tendentious wording of the question is misleading. In reality, during a blasting phase, up to 1,296 kg AM will be detonated, resulting in a mining mass of 8,000 – 10,000 t. In order to obtain the daily production (tailings and ore), the movement of the rock of approx. 28-32 mining panels is necessary, respectively the detonation of a quantity of approx. 10 t of explosive AM-type, as presented in Chapter 2 – Technological Processes, Section 4.1.1.2, p 60 et seq. The priming will be of sequential type and NONEL-type non-electric fuses (non-electric) and detonating wire will be used, technology that assures a mining mass crushing degree compatible to the loading machines capacity and determines the reduction of the exploded rock spreading area. For the definitive outlining of the pit sides, bore holes similar to those used for recovery will be used having though a smaller explosive quantity with approx. 20% compared to the production holes, the start being given by dynamite cartridges. For the detonation the NONEL technology will be used. The load blasting order will be performed with micro delay, from the hole center to the base part and to the upper one, and from the center hole of the first row to the side extremities and to the following rows, technology that assures the significant decrease of the seismic intensity and an increased effectiveness of the rock movement explosions. The "destruction" of certain geological structures may occur in case of natural cataclysms, such as volcanic eruptions or earthquakes of maximum intensity, which involve the release of huge energy; this does not happen in the case of pit explosions. Previous underground and massive surface blasting has been carried out in the area of the Roşia Montană deposit. The impact of these blasting operations on the geological structure has been limited to very small distances, such impact being insignificant on longer distances. A relevant example is represented by the underground galleries underneath the Cetate pit, which resisted the massive blasting carried out in this pit, although they were not reinforced. Only the works located 10-15 m underneath the pit floor have been impacted, several blocks falling due to the local increase of the rock cracking degree. The earth shell is permanently subject to earthquakes of various intensities, of tectonic and anthropic nature. For the comfort of population and safety of constructions, the level of these earthquakes should not exceed the maximum admissible limits imposed by the standards. Pit blasting activities and heavy equipment traveling are allowed provided that the parameters of the generated vibrations comply with the limits imposed by the law. The Noise and Vibration Management Plan uses all adequate techniques, presenting the measures for the minimization/elimination of the potential impact, meant to maintain the parameters of noise and vibration phenomena within the admissible limits. It is worth mentioning that these measures

have already proven their efficiency in other similar projects implemented in Europe (Spain, Sweden, Finland,) or worldwide (for example, the Martha mine in New Zeeland – see www.marthamine.co.nz)

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	337
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Lupsa, 16.08.2006
RMGC internal unique code	MMGA_0691

Proposal

The questioner wants to know what impact will the tons of explosives used in the project have on the air, the climate and the land. Can the blasting re-activate the volcanoes or generate earthquakes?

Solution

The model of atmospheric dispersion has been developed using the Best Available Techniques, in order to simulate the transport of the pollutants generated by the mining activities outside the Project area. Modern concepts related to the flow and dispersion in complex terrains are incorporated in AERMOD by using a new and simple approach. If this is not necessary, the plume is modelled, either having a path that impacts the terrain or with a path that follows the terrains' topography.

AERMOD may forecast concentrations of pollutants from multiple sources for a wide variety of sites, meteorological conditions, types of pollutants and mediation periods. For this project, the concentrations on short term have been calculated using the maximum hourly rates of emission for activities developed simultaneously and for the averages calculated for intervals of 1 hour, 8 hours and 24 hours. The annual concentrations have been calculated using all active sources during the respective year.

For the dust emission control from open pits and haulage roads of ore and waste rock, the following measures have been taken:

- Utilization of a new blasting technology, namely the sequential blasting technology which reduces drastically the height of the dust plume and dispersion area;
- Ceasing of the activities generating dust during the periods with intense winds or when the automatic monitor for particles installed in the Roșia Montană protection area indicates an alert situation;
- Implementation of a program for dust control on the unpaved roads during the drought seasons by means of watering trucks and inert substances for dust restraining. These measures will reduce the dust emissions with 90%;
- Minimizing of the unloading height at manipulation/discharge of materials;
- Prescribing and application of speed limitation on traffic;
- Implementation of a program of periodically maintenance of vehicles and motorized equipments;
- Automatic monitoring of the air quality and meteorological parameters
- Implementation of additional measures for dust emission control: ore and waste rock watering at the loading into trucks.

Details: the Report on Environmental Impact Assessment Study (Volume 12 – Chapter 4.2, Subchapter 4.2.4) and the Air quality Management Plan (Volume 24, Plan D) include, in a detailed manner, technical and operational measures for decreasing/eliminating dust emissions generated by the activities developed within the Project.

The impact of the blasting operations on the air quality from the area is within the limits stipulated by the legislation. Blasting procedures have no major impacts on climate, and the pits neighbouring area is going to be exposed at levels of vibrations that meet the limits stipulated by the legislation.

Roşia Montană area is not active from a volcanic point of view and there is no risk to reactivate them after the conducting blasting operations within the Roşia Montană pits. Volcanic activities took place approximately 13 million years ago.

The geologic structure of the area won't be impacted by the blasting operations, as it could be noticed until now from the analysis of the blasting impacts resulted from Roșia Poieni and Roșia Montană pits.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	391
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Bucuresti, 21.08.2006
RMGC internal unique code	MMGA_0825

Proposal	If this project is implemented, no human life, in fact no life at all will exist in Rosia Montana. When the massive blasting begins, two – three times a week, given the production amount provided in the project, Rosia Montana will disappear from the face of the earth; then, the USD 9 million allocated for the historical buildings and churches will no longer be necessary.

Solution

The environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorized equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate Best Management Practices/Best Available Techniques for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see **Tables 4.3.8** through **4.3.16** and **Exhibits 4.3.1** through **4.3.9**. All these details related to the applied assessment methodology, the input data of the dispersion model, the modeling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 Noise and Vibrations of the EIA Report.

Through the use of modern technologies, adequate measures and actions, the vibrations (or earthquakes) generated by the open pit explosions will be maintained within certain limits, such as to ensure the protection of the constructions and other historical monuments existing in the area and proposed for conservation.

S.C. Ipromin S.A. has prepared a study entitled "Geo-mechanical study for measuring the effects of quarrying operations on the constructions located inside the protected area" for the purpose of analyzing the effects of the excavation technologies to be used in the Roşia Montană mining perimeter and identifying the technological solutions to ensure the protection of the constructions existing inside the protected area or other heritage constructions.

In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the effects of quarrying explosions the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction.

Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roşia Montană.

Due to the fact that România, at the time of preparation of the EIA, had not adopted any specific standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the *German standard DIN 4150/83* – the most exigent European standard (Table no. 1).

