

DEVELOPMENT OF A COMPUTER-BASED RISK ASSESSMENT TOOL
FOR UNDERGROUND COAL MINES

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FOR UNDERGROUND COAL MINES**

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ABSTRACT

DEVELOPMENT OF A COMPUTER-BASED RISK ASSESSMENT TOOL FOR UNDERGROUND COAL MINES

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Underground coal mining remains one of the world's most hazardous occupations. There are numerous hazards in a mine, such as gas, dust, noise, temperature, and high humidity. Besides, increasing number of occupational accidents in underground coal mines shows the importance of occupational health and safety in these workplaces. By means of Occupational Health and Safety Law No 6331, attention to health and safety in the workplace has grown in recent years in Turkey. In addition, conducting an occupational health and safety risk assessment is a legal obligation for all workplaces also including underground coal mines under the scope of the Law. Thus, preparation of a risk assessment both considering mining workplaces' hazards, their unique characteristics, and satisfying legal obligations becomes a requirement for mining workplaces. The main objective of this study is to develop a computer-based risk assessment tool for underground coal mines in Turkey.

The methodology of the study starts with collection of the occupational health and safety related Turkish legislations and gathering information about underground coal mines' hazards. Then risk assessment steps were determined and an algorithm for the

risk assessment was developed. After the determination of the modules' headings and questions for each module, computer programs were searched to select the most appropriate one. Finally, computer-based risk assessment tool was developed with the selected program considering the developed risk assessment algorithm.

This study is a pioneer one for underground coal mines because of the fact that prepared computer-based risk assessment tool is compatible with the Occupational Health and Safety Law, Regulation on Occupational Health and Safety Risk Assessment, Regulation of Occupational Health and Safety in the Mining Workplace, and other occupational health and safety related regulations. Tool is prepared as simple as possible and it is user friendly. Moreover, tool provides to update the risk assessment any time. Prepared computer-based risk assessment tool could be developed and adopted as an application which can be used by smart phones. In future studies, similar tools could be prepared for other mining workplaces and also for other sectors.

Keywords: Underground coal mine, occupational health and safety, risk assessment tool

ÖZ

YERALTI KÖMÜR MADENLERİ İÇİN BİLGİSAYAR TABANLI BİR RİSK DEĞERLENDİRMESİ ARACI GELİŞTİRİLMESİ

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Yeraltı kömür madenciliği dünyadaki en tehlikeli mesleklerden biridir. Gaz, toz, gürültü, sıcaklık ve yüksek nem gibi pek çok tehlike madenlerde bulunmaktadır. Bunun yanı sıra, yeraltı kömür madenlerinde artan iş kazası sayısı bu işyerlerinde iş sağlığı ve güvenliğinin önemini göstermektedir. Türkiye’de, işyerlerinde iş sağlığı ve güvenliğine gösterilen ilgi İş Sağlığı ve Güvenliği Kanunu sayesinde son yıllarda artmıştır. Üstelik, Kanun kapsamındaki yer altı kömür madenleri de dahil olmak üzere tüm işyerlerinde iş sağlığı ve güvenliği risk değerlendirmesi yapılması yasal bir yükümlülüktür. Bu yüzden, maden işyerleri için hem maden işyerlerinin tehlikelerini, kendilerine özgü emsalsiz yapılarını göz önünde bulunduran hem de yasal yükümlülükleri sağlayan bir risk değerlendirmesinin hazırlanması bir gereklilik olmuştur. Bu çalışmanın esas amacı, Türkiye’deki yeraltı kömür madenleri için bilgisayar tabanlı bir risk değerlendirmesinin geliştirilmesidir.

Araştırmanın metodolojisi, iş sağlığı ve güvenliği ile ilgili Türk mevzuatının derlenmesi ve yeraltı kömür madenlerindeki tehlikeler hakkında bilgi toplanması ile

başlamaktadır. Daha sonra, risk değerlendirmesi aşamaları belirlenmiş ve risk değerlendirmesi algoritması oluşturulmuştur. Modül başlıklarının ve her modüldeki soruların belirlenmesinden sonra, en uygun bilgisayar programını seçmek için bilgisayar programları araştırılmıştır. Son olarak, risk değerlendirmesi algoritmasını dikkate alarak seçilen bilgisayar programı ile risk değerlendirmesi aracı hazırlanmıştır.

İş Sağlığı ve Güvenliği Kanunu, İşyerlerinde İş Sağlığı ve Güvenliği Risk Değerlendirmesi Yönetmeliği, Maden İşyerlerinde İş Sağlığı ve Güvenliği Yönetmeliği ve diğer iş sağlığı ve güvenliği mevzuatı ile uyumlu hazırlanan bilgisayar tabanlı risk değerlendirmesi aracı, yeraltı kömür madenleri için öncü bir araçtır. Aracın kullanımı mümkün olduğunca kolaydır ve araç kullanıcı dostudur. Ayrıca, araç risk değerlendirmesinin herhangi bir zamanda güncellenmesini sağlamaktadır. Hazırlanan bilgisayar tabanlı risk değerlendirmesi aracı geliştirilebilir ve akıllı telefonlarda kullanılabilecek bir uygulama olarak adapte edilebilir. Gelecekteki çalışmalarda, benzer araçlar diğer maden işyerleri ve diğer sektörler için de hazırlanabilir.

Anahtar Kelimeler: Yeraltı kömür madeni, iş sağlığı ve güvenliği, risk değerlendirmesi aracı

To Soma and Ermenek

Miners

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CHAPTER 1

INTRODUCTION

1.1 Background Information

Occupational health and safety is a branch of science that goals to provide healthier working environment for workers and protect workers from occupational accidents and occupational diseases (Hızıroğlu *et al.*, 2011). The fundamental indicators of occupational health and safety are occupational accidents and occupational diseases. According to International Labor Organization (ILO), more than 2.3 million individuals die each year because of the work-related diseases or occupational accidents (ILO, 2016a). Furthermore, fatal work-related diseases are about 1.95 million every year (Niu, 2010). It is important that prevention of occupational accidents and occupational diseases shall be enabled by establishing occupational safety and health culture, raising awareness and obeying the legal rules.

