



ASSESSMENT OF THE RISK OF TECHNICAL INCIDENTS, DISTURBANCES AND DAMAGES AT LUPENI MINE

Gheorghe Eugen SAFTA¹, Manuel Cristian SĂVULESCU², Florin MUREȘAN – GRECU³, Adrian Mihai ȘCHIOPU⁴, Emanuel Alin CRUCERU⁵, Nicolae Daniel FÎŢĂ^{6*}

¹University of Petrosani, Petrosani, Romania, saftaeugen70@yahoo.com
 ²University of Petrosani, Petrosani, Romania, savio_scm@yahoo.com
 ³University of Petrosani, Petrosani, Romania, flomavon2002@yahoo.com
 ⁴Strategic Studies of Energy Security European Center, Petrosani, Romania, schiopu.adrian.mihai@gmail.com
 ⁵Strategic Studies of Energy Security European Center, Petrosani, Romania, România, alincruceru1988@gmail.com
 ⁶University of Petrosani, Petrosani, Romania, România, daniel.fita@yahoo.com

DOI: 10.2478/minrv-2024-0032

Abstract: The assessment of technical incident risk, disturbance or technical damage at Lupeni Mine comes in the context in which the possibility of a power failure is very likely due to very old coal mining methods, very precarious facilities and equipment and lack of investment. The danger of electric shock is imminent and poses a clear threat to the safety of the workers. In some unfortunate cases, failure to comply with electrical safety can cause the risk of life-threatening explosions of underground workers. The authors assessed the risk of technical incident, technical disturbance or technical damage and developed recommendations on how to eliminate such risks.

Keywords: *assessement, risk, technical incident, disturbance, damage*

1. Introduction

Lupeni Mine is part of the Energy Complex Valea Jiului within the Ministry of Energy and provides the coal (hard coal) used as fuel for the electricity generation at Paroseni Thermo Power Plant. Lupeni Mine will permanently stop its activity by the end of 2024, and in the next two years, closure and greening works will be carried out in the mining area.

The closure phase of Lupeni Mine was organized according to the program for the final closure of Lupeni and Lonea mines, established by the Romanian Government and the European Commission. [1, 2, 3]

The closing of the activity of Lupeni Mine (maintenance, airing, recovery, evacuation and transport of materials/equipment) due to not complying with the electrical safety rules, a number of electrical risks are generated (technical incident, disturbance and damage), which may endanger the proper functioning of the mine and the life of the underground and/or surface workers.

Risks generated by certain vulnerabilities designate internal and external situations, circumstances, elements or conditions, sometimes doubled by a series of actions, determining or favoring the materialization of a threat to the workers, or, in the case of Lupeni Mine, generating effects of lack of safety and insecurity. [4, 5, 6]

2. Risk scenario assessment: technical incidents, disturbances and damages at the electrical installations of Lupeni Mine

The abnormal electrical functioning of Lupeni Mine (technical incident, disturbance and damage) requires the identification of all the risk factors related to the work system: *performing factors* (wrong actions and omissions), *work loading* (inadequate labor load content in relation to security requirements and sub/oversized load in relation to the capacity of the performer), *means of production* (mechanical, thermal, electrical, chemical and biological risk factors) and *work environment factors* (physical, chemical, biological risk factors) and *work environment factors* (physical, chemical, biological risk factors), as well as the exact form of their occurrence. [4]

^{*} Corresponding author: Nicolae Daniel Fîță, lect. Ph.D. eng., University of Petrosani, Petrosani, Romania, Contact details: University of Petrosani, 20 University Street, daniel.fita@yahoo.com

2.1. Causal analysis

Table 1 presents the causal analysis (causes and effects) [1]

	~ .		,		<i>00</i>)
Tahle I	Causal	analysis	(causes	and	offorts)
10010 1.	Cansai	chick yord	cunses	unu	cjjecusj

Causal analysis					
Causes:	Effects:				
	The abnormal operations at Lupeni Mine in terms of				
	electrical safety may have the following consequences:				
Failure to comply with electrical safety rules and	• technical incidents;				
procedures in the operation of Luponi Mine	 technical disturbances; 				
procedures in the operation of Eupeni Mine.	technical damages.				
	Such abnormal operations at Lupeni Mine might cause				
	enormous economic losses (production).				