Limit values of the oscillation velocity (mm/s) according to *DIN 4150/83*.

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

One may notice that the value of 3 mm/s is the maximum velocity admitted for the protection of historical monuments.

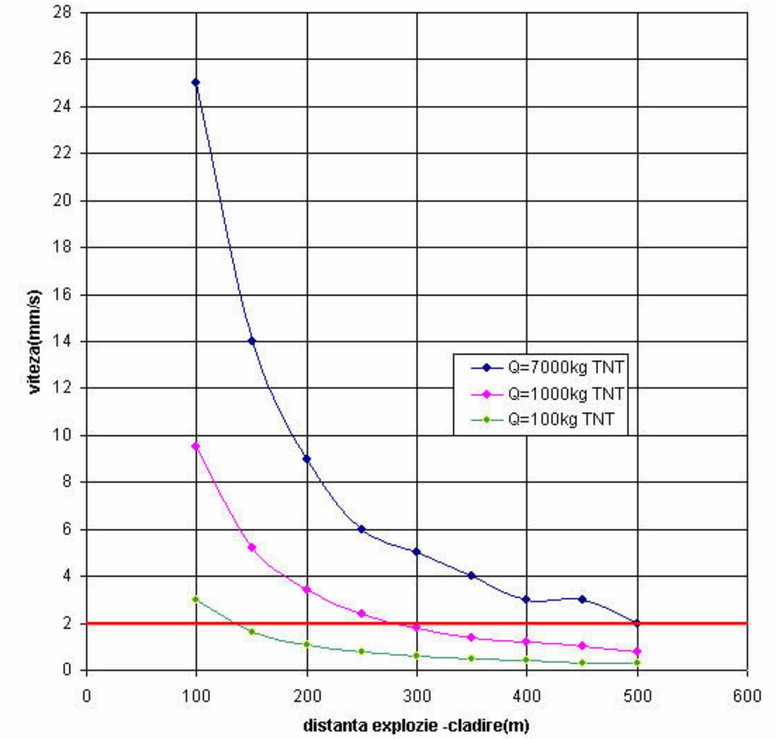
Using the formulas provided in the specialized literature, the values of the oscillation velocity at a distance of 100 m, 200 m and 300 m from the protected constructions have been determined, in case of blasting 6,860 kg per blasting phase.

The following values of the oscillation velocity of the material particle are determined (Table no. 2 and Figure 1).

Table no. 2

Blasting Type	Distance from the explosion centre				
	100 m	200 m	300 m	400 m	500 m
	Oscillation velocity [mm/s]				
Instantaneous	24,8	9,1	4,7	3,0	2,2
nΔt = 0,140 s micro-delay	17,6	6,5	3,3	2,2	1,6
nΔt = 0,600 s micro-delay	14,6	5,4	2,8	1,7	1,3

Figure 1. Diagram of the oscillation velocity variation depending on the distance depending on the load detonated per blasting phase.



This technology can be used for an area representing approximately 85% of the open pits area.

At smaller distances, in order to ensure an oscillation velocity of maximum 0.2 cm/s next to the construction, *i.e.* to ensure a negligible seismic impact, some special technological variants of the quarrying technology are required. Such technological variants consist in the reduction of the auger hole diameter and depth, reduction of the amount of explosive detonated per blasting phase, etc.

This area covers approximately 15%, containing small amounts of ore to be blasted. Zone 2 extends to maximum 300 m from the nearest construction. In its turn, this zone is divided into three sub-zones of application of the technological variants for ore blasting.

A maximum load of explosive/blasting phase corresponds to each sub-zone.

In order to measure the quarrying explosions impact on the constructions located inside the protected area and other historical buildings, a monitoring system will be implemented, consisting in a fixed network of digital seismographs, with three components installed at the main constructions to be protected, and a mobile network composed of three mobile seismographs installed on a longitudinal profile between the protected construction and the centre of the explosions. The processing of the monitoring data obtained during the operation of the Roşia Montană open pits will also determine the variation of the dynamic parameters of the seismic oscillations (seismic impact mitigation coefficient).

The secondary effects of open pit explosions, such as the oscillation velocity and over-pressure of the shock wave can be kept under control and reduced by a number of technical and organizational measures.

The over-pressure of the shock wave depends on the amount of explosive load and blasting technique (electrical or non-electrical, instantaneous or micro delay). It implies a risk to human beings and to highly deteriorated constructions. The shock wave over-pressure impact can be reduced using the same methods used in the case of the blast radius (work fronts orientation and compliance with the geometrical parameters of load placement).

The seismic wave (material particle oscillation) represents the most important secondary effect on the soil and constructions. This effect is assessed by the velocity, acceleration or movement of the material particle. For the protection of constructions, velocity is the most widely used parameter.

The oscillation velocity of the material particle has been used as a parameter for the delimitation of the two large areas of the open pits, under the condition of a maximum velocity of 0.2 cm/s measured at the nearest construction from the explosion centre.

This velocity ensures the protection of the constructions, provided that the consolidation works are executed. This value of the maximum velocity (of 0.2 cm/s) has been adopted based on the relevant standards existing in other countries having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83.

It is important to emphasize that it is not the quarrying technologies using explosives that represent a real threat to the 42 historical buildings, but rather their advanced state of degradation. For this reason, if no measures are taken, these buildings will be inevitably lost.

In conclusion, the special technologies used (within various zones) will not generate any adverse impact on the constructions from the Roşia Montană commune.

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Millisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 milliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 milliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly executed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of small intensity explosions will propagate the rock crushing wave.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	435
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Deva, 23.08.2006
RMGC internal unique code	MMGA_0933

Proposal

The questioner agrees with the project. He wants to know whether pits will be ventilated during the massive blasting operations that will be carried out.

Solution

Pit blasting activities represent one of the sources which generate particles in suspension. It is a surface source and doesn't require conducting ventilation of the pits.

Using a new sequential blasting technology will cause particles not to raise much into the air; this will lead to their fast sedimentation. One of the control measures to be taken is to shut down the activities which generate dust during strong winds conditions.

Open pit blasting operations as well as the movement of heavy equipments, are allowed if the generated vibration, noise, dust parameters are within the legal limits.

The model of atmospheric dispersion has been developed using the Best Available Techniques, in order to simulate the transport of the pollutants generated by the mining activities outside the Project area. Modern concepts related to the flow and dispersion in complex terrains are incorporated in AERMOD by using a new and simple approach. If this is not necessary, the plume is modelled, either having a path that impacts the terrain or with a path that follows the terrains' topography.