In Turkey, attention to health and safety in the workplace has grown in recent years, spurred by Occupational Health and Safety Law No 6331 which came into effect upon being published on the Official Gazette dated 30 June 2012 and No 28339. The Law No 6331 has been a milestone in terms of working life in our country because of embracing all workers regardless of whether they work in public or private sector. In the Law, proactive approach rather than reactive and normative approach has been adopted. By considering this main issue, the Law brings along a number of new significant practices. For instance, carrying out occupational health and safety risk assessment is a legal obligation for all workplaces under the scope of the Law.

The principles and procedures of risk assessment in the workplace in terms of occupational health and safety were regulated by the Regulation on Occupational Health and Safety Risk Assessment. As known, there are several risk assessment

methods, but there is no method implied in this Regulation and instead of this, risk assessment phases are defined for all workplaces.

1.2 Problem Statement

Mine is basically an excavation made in the earth for extraction of minerals and mining is the industry, occupation, and activity in order to extract minerals (Hartman, 1987). Mining products constitute the backbone of the most sectors and some form of mining or quarrying is carried out nearly every country in the world (ILO, 2015a). Moreover, mining activities are important for human welfare and this is valid for not only in industrialized countries, but also in transition and developing countries (ISSA, 2015).

According to ILO, mining sector comprises about one percent of the globe's labor force; nonetheless about eight percent of fatal accidents occurs in mining industry. Besides, it is estimated that more than six million people work in small-scale mines and even in industrialized countries, occupational accident rates in small-scale mine workplaces are usually six or seven times more than in larger enterprises (ILO, 2015b).

Coal mining has been hazardous work since coal mining began during the colonial times (Margolis, 2010). As well, either underground or surface coal mining, has many hazards that make it unique concerning occupational health and safety (Sarı *et al.*, 2009). However, working conditions in underground mining are generally different from surface mining (Mahdevvari *et al.*, 2014). During the coal production process, there are many types of hazardous sources, such as poisons, dust, noise, temperature, and high humidity which prompt the hazards and pose a great threat to health and safety of the miners (Zhu-Wu *et al.*, 2011).

Coal is the most commonly used energy source in Turkey. Even though modern and safer underground mining methods have been introduced, mine accidents cause deaths, injuries and loss of money in some mines (Sarı *et al.*, 2004). Actually, risk assessment is one of the basic process to prevent accidents (Hadži-Nikolova *et al.*, 2012). In the Law No 6331, risk assessment is defined as activities required for identifying hazards which are existing in or may arise from outside the workplace, analyzing, and rating

the factors causing these hazards to turn into risks and the risks caused by hazards and determining control measures.

As it was mentioned, one of the legal obligation of all workplaces is that conducting a risk assessment which provides continuous improvement and proactive approach by regularly updating the working conditions related to occupational health and safety risks. This obligation is valid for mining workplaces, too. Furthermore, this issue is once more emphasized in the Regulation for Occupational Health and Safety at Mining Workplaces that the employer shall ensure the risks, including psychosocial risks, to which workers at the workplace might be exposed have been determined and assessed.

On the other hand, each workplace has its own distinctive characteristics and unique nature. In addition to this, underground coal mining is very dangerous occupation involving many risks, such as methane explosion, coal dust explosion, fire, suffocation, and roof collapses. Besides these main risks, workers are dealing with the mandatory working environments. For example; working in poor illuminated and narrow fields, noisy conditions which may cause stress and affect the quality of working life. For this reason, preparation of an inclusive, lucid and simple risk assessment both considering mining workplaces' hazards, their unique characteristics and satisfying legal requirements becomes a requirement for mining workplaces.

1.3 Scope and Objectives of the Study

The scope of this study is underground coal mines in Turkey and the main objective is to develop a computer-based risk assessment tool for underground coal mines. It is aimed to prepare a risk assessment tool which;

- is parallel to the occupational health and safety legislation,
- is easy-to-handle,
- is documentable,
- is updatable,
- simplifies the employers' business, and
- provides recording an increasing amount of data.

1.4 Research Methodology

The methodology of this study mainly includes the following items.

1. Collection of the occupational health and safety related Turkish legislations.
2. Gathering information about underground coal mines hazards.
3. Determination of the risk assessment steps.
4. Developing an algorithm for the risk assessment.
5. Determination of the modules' headings.
6. Determination of the questions for each module.
7. Searching computer programs to select the most appropriate one.
8. Preparation of the risk assessment tool with the selected program considering the developed risk assessment algorithm.

1.5 Thesis Outline

This thesis is consisted of five chapters. Chapter 1 covers brief information about occupational health and safety, risk assessment and underground coal mines. It also includes problem statements, objectives, scope, and research methodology of the study. Chapter 2 covers fundamental occupational health and safety definitions, past and current Turkish legislations about occupational health and safety, studies about underground coal mines, and occupational health and safety statistics. Chapter 3 comprises risk assessment steps, hazards in underground coal mines, and previous risk assessment studies. Chapter 4 presents the computer-based risk assessment tool which is developed in this thesis. Chapter 5 covers conclusions and recommendations part.

CHAPTER 2

OCCUPATIONAL HEALTH AND SAFETY IN UNDERGROUND COAL MINES

2.1 Definitions

In this section, fundamental definitions and terms related to occupational health and safety are presented and they are adopted from Occupational Health and Safety Law No 6331 unless otherwise stated.

Occupational Health and Safety Management Systems - Requirements (OHSAS 18001, 2007) defines “**Occupational Health and Safety**” as conditions and factors that affect, or could affect, the health and safety of employees or other workers (including temporary workers and contractor personnel), visitors, or any other person in the workplace.