Table 2 presents the analysis of identified dangers and threats [1]

	Table 2. Analysis of identified dangers and threats							
No.	Identified dangers and threats	Generating risks						
1.	 short-circuits of 110 kV overhead power lines at Lupeni Mine supply due to natural causes, overloads or the fault of the electricity distributor; short-circuits or unexpected decoupling of 110/20 kV power transformers from the power substation inside Lupeni Mine, due to natural disasters, overloads or wrong maneuvers of the operating personnel; unsupplied at 110 kV or 20 kV of Lupeni Mine from three separate sources; short-circuits or unexpected decoupling of 20/6/0,4 kV power transformers from the power substation inside Lupeni Mine, due to equipment age, overloads or wrong maneuvers of the operating personnel; unexpected decoupling of power enclosure transformers (supply points) inside Lupeni Mine (surface/underground), due to overloads or wrong maneuvers of the electrical personnel; fires due to electrical equipment and installations; electrocution by step voltage, indirect touch, direct touch; the improvisation in electrical equipment and installations; failure to comply with the electrical safety rules; corresponding non-charged electrical equipment; unprotected electrical equipment, anti-explosive or anti-gray (anti-grizutous), in a potentially explosive environment; flame in case of ignition of methane; poor condition of underground mining electrical installations; lack of electrical current revisions and repairs; electrical repairs under the action of methane gas; carelessness and non-training and of the electrical personnel; failure to communicate or poor communication with the area or local dispatcher; unspecialized evacuation personnel in times of crisis; lack of personnel training for the purpose of preventing and eliminating sources of risk; the lack of personnel training for the purpose of preventing and eliminating sources of risk; 	Operating safety risk: • technical incident; • technical disturbance; • technical damage.						

2.2. Likelihood

Level		Likelihood		
	1.	It has a very low likelihood of occurring.	over	
	Very low	Normal measures are required to monitor the evolution of the event.	20 years	
	2.	The event has a low likelihood of occurring.	16 - 20	
	Low	Efforts are needed to reduce the likelihood and/or mitigate the impact produced.	years	
	3.	The event has a significant likelihood of occurring. Significant efforts are needed to	11 – 15	
	Medium	reduce the likelihood and/or mitigate the impact produced.	years	
	4.	The event has a high likelihood of occurring. Priority efforts are needed to reduce the	6 – 10	
	High	likelihood and mitigate the impact produced.	years	
v	5.	The event is considered imminent. Immediate and extreme measures are required to	1 – 5	
Λ	Very high	protect the target, evacuation to a safe location if the impact so requires.	years	

2.3. Gravity

	Level	Gravity
	1. Very low	The event produces a minor disturbance in the activity, without material damage.
	2. Low	The event causes minor material damage and limited disruption to activity.
	3. Medium	Injuries to personnel, and/or certain losses of equipment, utilities and delays in providing the service.
	4. High	Serious personnel injuries, significant loss of equipment and facilities, delays and/or interruption of service provision.
X	5. Very high	The consequences are catastrophic resulting in deaths and serious injuries to personnel, major losses in equipment, facilities, and termination of service provision.

2.4. Risk

	Veru high 5					Risk scenario
0 D	High 4					
ΟHΙ	Medium 3					
EL]	Low 2					
LIK	Very low 1					
	0	Very low 1	Low 2	Medium 3	High 4	Very high 5
			G R A V	ΊΤΥ		
Note	\cdot The level of risk is a	viven by the product of	of Likelihood	Gravity		

ote: The level of risk is given by the product of Likelihood x Gravity

Calculated risk level			
Level Score			
Very low	1-3		
Low	4 – 6		
Medium	7 – 12		
High	13 - 16		
Very high	17 – 25		

The risk scenario chosen has the *risk level 25 – Very high* (Likelihood 5 x Gravity 5), and for this reason the risk is being treated with proposed recommendations.

2.5. Risk treating

Table 3 presents the proposed recommendations.