AERMOD may forecast concentrations of pollutants from multiple sources for a wide variety of sites, meteorological conditions, types of pollutants and mediation periods. For this project, the concentrations on short term have been calculated using the maximum hourly rates of emission for activities developed simultaneously and for the averages calculated for intervals of 1 hour, 8 hours and 24 hours. The annual concentrations have been calculated using all active sources during the respective year.

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For the dust emission control from open pits and haulage roads of ore and waste rock, the following measures have been taken:

- Utilization of a new blasting technology, namely the sequential blasting technology which reduces drastically the height of the dust plume and dispersion area;
- Ceasing of the activities generating dust during the periods with intense winds or when the automatic monitor for particles installed in the Roșia Montană protection area indicates an alert situation;
- Implementation of a program for dust control on the unpaved roads during the drought seasons by means of watering trucks and inert substances for dust restraining. These measures will reduce the dust emissions with 90%;
- Minimizing of the unloading height at manipulation/discharge of materials;
- Prescribing and application of speed limitation on traffic;
- Implementation of a program of periodically maintenance of vehicles and motorized equipments;
- Automatic monitoring of the air quality and meteorological parameters;
- Implementation of additional measures for dust emission control: ore and waste rock watering at the loading into trucks.

Details: the Report on Environmental Impact Assessment Study (Volume 12 – Chapter 4.2, Subchapter 4.2.4) and the Air quality Management Plan (Volume 24, Plan D) include, in a detailed manner, technical and operational measures for decreasing/eliminating dust emissions generated by the activities developed within the Project.

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Millisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 milliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 milliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly performed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of small intensity explosions will propagate the rock crushing wave.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	469
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	Arad, 25.08.2006
RMGC internal unique code	MMGA_1005
Proposal	The questioner needs information on the blasting operations that will be carried out in the Rosia Montana area.:- It has been said in the EIA report that each single blast occuring in the area will contain approximately 20,000 tons of explosive. It is generally known that there is a certain limit as to the seismic waves a building can withstand. Nowhere in the EIA is there mentioned the velocity, frequence and amplitude of the blasts. The questioner wants to know exactly the quantity of explosive used, the velocity, seismic waves, amplitude and frequency of the blasts.
Solution	The quantity of TNT mentioned in the question is over-exaggerated, and the tendentious wording of the question is misleading. All details related to the blasting technologies can be found in Chapter 2 – Technological Processes, Section 4.1.1.2 Recovery Works. In reality, during a blasting phase, up to 1,296 kg AM will be detonated, resulting in a mining mass of 8,000 – 10,000 t. In order to obtain the daily production (tailings and ore), the movement of the rock of approx. 28-32 mining panels is necessary, respectively the detonation of a quantity of approx. 10 t of explosive AM-type, as presented in Chapter 2 – Technological Processes, Section 4.1.1.2, p. 60 *et seq*. The priming will be of sequential type and NONEL-type non-electric fuses (non-electric) and detonating wire will be used, technology that assures a mining mass crushing degree compatible to the loading machines capacity and determines the reduction of the exploded rock spreading area. For the definitive outlining of the pit sides, bore holes similar to those used for recovery will be used having though a smaller explosive quantity with approx. 20% compared to the production holes, the start being given by dynamite cartridges. For the detonation the NONEL technology will be used. The load blasting order will be performed with micro delay, from the hole center to the base part and to the upper one, and from the center hole of the first row to the side extremities and to the following rows, technology that assures the significant decrease of the seismic intensity and an increased effectiveness of the rock movement explosions. Through the use of modern technologies, adequate measures and actions, the vibrations (or earthquakes) generated by the open pit explosions will be maintained within certain limits, such as to ensure the protection of the constructions and other historical monuments existing in the area and proposed for conservation. S.C. Ipromin S.A. has prepared a study entitled "Geo-mechanical study for measuring the effects of quarrying operations on the constructions located inside the protected area" for the purpose of analyzing the effects of the excavation technologies to be used in the Roșia Montană mining perimeter and identifying the technological solutions to ensure the protection of the constructions existing inside the protected area or other heritage constructions. In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the effects of quarrying explosions the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction. Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roșia Montană.

Due to the fact that România, at the time of preparation of the EIA, had not adopted any specific standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83 – the most exigent European standard (Table no. 1).

Limit values of the oscillation velocity (mm/s) according to DIN 4150/83.

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

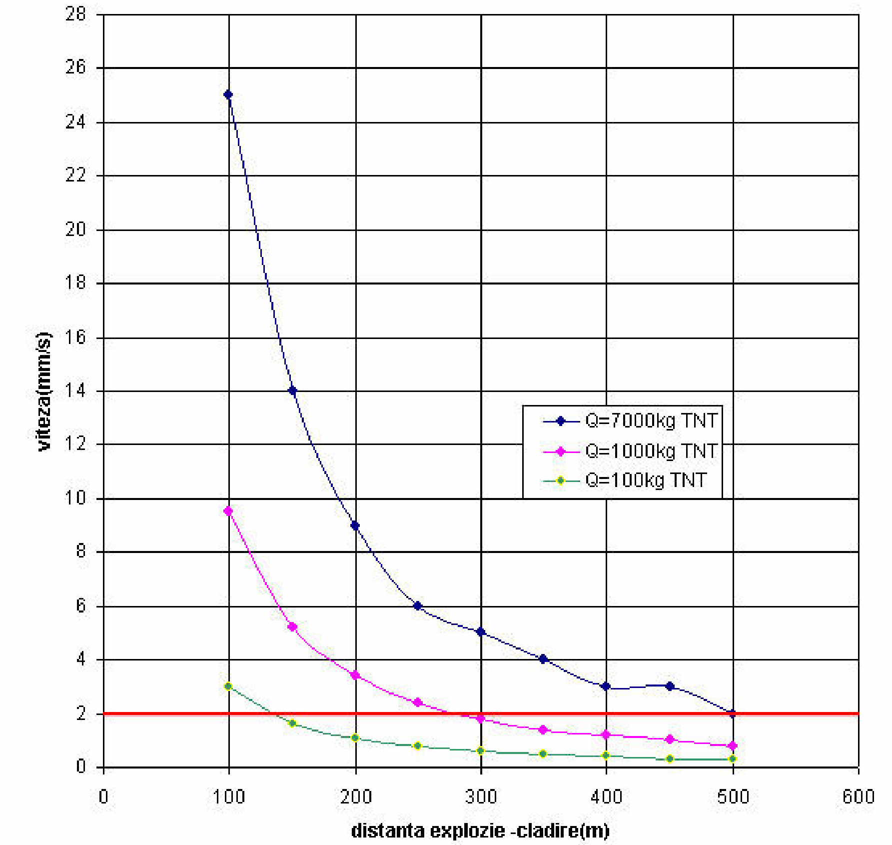
One may notice that the value of 3 mm/s is the maximum velocity admitted for the protection of historical monuments.