Hazard is defined as potential which exists at the workplace or may arise from outside the workplace to cause harm or damage which could affect the worker or the workplace.

Occupational accident is defined as any occurrence taking place at the workplace or due to the performance of work which leads to death or physical or mental disability to the physical integrity of the victim.

Occupational disease is defined as any illness caused by exposure to occupational risks.

Risk is defined as probability of loss, injury or other harmful result arising from hazard.

Risk assessment is defined as activities required for identifying hazards which are existing in or may arise from outside the workplace, analyzing and rating the factors causing these hazards to turn into risks and the risks caused by hazards and determining control measures.

2.2 Legislation

In this section, occupational health and safety in Turkey is handled in the sense of legislation from past to present.

2.2.1 A Brief History of Legislation

The history of occupational health and safety in Turkey stretches over a long path from the Ottoman Empire to the Republic of Turkey. During the Ottoman Empire period, "Dilaver Paşa Regulation" was published in 1865. Then, "Maadin Regulation" was published in 1869 as a significant document. It was generally based on provisions about occupational safety and had a progressive and comprehensive approach (MoLSS, 2013a).

In 1920, by the establishment of the Grand National Assembly of Turkey, two laws on occupational health and safety came into force before the declaration of the republic: "Law on Coal Dust Trade in Zonguldak and Ereğli Region for the Benefit of Workers" dated 28 April 1921 and numbered 114; and "Law on Rights of Mining Workers in Ereğli Region" dated 10 September 1921 and numbered 151. In the following years of the Turkish Republic, several regulations were published such as "Weekly Rest Days Law" (1924), "Code of Obligations" (1926), "Public Hygiene Law" (1930), and "Municipalities Law" (1930) (MoLSS, 2013a).

The first "Labour Law" numbered 3008 was published in 1936 and had been in force until 1967. The second Labour Law numbered 931 was published in the late 1960s; however, it was annulled by a Constitutional Court decision. Labour Law numbered 1475 came into force in 1971 with detailed provisions on occupational health and safety. Labour Law numbered 1475 remained in force till 2003 when the recent Labour Law numbered 4857 came into force. Labour Law numbered 4857 also had a chapter

for occupational health and safety, comprised of 13 articles. At the end of this long course of legislative activities, "Occupational Health and Safety Law" numbered 6331 came into force on 30 June 2012 (MoLSS, 2013a).

2.2.2 Current Legislation

In the Constitution of the Republic of Turkey, Article 49 states that everyone has the right and duty to work and Article 56 stipulates that the state regulates health services through central plans from one hand to ensure that every person lives in good mental and physical health (MoLSS, 2013a).

2.2.2.1 Occupational Safety and Health Law No 6331

Occupational Safety and Health Law No 6331 came into effect upon being published on the Official Gazette dated 30 June 2012 and numbered 28339. The Law was prepared by the Ministry of Labour and Social Security considering national requirements, European Union accession process and international conventions ratified by Turkey. The Law is based on three pillars:

- encouraging active participation of workers in occupational health and safety,
- adopting a preventive approach, and
- ensuring occupational health and safety for all workers.

What comes after the Law presented below (MoLSS, 2013b):

- Occupational health and safety is handled for the first time with an independent Law.
- All workers are included within the scope of the Law regardless of whether they work in public or private sector.
- Proactive approach rather than reactive and normative approach has been adopted.
- Workplaces are classified by hazard classes according to the nature of their main activity.
- Occupational health and safety services are to be provided by every workplace.

- Employers are given the opportunity to provide services from joint health and safety units.
- The expenditures in micro enterprises arising from receiving occupational health and safety services are to be partially supported by the State.
- Risk assessment is conducted in order to prevent occupational diseases and occupational accidents.
- Workers are to receive regular health surveillance.
- Recording of occupational accidents and occupational diseases are to be carried out in an efficient and updated manner.
- “Occupational Health and Safety Committee” is to be set up in all workplaces recruiting fifty or more workers.
- Emergency plans are to be ready in workplaces.
- All workers are informed on occupational health and safety issues and their rights in work life.
- Workers are actively joined in decision making process on occupational health and safety activities in the workplace.
- Workers are able to use their right to refrain from work in the event of serious and imminent danger.
- In workplaces with more than one employer, occupational health and safety activities are to be carried out in coordination.
- Operation may be ceased in any part of the premises or completely in case of any vital danger.
- In order to facilitate the adaptation process, some articles of the Law are to be put into practice gradually.
- Workplaces bearing a risk of major industrial accident are not allowed to start operation without a “safety report” and “major accident prevention policy document”.
- Effective administrative sanctions are to be applied in order to facilitate the implementation of the Law efficiently.

2.2.2.2 Regulations about Occupational Health and Safety

Following the publication of the Law No 6331, it was published 36 regulations in the Official Gazette as the secondary legislation (Table 2.1). The current legislation is updated so as to ensure a dynamic working life and to eliminate problems experienced during practices in line with the changing needs. Moreover, 18 regulations are prepared in parallel with the related European Union Council Directives which means that they are compatible with relevant European Union directives (Table 2.1).