Revista Minelor – Mining Revue ISSN-L 1220-2053 / ISSN 2247-8590

The most serious identified dangers and threats		Proposed recommendations			
		Technical measures:			
		• observing working technologies, specific working			
		instructions, work permits and work safety requirements:			
		• observing fire prevention and extinguishing plan:			
		• 1049/2006 GD on requirements for labor protection			
		Organization measures:			
		• training workers on the importance of complying with			
1	Flames in case of ignition of methane	specific work instructions, work permits, occupational			
1.	r fames in case of fightion of methane.	safety and health measures:			
		safety and nearth incastres,			
		• control of the underground atmosphere with portable			
		equipment and collection of samples;			
		• training of workers and verification by senior hierarchical			
		managers of compliance with occupational safety			
		requirements;			
		• immediate evacuation of workers in the fresh air current.			
		Technical measures:			
		For direct touch:			
		• coatings with electro-insulating materials of the active			
		parts of electrical installations and equipment;			
		 enclosures or coverings with outer shells; 			
		• enclosures, protection by location inaccessible/guarded			
		places, by ensuring minimum security distances;			
		• the removal from voltage of the installations, electrical			
		equipment to be carried out and the verification of the			
		lack of voltage:			
		• use of special devices for grounding and short-circuiting:			
		• the use of electro-insulating means of protection:			
		• equalization of potentials and isolation from the ground of			
		the working platform:			
		 electrical equipment introduced underground must be in 			
		closed construction with the normal degree of protection			
		at least IP 33			
		For indirect touch:			
		• use of very low security supply voltages:			
		• use of very low security supply voltages, the corthing of electrical equipment:			
		• the earthing of electrical equipment,			
2	Electrocution by step voltage, indirect touch,	• insulation of the location where the electrical equipment is			
2.	direct touch - non-compliance with the rules of	located;			
	electrical safety.	• additional protective insulation applied to the machine in			
		the manufacturing process;			
		• the protection surface;			
		• the equalization and/or direction of potentials;			
		realization of automatic disconnection in case of			
		occurrence of a voltage or a current of dangerous defect;			
		• the use of electro-insulating means.			
		Organization measures:			
		For direct touch:			
		• the execution of the interventions at the electrical			
		installations will be done by the personnel qualified in the			
		specialization of electrician, with authorizations and			
		trainings for this purpose;			
		• execution of interventions based on one of the forms of			
		work, namely, written work permit;			
		• internal technical instructions for labor protection, work			
		duties, verbal provisions, minutes, service obligations,			
		own liability;			
		• fencing the workplace;			
		• elaboration of working instructions (work permits) for			
		each intervention in electrical installations;			

		 the organization and execution of periodic checks of technical measures for protection against direct touch; training of workers on the consequences of ignoring security bans; verification by permanent control, by the head of the team, and/or by survey, by the superior hierarchical heads.
3.	Non-use of personal protective equipment and other protective equipment (thermic-resistant overalls, visor helmet, insulating boots, electro- insulating gloves, electro-insulating tools, self- rescue mask, etc.).	 <i>Technical measures:</i> equipping workers with personal protective equipment corresponding to the work to be carried out; workers must wear protective equipment during the performance of the work task; workers who go underground must wear the mask of self-rescue on them all the time; compliance with GD no. 1048/2006 on minimum requirements for the use of personal protective equipment by workers at work. <i>Organization measures:</i> training of workers on the consequences of not using personal protective equipment; verification by permanent control, by the head of the band, and/or by survey, by the senior hierarchical heads.
4.	 short-circuits of 110 kV overhead power lines of Lupeni Mine supply due to natural causes, overloads or the fault of the electricity distributor; short-circuits or unexpected decoupling of 110/20 kV power transformers from the power substation inside Lupeni Mine, due to natural disasters, overloads or wrong maneuvers of the operating personnel; unsupplied at 110 kV or 20 kV of Lupeni Mine from three separate sources; short-circuits or unexpected decoupling of 20/6/0,4 kV power transformers from the power substation inside Lupeni Mine, due to equipment age, overloads or wrong maneuvers of the operating personnel; unexpected decoupling of power enclosure transformers (supply points) inside Lupeni Mine (surface/underground), due to overloads or wrong maneuvers of the electrical personnel. 	Massive investments in modern energy equipment; Well trained operating personnel in times of crisis, disturbance or damage; Rational electricity consumption in the context of preventing overloading of power lines, transformers or electrical enclosures (supply points).
5.	 corresponding non-charged electrical equipment; unprotected electrical equipment, anti-explosive or anti-gray, in a potentially explosive environment. 	Use only of electrical equipment protected anti-explosive and anti-gray.
6.	 poor condition of underground mining electrical installations; lack of investment. 	Massive investments in mining electrical installations and equipment.
7.	 lack of electrical current revisions and repairs; electrical repairs under the action of methane gas. 	Periodic revisions executed on time and quality; Electrical repairs will always be done outside the action of methane gas.
8.	 carelessness and non-training and of the electrical personnel; unspecialized evacuation personnel in times of crisis; lack of working procedures in case of insecurity (lack of normality); 	Electric personnel well trained and trained. Working procedures in the home of insecurity and insecurity.