The following values of the oscillation velocity of the material particle are determined (Table no. 2 and Figure 1).

Table no. 2

Blasting Type	Distance from the explosion centre				
	100 m	200 m	300 m	400 m	500 m
	Oscillation velocity [mm/s]				
Instantaneous	24,8	9,1	4,7	3,0	2,2
nΔt = 0,140 s micro-delay	17,6	6,5	3,3	2,2	1,6
nΔt = 0,600 s micro-delay	14,6	5,4	2,8	1,7	1,3

Figure 1. Diagram of the oscillation velocity variation depending on the distance depending on the load detonated per blasting phase.



This technology can be used for an area representing approximately 85% of the open pits area.

At smaller distances, in order to ensure an oscillation velocity of maximum 0.2 cm/s next to the construction, *i.e.* to ensure a negligible seismic impact, some special technological variants of the quarrying technology are required. Such technological variants consist in the reduction of the bore holes diameter and depth, reduction of the amount of explosive detonated per blasting phase, etc.

This area covers approximately 15%, containing small amounts of ore to be blasted. Zone 2 extends to maximum 300 m from the nearest construction. In its turn, this zone is divided into three sub-zones of application of the technological variants for ore blasting.

A maximum load of explosive/blasting phase corresponds to each sub-zone.

In order to measure the quarrying explosions impact on the constructions located inside the protected area and other historical buildings, a monitoring system will be implemented, consisting in a fixed network of digital seismographs, with three components installed at the main constructions to be protected, and a mobile network composed of three mobile seismographs installed on a longitudinal profile between the protected construction and the centre of the explosions. The processing of the monitoring data obtained during the operation of the Roșia Montană open pits will also determine the variation of the dynamic parameters of the seismic oscillations (seismic impact mitigation coefficient).

This velocity ensures the protection of the constructions, provided that the consolidation works are executed. This value of the maximum velocity (of 0.2 cm/s) has been adopted based on the relevant standards existing in other countries having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83.

It is important to emphasize that it is not the quarrying technologies using explosives that represent a real threat to the 42 historical buildings, but rather their advanced state of degradation. For this reason, if no measures are taken, these buildings will be inevitably lost.

In conclusion, the special technologies used (within various zones) will not generate any adverse impact on the constructions from the Roșia Montană commune.

When the sequential starter is adequately delayed, only small amounts of explosive are detonated simultaneously. The use of blast sequences controlled with the NONEL delay system allows multiple small explosions, which nonetheless act as one loading, without generating a movement of material outside the blasting area larger than the coverage of each individual explosion.

Millisecond delays techniques are efficient, due to the fact that the movement of rock outside the action radius of a single hole is approximately 3 milliseconds per meter. For example, if two blasting holes rows are drilled at a distance of 8 meters, the second row of holes will explode approximately 24 milliseconds after detonation of the first row. Thus, the time of detonation of the second row of holes can be set up such as to maximize the rock movement efficiency.

When mine blasting is properly executed, an outside observer can see the land going up and down, like a wave front, as if someone induced a smooth oscillation to a carpet placed on the floor. As the wave moves, a series of small intensity explosions will propagate the rock crushing wave.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	14, 15, 16, 17, 21, 24, 25, 26, 27, 28, 29, 30, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 62, 63, 64, 65, 67, 68, 69, 70, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 151, 152, 158, 163, 164, 165, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 190, 196, 197, 198, 199, 200, 201, 204, 206, 210, 211, 212, 213, 215, 217, 218, 219, 220, 222, 223, 224, 225, 226, 227, 228, 229, 235, 236, 237, 238, 239, 240, 241, 244, 247, 249, 250, 251, 252, 253, 254, 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RMGC internal unique code	MMGA_1052
Proposal	The EIA report does not refer to the impact on the listed heritage buildings of noise and vibrations caused by the mining operations; SEE CONTENT CONTESTATION TYPE 1
Solution	This statement is ungrounded, because the environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorized equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate Best Management Practices/Best Available Techniques for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see **Tables 4.3.8** through **4.3.16** and **Exhibits 4.3.1** through **4.3.9**. All these details related to the applied assessment methodology, the input data of the dispersion model, the modeling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 Noise and Vibrations of the EIA Report. Project Years 0, 9, 10, 12, 14, and 19 were selected for modeling because they are considered to be representative of the most significant levels of noise-generating activity. They are also the same years used for air impact modeling purposes in Section 4.2, as air and noise impacts share many of the same sources or are otherwise closely correlated. In order to more accurately reflect potential receptor impacts, all of these exhibits integrate the background traffic estimates discussed in Section 4.3.6.1. The Project site plan and process plant area and facility drawings were used to establish the position of the noise sources and other relevant physical characteristics of the site. Receptor locations were established using background reports and project engineering and environmental documentation provided by RMGC. With this information, the source locations and receptor locations were translated into input (x, y, and z) co-ordinates for the noise-modeling program. **Tables 4.3.8 through 4.3.16** and **Exhibits 4.3.1 through 4.3.9** present the average maximum noise

values likely to be experienced by the receptor community over all Project phases after incorporation of a variety of initial mitigation measures designed specifically to reduce the impacts associated with mobile and stationary machinery sources. The influence of non-mining related background (primarily traffic) noise is also included.

To evaluate the sound levels associated with haul trucks and other mobile sources crossing the site carrying excavated ore, waste rock, and soil, a noise analysis program based on the (U.S.) Federal Highway Administration's (FHWA) standard RD-77-108 [1] model was used to calculate reference noise emissions values for heavy trucks along the project roadways. The FHWA model predicts hourly L_{eq} values for free-flowing traffic conditions and is generally considered to be accurate within 1.5 decibels (dB).

The model is based on the standardized noise emission factors for different types and weights of vehicles (e.g., automobiles, medium trucks, and heavy trucks), with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The emission levels of all three vehicle types increase as a function of the logarithm of their speed.

To evaluate the sound sources from the proposed mine processing facility and the semi-stationary material handling equipment (at the ore extraction, waste rock and soil stockpiling areas), a proprietary computerized noise prediction program was used by AAC to simulate and model the future equipment noise emissions throughout the area. The modeling program uses industry-accepted propagation algorithms based on the following American National Standards Institute (ANSI) and International Organization for Standardization (ISO) standards:

- *ANSI S1.26-1995 (R2004), Method for the Calculation of the Absorption of Sound by the Atmosphere;*
- *ISO 9613-1:1993, Acoustics -- Attenuation of sound during propagation outdoors-- Part 1: Calculation of the absorption of sound by the atmosphere;*
- *ISO 9613-2:1996, Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation;*
- *ISO 3891:1978, Acoustics -- Procedure for describing aircraft noise heard on the ground*.