Table 2.1 List of Occupational Health and Safety Law Based Regulations (Official Gazette of the Republic of Turkey, 2016)

Name of Regulation	Official Gazette Date and Number
Regulation on Occupational Health and Safety Risk Assessment	29.12.2012 - 28512
Regulation on Occupational Health and Safety Services	29.12.2012 - 28512
Regulation on Duties, Authority, Responsibility and Training of Occupational Safety Experts	29.12.2012 - 28512
Regulation for Occupational Health and Safety Committee	18.01.2013 - 28532
Regulation on Health And Safety Precautions in Asbestos Related Works (83/477/EEC, 91/382/EEC, 2003/18/EC, 2009/148/EC)	25.01.2013 - 28539
Regulation for National Occupational Health and Safety Council	05.02.2013 - 28550
Regulation for Stopping the Operation in Workplaces	30.03.2013 - 28603
Regulation on Health and Safety Measures in Working with Screened Devices (90/270/EEC)	16.04.2013 - 28620

Table 2.1 List of Occupational Health and Safety Law Based Regulations (Official Gazette of the Republic of Turkey, 2016) (Continued)

Regulation on Occupational Health and Safety Services in Using Work Equipments (2009/104/EC)	25.04.2013 - 28628
Regulation on Protection of Employees from the Dangers of Explosive Environments (1999/92/EC)	30.04.2013 - 28633
Regulation on Procedures and Principals of the Occupational Health and Safety Training of the Employees	15.05.2013 - 28648
Regulation on Prevention of the Risks due to the Exposure to Biological Factors (2000/54/EC)	15.06.2013 - 28678
Regulation on Emergency Cases in Workplaces	18.06.2013 - 28681
Regulation for the Use of Personal Protective Equipment at the Workplace (89/656/EEC, 89/686/EEC)	02.07.2013 - 28695
Regulation on Vocational Educations of Workers to be employed in Hazardous and Extremely Hazardous Works	13.07.2013 - 28706
Regulation of Works need to be employed Seven and Half Hour or Less due to Health Reasons	16.07.2013 - 28709
Regulation for the Health and Safety Measures To Be Taken in the Buildings and the Extensions of the Workplace (89/654/EEC)	17.07.2013 - 28710
Regulation on Duties, Authority, Responsibility and Training of Occupational Physician and Other Health Technician	20.07.2013 - 28713
Regulation for the manual handling of the loads (90/269/EEC)	24.07.2013 - 28717
Regulation on Working Conditions at Night Shift for Female Employees	24.07.2013 - 28717
Regulation for Health and Safety Measures in Working with Carcinogen and Mutagen Substances (2004/37/EC)	06.08.2013 - 28730
Regulation of Protection of Workers to the Risks Arising from Noise (2003/10/EC)	28.07.2013 - 28721

Table 2.1 List of Occupational Health and Safety Law Based Regulations (Official Gazette of the Republic of Turkey, 2016) (Continued)

Regulation on the Protection of the Health and Safety Measures from the Risks Related to Chemical Agents at Work (1998/24/EC, 1991/322/EEC, 2000/39/EC, 2006/15/EC, 2009/161/EU)	12.08.2013 - 28733
Regulation of the Audit and Inspection of Military Workplace and the Workplace Producing Materials for Home Security and Cease of Operations	16.08.2013 - 28737
Regulation on Working Condition of Pregnant and Nursing Women, Establishing Breast Feeding Room and Day-Care Dormitories (92/85/EEC)	16.08.2013 - 28737
Regulation of Safety and Health Requirements for Work on Board Fishing Vessels (93/103/EC)	20.08.2013 - 28741
Regulation on Author of Occupational Hygiene Measurement, Testing and Analysis Laboratory	20.08.2013 - 28741
Regulation of Protection of Workers to the Risks Arising from Vibration (2002/44/EC)	22.08.2013 - 28743
Regulation on Health and Safety at Work of Workers with a Fixed-Duration Employment Relationship or a Temporary Employment Relationship (91/383/EEC)	23.08.2013 - 28744
Regulation for Safety and Health Signs (92/58/EEC)	11.09.2013 - 28762
Regulation of Occupational Health and Safety in the Mining Workplaces (92/104/EEC, 92/91/EEC)	19.09.2013 - 28770
Regulation on Health and Safety at Construction Work (92/57/EEC)	05.10.2013 - 28786
Dust Control Regulation	05.11.2013 - 28812
Regulation on Occupational Health and Safety Support Service	24.12.2013 - 28861
Regulation on Prevention of Major Industrial Accidents and Mitigation of Impacts (96/82/EC)	30.12.2013 - 28867
Regulation on Occupational Health and Safety Service Conducted by Employer or Representative	29.06.2015 - 29401

2.2.2.3 International Labour Organization Conventions

There are 198 recommendations and 187 declarations published by ILO in the area of health and safety at work (Hadži-Nikolova *et al.*, 2012). In this direction, five occupational health and safety related conventions were ratified by Turkey (Table 2.2) and ILO conventions 167 and 176 numbered will enter into force for Turkey on 23 March 2016 (ILO, 2016b).

Table 2.2 Ratified ILO Conventions by Turkey (Official Gazette of the Republic of Turkey, 2016 and ILO, 2016b)

Convention No	Convention Name	Law Date	Law No
155	Occupational Safety and Health Convention	07.06.2004	5038
161	Occupational Health Services Convention	07.06.2004	5039
187	Promotional Framework for Occupational Safety and Health Convention	29.05. 2013	6485
167	Safety and Health in Construction Convention	29.11.2014	6571
176	Safety and Health in Mines Convention	12.12.2014	6580

2.3 Studies about Underground Coal Mines

Coal mining has always been a hazardous job. Causes of mining accidents often are roof caving, drilling and blasting operations, confined spaces with narrow corridors, the use of chain and belt conveyors for coal hauling, the presence of methane, high ground pressures, the abandoned workplaces and oxidation processes in coal (Stojadinović *et al.*, 2012). Workers in coal mining are more likely to have loss of lives or to suffer from non-fatal injuries or illnesses, and their injuries are more likely to be severe than workers in private industry in general (Bureau of Labor Statistics, 2007).

On the other side, underground coal mining is the particular industrial activity where employees constantly work in explosive atmosphere. In an underground coal mine, coal dust explosion is the most severe accident that may occur being able to destroy the whole mine (Medic Pejic *et al.*, 2013).