	 precarious procedures in case of accident followed by serious damage; 	
	• the lack of personnel training for the purpose of preventing and eliminating sources of risk;	
9.	The entry into the mine under the influence of alcohol/drugs or the presentation to the workstation in poor health or under the influence of alcohol/drugs;	Random checking of electrical personnel with alcoholtest.

2.6. Risk recalculation

Risk	Identified		Following the proposed recommendations	
		1. Very low		1. Very low
		2. Low	X	2. Low
Dangers and threats: 1, 2, 3, 4, 5, 6, 7, 8, 9		3. Medium		3. Medium
		4. High		4. High
	Χ	5. Very high		5. Very high

	Veru high 5		Risk scenario				
LIKELIHOOD	High 4						
	Medium 3						
	Low 2						
	Very low 1						
	0	Very low	Low	Medium	High	Very high	
		1	2	3	4	5	
G R A V I T Y							

Note: The level of risk is given by the product of Likelihood x Gravity

Calculated risk level				
Level	Score			
Very low	1-3			
Low	4 – 6			
Medium	7 – 12			
High	13 - 16			
Very high	17 – 25			

Following the treatment of dangers and threats 1, 2, 3, 4, 5, 6, 7, 8, 9, by proposed recommendations, the chosen risk scenario has the *risk level 10 - Medium* (Likelihood 5 x Gravity 2).

3. Conclusions

Following the assessment of the risk scenario: technical incidents, disturbances and damages at the electrical installations of Lupeni Mine, the following results:

a) *risk level 25* – Very high (Likelihood 5 x Gravity 5);

after the proposed recommendations:

b) *risk level 10* – Medium (Likelihood 5 x Gravity 2).

The recommendations proposed following the 9 dangers and threats will be an integral part of the Prevention, Protection and Security Plan.

Revista Minelor – Mining Revue ISSN-L 1220-2053 / ISSN 2247-8590

References

[1] * * *, 2024 Energy Complex Jiu Valley – Lupeni Mine

[2] Preda G., Marinescu M., Năstase G., 2004

Harnessing Natural Resources – Volume I – Basics of Natural Resources, International University Press Publishing, ISBN: 973-99374-5-4, Bucharest.

[3] **Băhnăreanu C.**, 2008 *Energy Security*, Defense and Security Strategic Studies Center, "Carol I" National Defense University Publishing House, Bucharest

[4] Fîță N.D., et al., 2021

Occupational Health and Safety Management, An Important Pillar of National Security from Romania, International Conference on Electrical, Computer and Energy Technologies (ICECET), Cape Town, South Africa, pp. 1-5, doi: 10.1109/ICECET52533.2021.9698802.

[5] **Covaci Ş.**, 1983 Underground Mining, Volume I, Didactic and Pedagogical Publishing House, Bucharest

[6] **Covaci Ş., et al.**, 1999 *Underground Mining*, Volume II, Corvin Publishing House, Deva



This article is an open access article distributed under the Creative Commons BY SA 4.0 license. Authors retain all copyrights and agree to the terms of the above-mentioned CC BY SA 4.0 license.