The calculations account for classical sound wave divergence (i.e., spherical spreading loss with adjustments for source directivity from point sources) plus attenuation factors due to air absorption, minimal ground effects, and barriers/shielding.

This model has been validated by AAC over a number of years via noise measurements at several operating industrial sites that had been previously modeled during the engineering design phases. The comparison of modeled predictions versus actual measurements has consistently shown close agreement; typically in the range of 1 to 3 dB (A).

References:
[1] FHWA Highway Traffic Noise Prediction Model; see Federal Highway Administration Report Number FHWA-RD-77-108, USA, Washington, D.C., 1978.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project.

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	2984
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	No. 111777/25.08.2006
RMGC internal unique code	MMGA_1271

Proposal

The way and time period in which the noises and vibrations will be reduced are not specified

Solution

The environmental impact assessment (EIA) process has included preliminary cumulative estimates for stationary motorized equipment and linear (vehicular) sources were prepared in order to provide an initial understanding of the potential cumulative noise and vibration impacts from background and Roşia Montană Project sources, and to guide future monitoring and measurement activities as well as the selection of appropriate Best Management Practices/Best Available Techniques for further mitigation of the potential noise and vibration impacts from Project activities. These preliminary estimates apply to major construction activities, as well as the operation and decommissioning/closure of the mine and process plant. They are documented as data tables and isopleth maps for major noise-generating activities in selected, representative Project years; see Tables 4.3.8 through 4.3.16 and Exhibits 4.3.1 through 4.3.9. All these details related to the applied assessment methodology, the input data of the dispersion model, the modeling results and the measures established for the prevention/mitigation/elimination of the potential impact for all project stages (construction, operation, closure) are included in Chapter 4, Section 4.3 Noise and Vibrations of the EIA Report.

Project Years 0, 9, 10, 12, 14, and 19 were selected for modeling because they are considered to be representative of the most significant levels of noise-generating activity. They are also the same years used for air impact modeling purposes in Section 4.2, as air and noise impacts share many of the same sources or are otherwise closely correlated. In order to more accurately reflect potential receptor impacts, all of these exhibits integrate the background traffic estimates discussed in Section 4.3.6.1.

The Project site plan and process plant area and facility drawings were used to establish the position of the noise sources and other relevant physical characteristics of the site. Receptor locations were established using background reports and project engineering and environmental documentation provided by RMGC. With this information, the source locations and receptor locations were translated into input (x, y, and z) co-ordinates for the noise-modeling program.

Tables 4.3.8 through 4.3.16 and **Exhibits 4.3.1 through 4.3.9** present the average maximum noise values likely to be experienced by the receptor community over all Project phases after incorporation of a variety of initial mitigation measures designed specifically to reduce the impacts associated with mobile and stationary machinery sources. The influence of non-mining related background (primarily traffic) noise is also included.

To evaluate the sound levels associated with haul trucks and other mobile sources traversing the site carrying excavated ore, waste rock, and topsoil, a noise analysis program based on the (U.S.) Federal Highway Administration's (FHWA) standard RD-77-108 [1] model was used to calculate reference noise emissions values for heavy trucks along the project roadways. The FHWA model predicts hourly L_{eq} values for free-flowing traffic conditions and is generally considered to be accurate within 1.5 decibels (dB).

The model is based on the standardized noise emission factors for different types and weights of vehicles (e.g., automobiles, medium trucks, and heavy trucks), with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The emission levels of all three vehicle types increase as a function of the logarithm of their speed.

References:

[1] FHWA Highway Traffic Noise Prediction Model; see Federal Highway Administration Report Number FHWA-RD-77-108, USA, Washington, D.C., 1978.

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	2984
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	No. 111777/25.08.2006
RMGC internal unique code	MMGA_1272

Proposal	It is not specified how the physical effects of the vibrations will be remedied and avoided

Solution

Mitigation Strategy

RMGC will adopt and implement a noise and vibration management strategy that is designed to minimise the noise and vibration footprint of the Project to the extent possible through the implementation of internationally recognized Best Available Techniques/Best Management Practices. The Roşia Montană Project will:

- employ currently applicable regulatory limits for noise and vibration as specific monitoring goals or performance targets;
- select and monitor representative sensitive receptor locations in the zones suggested by the preliminary, intrinsically conservative modeling results documented in **Exhibits 4.3.1** through **4.3.9** (and/or as established by physical surveys of sensitive structures);
- at the selected monitoring locations, measure ambient noise levels as well as vibration frequency, velocity, and acceleration to determine actual noise and vibration impacts; these data will provide the basis for an ongoing noise and vibration monitoring program [see Chapter 6.2 of the Project Noise and Vibration Management Plan (**ESMS Plans, Plan E**)] that will be continually adjusted to account for changing Project characteristics, stakeholder interests, and regulatory requirements, as they may occur over the life of the Project;
- undertake proactive communications with local residents through public meetings and regular individual contacts as the means of communicating blasting schedules, deliveries of SHLO equipment, or other significant noise- or vibration-generating activities and obtain resident feedback on the effectiveness of mitigation measures;
- evaluate monitoring program data and apply additional Best Available Techniques (see **Table 4.3.17** for a list of proven Best Available Techniques (BAT) options that may be selected from to address specific monitored conditions) to minimize noise and vibration impacts to the extent possible, as appropriate for the various job functions of the workforce and the location of the Project boundaries and receptors in relation to specific sources or sets of sources;
- evaluate the relative effectiveness of the BATs so applied, through continued monitoring actions;
- continue to refine or update source controls, apply alternate BATs or BMPs, and/or undertake additional corrective or preventive action in order to continually minimize or mitigate noise and vibration impacts to the workforce and local residents for the life of the mining operation.