Accidents are very complex realizations and many factors can contribute to their occurrence (Sari *et al.*, 2004). Primary causes of accidents and frequency distribution is given in Table 2.3. This data contained 1,390 days-lost accident cases recorded at GLI-Tuncbilek underground mine between January 1994 and December 2002 (Sari *et al.*, 2009). Falls of ground and handling of tools and supports constitute the nearly half of the accidents. It is obvious that underground coal mines are often influenced by roof falls which have numerous consequences ranging from fatalities and injuries to lost time. However, it is often tough to expect due to the uncertainties associated with the mine environment and inherent variability in geological conditions.

Table 2.3 Primary Causes of Occupational Accidents and Frequency Distribution
(Sari *et al.*, 2009)

Type of accident	Number of accidents	% of accidents
Falls of ground	396	28.5
Handling of tools and supports	330	23.7
Struck by/falling object	235	16.9
Machinery	112	8.1
Movement of personnel	96	6.9
Powered haulage	51	3.7
Hand tools	50	3.6
Electricity	5	0.4
All other causes	112	8.3

Wu *et al.* (2011) analyzed the major accidents of coal mines in China between 1949 and 2009. They implied that a country with good safety conditions pays much attention to the coordination between the worker, employer, and government which is cooperative in dealing with misunderstandings between management and labor, ease

the contradiction, solve the social problems and encourage the safety management at workplace.

Coal mines have always been under threaten by occupational accidents, such as roof fall, gas, fire, and flood. In the meantime, coal mine accidents, whose prompting factors are much closely related to both the artificial factors and the exploitation environment, are also quite complicated and embodied in the interactions of human beings, environments, and substance. According to the several origins and bounds of human accidents in coal mines, it is explained the chief factors in four parts: facilities, individual factors, environment, and organization and administration which are presented in Table 2.4 (Zhu and Xiao-ping, 2009).

Table 2.4 Leading Factors of Human Accidents in Coal Mine (Zhu and Xiao-ping, 2009)

Facilities	Individual Factors	Environment	Organization and Administration
Timeworn facilities	Eager for quick	Lightning	Safety culture
Stability	success	Status	education
Technology	Incorrect motivation	Temperature	Unreasonable
Complicated working	Psychology of fluke	Dust	regulations
procedures	Profession skills	Gas	Distribution system
Unconformity with	Age	Working space	Failure to carry out
human engineering	Safety education	Social role	Policy and statute
Reliability	Sex	Humidity	Supervisory institution
Tiresome tasks	Tiredness	Social relations	Irrational task
Maintenance	Civilized level	Noise	assignment
	Negligence	Social approbation	Organizational
	Social psychology		structure
	Strained emotion		Incorrect decision-
	Psychological		making
	characteristic		

Asfaw *et al.* (2013) studied on the relation between profitability and the incidence rate of occupational injuries in United States underground coal mines from 1992 to 2008. In this study, a total of 5,669 mine-year observations (number of mines \times number of

years) were involved. It is concluded that there is an inverse relationship between profitability and all of three pointers of occupational injuries which are whole reported injuries, reported injuries with lost workdays, and the most serious injuries reported.

Company experiences demonstrates that improving occupational health and safety provides not only fewer occupational accidents, but also a higher degree of involvement among workers, less absenteeism, and a favorable company image (Berg and Pranger, 2005).

In succeeding research, attention turned to workers' active participation in safety, where it was shown that workers' active engagement in related initiatives resulted in improved safety performance (Curcuruto *et al.*, 2015).

2.4 Occupational Health and Safety Statistics

2.4.1 World Statistics

Occupational accident is an indicator of the level of occupational health and safety in a country. According to ILO (2016a), more than 2.3 million individuals die each year because of the work-related diseases or occupational accidents that equals to 6,300 death per day. It is estimated that every year four percent of global Gross Domestic Product is vast and the economic burden of poor occupational safety and health practices because of the human cost of this daily adversity.

Mining sector comprises about one percent of the globe's labor force, nonetheless, about eight percent of fatal accidents occurs in mining industry (ILO, 2015b). Some of the mining accidents in the world from 1985 to 2009 which causes more than 50 fatalities are presented in Table 2.5. As seen, majority of the mine accidents occur in coal mines and explosions come to the forefront among reasons of the accidents.

Table 2.5 Mine Accidents from 1985 to 2009 which Causes more than 50 Fatalities
(The Grand National Assembly of Turkey, 2014)

Year	Country	Reason of Accident	# of Fatalities	Mine Type
1985	Italy	Collapse	268	Fluorite
1986	South Africa	Fire	177	-
1990	Bosnia- Herzegovina	Explosion	180	Coal
1991	China	-	147	-
1992	Turkey	Explosion	263	Coal
1995	South Africa	Elevator Fall	105	Gold
2000	China	-	159	-
2000	China	Collapse	100	-
2001	China	Flooding	200	-
2001	China	Explosion	150	-
2002	China	-	124	Gold
2004	China	-	148	Coal
2004	China	Explosion	166	Coal
2005	China	Explosion	214	Coal
2005	China	Flooding	123	Coal
2005	China	Explosion	134	Coal
2005	China	Explosion	-	Coal
2007	Russia	Explosion	108	Coal
2007	China	Flooding	181	Coal
2007	Ukraine	Explosion	101	Coal
2007	China	-	105	Coal
2008	China	Collapse	254	-
2009	China	Explosion	104	Coal

2.4.2 Turkey Statistics

The only source of occupational health and safety statistics in Turkey is the statistics of Social Security Institution (SSI). According to the data of SSI for the year 2013, 1,611,292 workplaces performed activity with 12,484,113 workers employed in these workplaces. Furthermore, 191,389 workers had occupational accidents and 371 occupational diseases were recorded within this year. In addition, 1,360 people lost

their lives as a result of the occupational accidents and there was no recorded occupational disease resulting in death. The number of working days lost due to occupational accidents and diseases was 2,358,195 and the number of cases resulting in permanent disability was 1,694 (MoLLS, 2014).

According to the data of SSI for the year 2014; 1,679,990 workplaces performed activity and 13,240,122 workers were employed in these workplaces. In addition, 221,366 workers had occupational accidents and 494 occupational diseases were recorded within this year. As a result of occupational accidents 1,626 workers dead and there was no recorded occupational disease resulting in death. The number of working days lost due to occupational accidents and diseases was 2,067,532 and the number of workers who had permanent incapacity was 1,509 (SSI, 2014).

From 2008 to 2014, some SSI statistics consisting the all sectors are presented in the following figures and tables. Figure 2.1 and 2.2 indicate that there was a rise both number of workplaces and workers between 2008 and 2014 in Turkey.

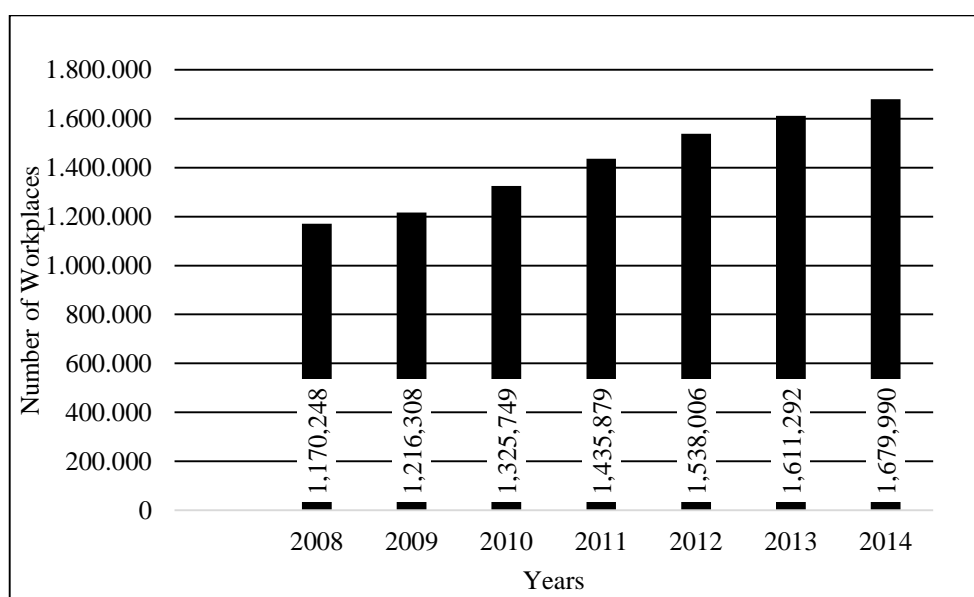


Figure 2.1 Number of Workplaces 2008-2014 (SSI, 2015)

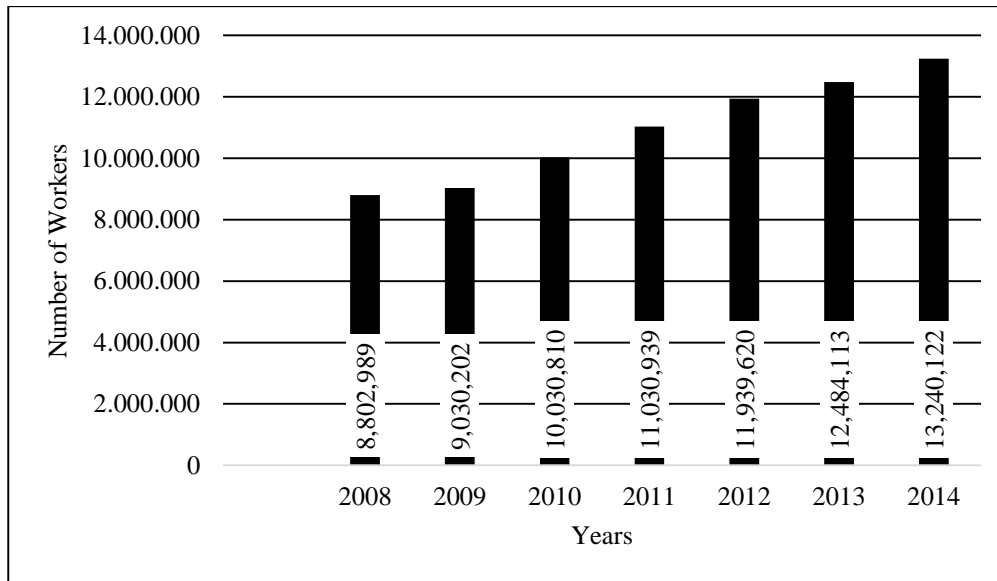


Figure 2.2 Number of Workers 2008-2014 (SSI, 2015)

It is important about the occupational health and safety statistics that all the given occupational accident and occupational disease statistics of SSI cover the active insured in scope of Article 4-1/a of the Law No 5510. The statistical data of SSI for 2013 and 2014 indicates the occupational accidents which were notified and occupational diseases which were ratified to be an occupational disease by institution board of health. Before 2013, SSI reports an occupational accident data if its process is completed by disbursement; but after 2013, SSI reports all occupational accident data which were prescribed in electronic environments to the SSI. This important issue should be in mind when evaluating the number of occupational accidents.

Number of workers who had occupational accidents fluctuates between 2008. However, there is a dramatical increase in 2013 and it peaked in 2014 when 221,366 workers had occupational accidents (Figure 2.3).