Table 4.3.46: Potential BAT Options or Mitigation /Minimization of Noise and Vibration

BAT	Minimization Potential	BAT Sources
1. Adjust frequency of deliveries by heavy vehicles to prevent concentrated impacts to adjacent communities	Variable	1
2. Adjust construction schedules to minimize night-time activities requiring the use of high acoustical-energy equipment (e.g., dozers, excavators)	Variable	1
3. Create noise control barriers via earthen berms or bunds, which can be as long as required and from 10 to 20m high depending on the topography and geometry of the source(s) and receptor(s)	5 to 20 dB(A)	1, 2, 3, 3
4. Acoustic treatment of dwellings in special situations, necessary to improve habitable spaces	10 to 20 dB(A)	3, 4, 6
5. Fit heavy haul trucks with additional noise control systems as necessary to achieve desired reductions; depending on dealer-installed options for EU-certified equipment, other options may include: - engine combustion management systems - enclosing engine bays - aerodynamic radiator fan design - noise-control louvers or baffles on radiator grille - noise-control louvers or baffles on hydraulic system cooling fans - high-performance silencers - variable backup warning systems, adjusted for ambient conditions - chain mesh mudflap - low-noise tyre tread design	- 2 to 5 dB(A) - 5 to 10 dB(A) - 2 to 3 dB(A) - 2 to 3 dB(A) - 2 to 3 dB(A) - 5 to 10 dB(A) - - variable benefits - <3 dB(A) - 1 to 3 dB(A)	3, 5, 6, 7, 8, 9, 7
6. Fit excavators with noise control systems as necessary to achieve desired reductions; depending on dealer-installed options for EU-certified equipment, options may include: engine combustion management systems sound-absorbing panels within engine bays, under the deck area, and inside the counterweigh sound absorbing panels around the powerpacks and hydraulic cooler house use multiple hydrostatically-controlled units for engine cooling (vs. single belt-driven fan) variable backup warning systems, adjusted for ambient conditions primary/secondary silencers, tuned to engine exhaust characteristics	- 2 to 5 dB(A) - 3 to 5 dB(A) - 5 to 10 dB(A) - 2 to 4 dB(A) - 1 to 3 dB(A) - variable benefits - 5 to 10 dB(A)	3, 6, 7, 9
7. Fit dozers with additional noise control systems as necessary to achieve desired reductions; depending on dealer-installed options for EU-certified equipment, options may include: - engine combustion management systems - high-performance silencers - engine shrouding - variable backup warning systems, adjusted for ambient conditions - optional tread control devices to reduce "track slap" characteristics	- 2 to 5 dB(A) - 5 to 10 dB(A) - 5 to 10 dB(A) - variable benefits - variable benefits	3, 6, 7, 8, 9, 10, 10

The monitoring and management of noise and vibration impacts to receptors in adjacent communities or habitations within the protected areas of the Project will be managed in accordance with the Noise and

Vibration Management Plan (ESMS Plans, Plan E), which describes the specific management processes that will be implemented to minimize noise and vibration in accordance with appropriate BMPs and BATs. As summarized in Figure 4.3.6, this includes the active incorporation of noise and vibration feedback into establishing or refining:

- *the Noise and Vibration Management Plan itself;*
- individual blasting plans for the two quarries and four open pits; and
- *the Cultural Heritage Management Plan* (which lists cultural important structures that must be considered with regard to their potential sensitivity to vibration impacts; as discussed in ESMS Plans, Plan N).

References:
[1] *Mine Planning for Environment Protection*, Commonwealth of Australia, Environmental Protection Agency, Best Practice Environmental Management in Mining, June, 1995.
[2] *Noise Management at Martha Mine, Newmont Mining; www.marthamine.co.nz/sound.html*.
[3] *Noise, Vibration, and Airblast Control*, Environment Australia, 1998; www.ea.gov.au/industry/sustainable/mining/booklets/noise/noise3.html#3.
[4] Australian Government, Department of the Environment and Heritage, *Checklists for Sustainable Minerals*, *Checklist for Noise, Vibration, and Airblast Control*, 2003.
[5] *Pollution Prevention and Abatement Guidelines for the Mining Industry*, World Bank/UNIDO/UNEP draft guidelines, July 1993.
[6] Caterpillar web site; www.cat.com.
[7] *Essentials – Noise Management in the Construction Industry: A Practical Approach*, Government of Western Australia, 3/99.
[8] *Noise Control Resource Guide – Surface Mining*, U. S. Department of Labor, Mine Safety and Health Administration (MSHA).
[9] *Environment and Community – Opportunities and Challenges for Mine Planning and Operations, Mt. Arthur Coal (BHP Billiton), May 2005.*
[10] *Bulldozer Noise Control, U. S. Department of Labor, Mine Safety and Health Administration (MSHA).*

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	2984
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	No. 111777/25.08.2006
RMGC internal unique code	MMGA_1273

Proposal	A situation of the underground voids and the effect which the large blasting and transit of large tonnage trucks could have towards them is not shown
Solution	All underground accessible voids have been topographically surveyed and tri-dimensionally modeled so that we currently have an accurate image of their location and dimensions. There are 2 types of underground voids. One is represented by the access and mining galleries, and their size has no impact on blasting operations an on the traffic of heavy load trucks. The others are voids that have been generated by previous mining operations, and they are "corandas" and "rooms and pillars". Special measures must be taken for the latter type of voids of large dimensions, in order to avoid the impact on blasting procedures and on ore transport. These measures would imply the adjustment of the drilling network and of the blasting loads, backfilling the voids with material, and void areas will be marked on the field so as to avoid accidents. These aspects will be subject to some very strict procedures regarding the blasting technologies and the occupational safety technique and they are characteristic to the construction and operation stages and not for the feasibility stage when the EIA process is being developed. *A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project*

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	3234
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	No. 111435/25.08.2006
RMGC internal unique code	MMGA_1414

Proposal

Blasting will cause landslides

Solution

The subsoil is rocky, therefore the land is very stable, and it is not exposed to sliding risk.

The analysis of the data included in Ipromin's study, entitled „Geo-mechanical study for the measurement of the effects of quarrying operations on the constructions located inside the protected area" indicates that, in the case of the excavation technologies to be used in the Roşia Montană mining perimeter, the oscillation velocity (the most important parameter of the seismic wave generated by the blasting) is significantly reduced as we move away from the centre of the explosion. This is a proof of the fact that the impact of pit explosions affects a rather limited area having reduced intensity in the neighbouring areas therefore the risk of land sliding is very low.

As shown in Table no. 1 and Figure no. 1, the oscillation velocity at a distance of 500 meters from the centre of the explosion corresponds, on the MKS scale, to natural earthquakes of 1^{st} and 2^{nd} degree.

The ore will be mined in open pits and will require blasting operations using explosive placed in bore holes. In order to ensure the necessary daily ore amount, at least 3 mining panels will be blasted, using approximately 6,860 kg explosive/front.