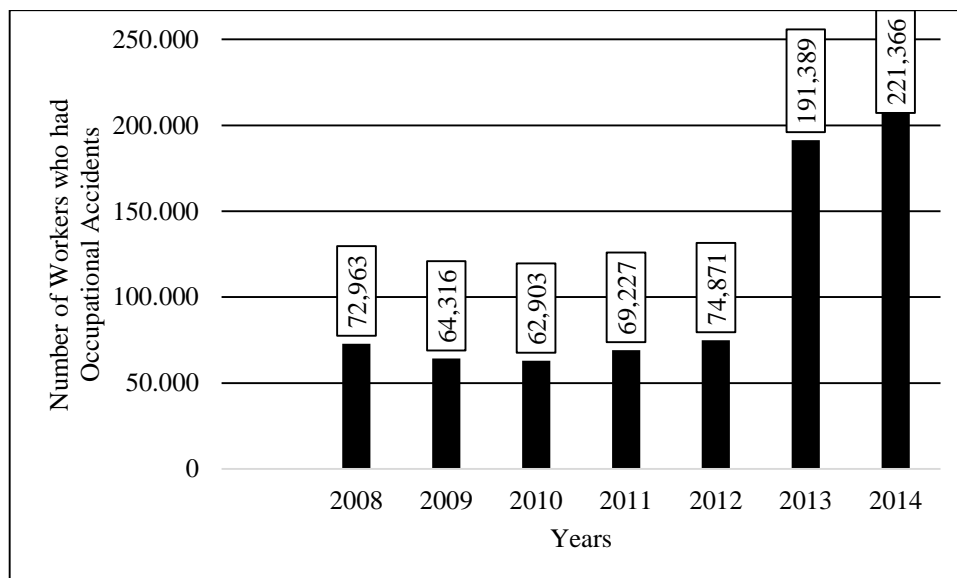


Figure 2.3 Number of Occupational Accidents 2008-2014 (SSI, 2015)

As seen in Figure 2.4, number of occupational diseases undulates between 2008 and 2014. It bottomed out in 2013 and peaked in 2011.

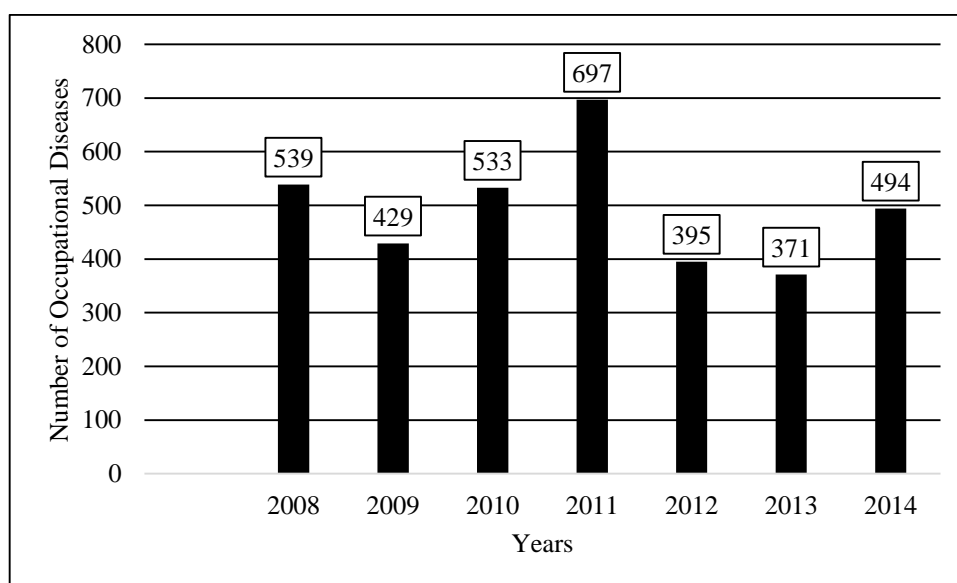


Figure 2.4 Number of Occupational Diseases 2008-2014 (SSI, 2015)

Table 2.6 deals with the number of fatalities due to occupational accidents and occupational diseases from 2008 to 2014. It was seen that number of fatalities due to occupational accidents constitutes the majority of total deaths.

Table 2.6 Annual Distribution of Fatalities 2008-2014 (SSI, 2015)

Year	Number Of Fatalities Due To Occupational Accidents	Number Of Fatalities Due To Occupational Diseases	Total Deaths
2008	865	1	866
2009	1,171	0	1,171
2010	1,444	10	1,454
2011	1,700	10	1,710
2012	744	1	745
2013	1,360	0	1,360
2014	1,626	0	1,626

From now on, some SSI statistics comprising only the mining sector are presented in the following figures and tables. According to Figure 2.5, number of mine workers peaked in 2008 with 145,114 mine workers. However, it sharply declined in 2009 with 115,934 mine workers. Afterwards, there was a rise from 2009 to 2013, however it declined in 2014 with 128,962 mine workers. On the other side, mining workplaces increased between 2008 and 2013. But it decreased in 2014 with 5,970 mining workplaces.

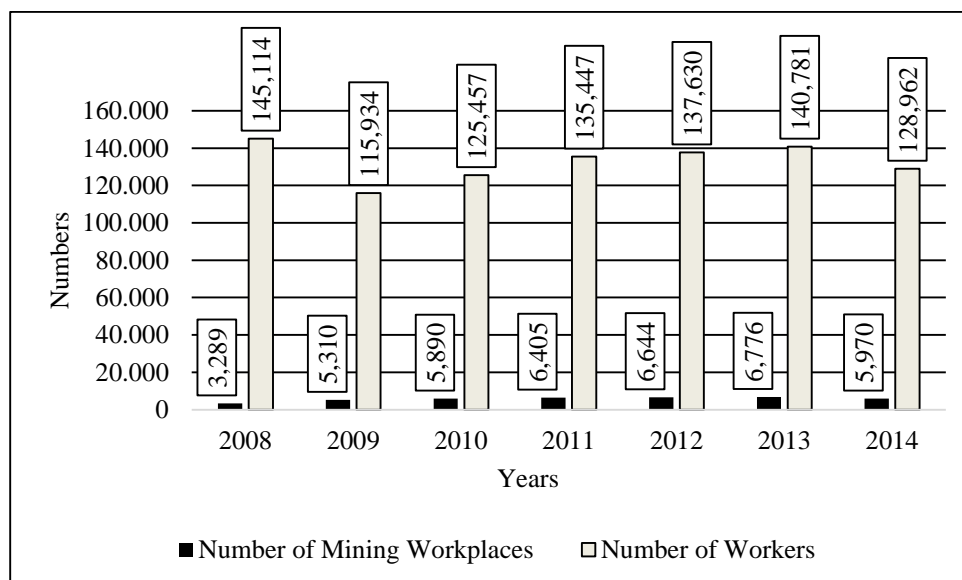


Figure 2.5 Number of Mining Workplaces and Mine Workers 2008-2014 (SSI, 2015)