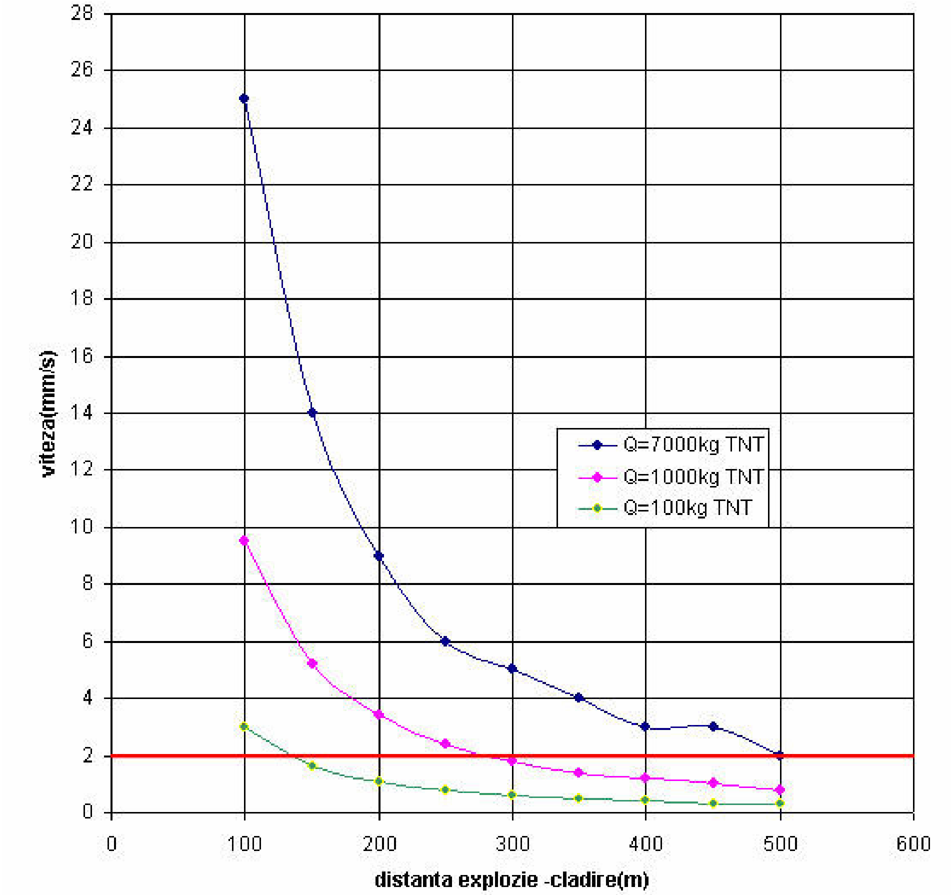
Using the formulas provided in the specialized literature, the values of the oscillation velocity at a distance of 100 m, 200 m and 300 m from the protected constructions have been determined, in case of blasting 6,860 kg per blasting phase, as provided by the planned work technology.

The following values of the oscillation velocity of the material particle are determined (Table no. 2 and Figure 1).

Table no. 2

Blasting Type	Distance from the explosion centre				
	100 m	200 m	300 m	400 m	500 m
	Oscillation velocity [mm/s]				
Instantaneous	24,8	9,1	4,7	3,0	2,2
nΔt = 0,140 s micro-delay	17,6	6,5	3,3	2,2	1,6
nΔt = 0,600 s micro-delay	14,6	5,4	2,8	1,7	1,3

Figure 1. Diagram of the oscillation velocity variation depending on the distance depending on the load detonated per blasting phase.



Neither the former blasting operations performed with old technologies, in the Cetate and Cârnic pits from Roşia Montană, have generated land sliding in the neighboring areas.

A detailed presentation can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	3252, 3253, 3254, 3255, 3256, 3593, 3594, 3595, 3596, 3816
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	No. 111108/25.08.2006, No. 111136/25.08.2006, No. 111135/25.08.2006, No. 111129/25.08.2006, No. 111128/25.08.2006, No. 111127/25.08.2006, No. 111126/25.08.2006, No. 111125/25.08.2006, No. 111124/25.08.2006, No. 111121/25.08.2006
RMGC internal unique code	MMGA_1440

Proposal

The utilization of hundreds of tones of explosives may have negative effects over atmosphere and earth crust

Solution

The quantity of TNT mentioned in the question is over-exaggerated, and the tendentious wording of the question is misleading.

In reality, during a blasting phase, up to 1,296 kg AM will be detonated, resulting in a mining mass of 8,000 – 10,000 t. In order to obtain the daily production (tailings and ore), the movement of the rock of approx. 28-32 exploitation panels is necessary, respectively the detonation of a quantity of approx. 10 t of explosive AM-type, as presented in Chapter 2 – Technological Processes, Section 4.1.1.2, p. 60 *et seq*.

The priming will be of sequential type and NONEL-type non-electric fuses (non-electric) and detonating wire will be used, technology that assures a mining mass crushing degree compatible to the loading machines capacity and determines the reduction of the exploded rock spreading area.

For the definitive outlining of the pit sides, bore holes similar to those used for mining will be used, having though a smaller explosive quantity with approx. 20% compared to the production holes, the start being given by dynamite cartridges.

For the detonation the NONEL technology will be used.

The load blasting order will be performed with micro delay, from the hole center to the base part and to the upper one, and from the center hole of the first row to the side extremities and to the following rows, technology that assures the significant decrease of the seismic intensity and an increased effectiveness of the rock movement explosions.

The model of atmospheric dispersion has been developed using the Best Available Techniques, in order to simulate the transport of the pollutants generated by the mining activities outside the Project area. Modern concepts related to the flow and dispersion in complex terrains are incorporated in AERMOD by using a new and simple approach. If this is not necessary, the plume is modelled, either having a path that impacts the terrain or with a path that follows the terrains' topography.

AERMOD may forecast concentrations of pollutants from multiple sources for a wide variety of sites, meteorological conditions, types of pollutants and mediation periods. For this project, the concentrations on short term have been calculated using the maximum hourly rates of emission for activities developed simultaneously and for the averages calculated for intervals of 1 hour, 8 hours and 24 hours. The annual concentrations have been calculated using all active sources during the respective year.

For the dust emission control from open pits and haulage roads of ore and waste rock, the following measures have been taken:

- Utilization of a new blasting technology, namely the sequential blasting technology which reduces drastically the height of the dust plume and dispersion area;
- Ceasing of the activities generating dust during the periods with intense winds or when the automatic monitor for particles installed in the Roşia Montană protection area indicates an alert situation;
- Implementation of a program for dust control on the unpaved roads during the drought seasons by means of watering trucks and inert substances for dust restraining. These measures will reduce the

dust emissions with 90%;

- Minimizing of the unloading height at manipulation/discharge of materials;
- Prescribing and application of speed limitation on traffic;
- Implementation of a program of periodically maintenance of vehicles and motorized equipments;
- Automatic monitoring of the air quality and meteorological parameters;
- Implementation of additional measures for dust emission control: ore and waste rock watering at the loading into trucks.

Details: the Report on Environmental Impact Assessment Study (Volume 12 – Chapter 4.2, Subchapter 4.2.4) and the Air quality Management Plan (Volume 24, Plan D) include, in a detailed manner, technical and operational measures for decreasing/eliminating dust emissions generated by the activities developed within the Project.

The "destruction" of certain geological structures may occur in case of natural cataclysms, such as volcanic eruptions or earthquakes of maximum intensity, which involve the release of huge energy; this does not happen in the case of pit explosions.

Previous underground and massive surface blasting has been carried out in the area of the Roşia Montană deposit. The impact of these blasting operations on the geological structure has been limited to very small distances, such impact being insignificant on longer distances. A relevant example is represented by the underground galleries underneath the Cetate pit, which resisted the massive blasting carried out in this pit, although they were not reinforced. Only the works located 10-15 m underneath the pit floor have been impacted, several blocks falling due to the local increase of the rock cracking degree.

The earth shell is permanently subject to earthquakes of various intensities, of tectonic and anthropic nature. For the comfort of population and safety of constructions, the level of these earthquakes should not exceed the maximum admissible limits imposed by the standards.

Pit blasting activities and heavy equipment traveling are allowed provided that the parameters of the generated vibrations comply with the limits imposed by the law.

A detailed presentation of blasting technology can be found in the annex 7.1 - Proposed blasting technology for the operational phase of Roşia Montană Project

Domain	NOISE VIBRATIONS
MMDD's item no. for the question which includes the observation identified by the RMGC internal code	749
MMDD's identification no. for the question which includes the observation identified by the RMGC internal code	No. 109706/21.08.2006 and No. 75023/21.08.2006
RMGC internal unique code	MMGA_1530

Proposal

there is no mention related to the funds made available for the protection or rehabilitation of the historical monuments and patrimony houses in case of collapsing due to a shock wave generated by explosion.

Solution

The company's policy regarding the historical monuments and historical buildings will ensure their protection in order to avoid the occurrence of any damage caused by Roşia Montană Project activities. In this regard, the company has allotted the necessary funds for the reinforcement, restoration and preservation of these buildings with historical value. These activities already have begun. Also, the company will implement a strict monitoring system of the blasting effects from the proposed open pits, so that measures of prevention in due time to be taken and continuous adaptation of the blasting technologies to be carried out. In this way, the security conditions will be observed. The cultural patrimony management plan (Vol. 33) provides the planned activities related to the buildings classified as monuments and related allotted budgets.

Regarding the shock wave resulted from blasting, S.C. Ipromin S.A. has prepared a study entitled "Geo-mechanical study for measuring the effects of quarrying operations on the constructions located inside the protected area" for the purpose of analyzing the effects of the excavation technologies to be used in the Roşia Montană mining perimeter and identifying the technological solutions to ensure the protection of the constructions existing inside the protected area or other heritage constructions.

In order to prevent the degradation or deterioration of the constructions located inside the protected area, due to the effects of quarrying explosions the project stipulates a maximum oscillation of 0.2 cm/s, measured next to the protected construction.

Theoretically, these velocities will ensure the integrity of the most sensitive and deteriorated historical constructions existing in Roşia Montană.

Due to the fact that România has not adopted any standards for the protection of constructions against the impact of quarrying explosions, this value has been established based on the relevant standards existing in other states having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83 – the most exigent European standard (Table no. 1).

Limit values of the oscillation velocity (mm/s) according to *DIN 4150/83*.

Table no. 1

Building Type	Velocity (mm/s)		
	< 10 Hz	10-50 Hz	50-100 Hz
Offices and factory buildings	20	20-40	40-50
Residential buildings	5	5-15	15-20
Historical monuments	3	3-8	8-10

One may notice that the value of 3 mm/s is the maximum velocity admitted for the protection of historical monuments.

Using the formulas provided in the specialized literature, the values of the oscillation velocity at a distance of 100 m, 200 m and 300 m from the protected constructions have been determined, in case of blasting

The following values of the oscillation velocity of the material particle are determined (Table no. 2).

Table no. 2

Blasting Type	Distance from the explosion centre				
	100 m	200 m	300 m	400 m	500 m
	Oscillation velocity [mm/s]				
Instantaneous	24,8	9,1	4,7	3,0	2,2
nΔt = 0,140 s micro-delay	17,6	6,5	3,3	2,2	1,6
nΔt = 0,600 s micro-delay	14,6	5,4	2,8	1,7	1,3

According to the data presented in Table no. 2, the load can be used at distances of more than 300 m from the protected constructions, with micro delay.

This technology can be used for an area representing approximately 85% of the open pits area. At smaller distances, in order to ensure an oscillation velocity of maximum 0.2 cm/s next to the construction, *i.e.* to ensure a negligible seismic impact, some special technological options of the quarrying technology are required. Such technological options consist in the reduction of the bore hole diameter and depth, reduction of the amount of explosive detonated per blasting phase, etc.

This area covers approximately 15%, containing small amounts of ore to be blasted. Zone 2 extends to maximum 300 m from the nearest construction. In its turn, this zone is divided into three sub-zones of application of the technological options for ore blasting.

A maximum load of explosive/blasting phase corresponds to each sub-zone.

In order to measure the quarrying explosions impact on the constructions located inside the protected area and other historical buildings, a monitoring system will be implemented, consisting in a stationary network of digital seismographs, with three components installed at the main constructions to be protected, and a mobile network composed of three mobile seismographs installed on a longitudinal profile between the protected construction and the centre of the explosions. The processing of the monitoring data obtained during the operation of the Roşia Montană open pits will also determine the variation of the dynamic parameters of the seismic oscillations (seismic impact mitigation coefficient).

The secondary effects of open pit explosions, such as the oscillation velocity and over-pressure of the shock wave can be kept under control and reduced by a number of technical and organizational measures.

The over-pressure of the shock wave depends on the amount of explosive load and blasting technique (electrical or non-electrical, instantaneous or micro delay). It implies a risk to human beings and to highly deteriorated constructions. The shock wave over-pressure impact can be reduced using the same methods used in the case of the blast radius (work fronts orientation and compliance with the geometrical parameters of load placement).

The seismic wave (material particle oscillation) represents the most important secondary effect on the soil and constructions. This effect is assessed by the velocity, acceleration or movement of the material particle. For the protection of constructions, velocity is the most widely used parameter.

The oscillation velocity of the material particle has been used as a parameter for the delimitation of the two large areas of the open pits, under the condition of a maximum velocity of 0.2 cm/s measured at the nearest construction from the explosion centre.

This velocity ensures the protection of the constructions, provided that the consolidation works are performed. This value of the maximum velocity (of 0.2 cm/s) has been adopted based on the relevant standards existing in other countries having a long tradition in this field, and complies with the requirements of the German standard DIN 4150/83.

It is important to emphasize that it is not the quarrying technologies using explosives that represent a real threat to the 42 historical buildings, but rather their advanced state of degradation. For this reason, if no measures are taken, these buildings will be inevitably lost.