In 2013, there are 140,781 mine workers and 14,186 of them had occupational accidents. Similarly, in 2014 there are 128,962 mine workers and 12,884 of them had occupational accidents. Therefore, it was evaluated that nearly 10 % of mine workers had occupational accidents in 2013 and 2014 (Figure 2.6).

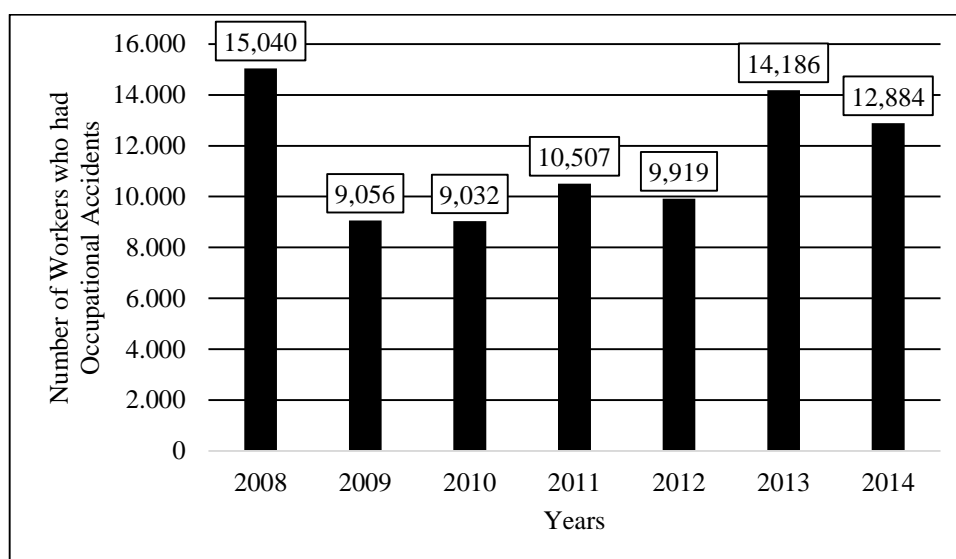


Figure 2.6 Number of Workers Who Had Occupational Accidents in Mining Sector
2008-2014 (SSI, 2015)

Figure 2.7 indicates the number of occupational diseases in Turkey between 2008 and 2014. It was seen that it had the highest level in 2008 with 589 occupational accidents and had the lowest level in 2014 with 21 occupational accidents.

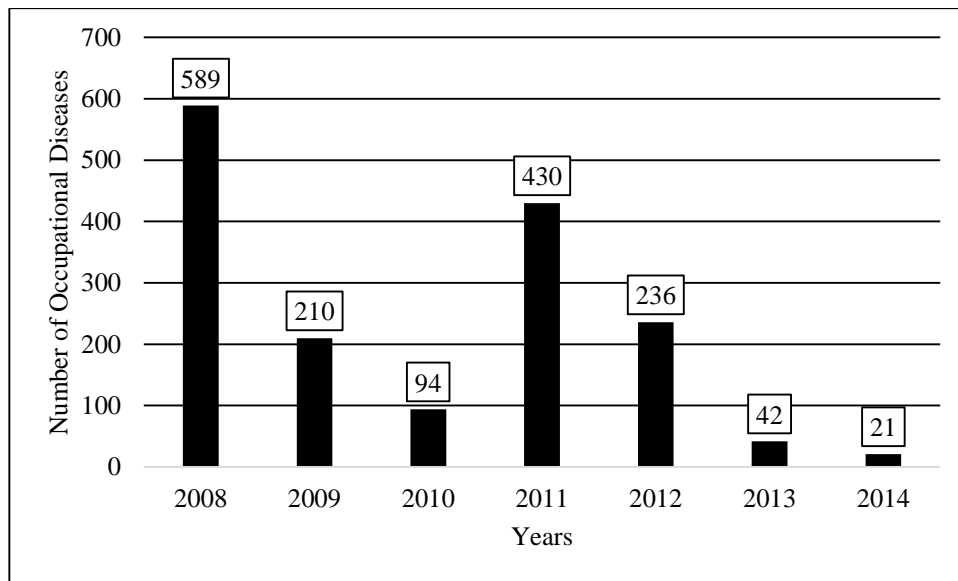


Figure 2.7 Number of Occupational Diseases in Mining Sector 2008-2014 (SSI, 2015)

CHAPTER 3

RISK ASSESSMENT

3.1 Risk Assessment Steps

Risk assessment is considered as the basic approach of modern safety management (Fung *et al.*, 2012). Cox, Griffiths, and Cox (1996) implied that risk assessments must be conducted in an organized manner, thus must be planned, also the necessary resources allocated such as people and time. Planning part of a risk assessment contains following issues:

- Scope of the risk assessment,
- Persons who will conduct the risk assessment,
- Implementation of risk assessment.

Reliability of information is an important issue and it is recommended that the risk assessment team always double-check and seek out supportive evidence for the data that they gather. Steps of risk assessment and risk management in a workplace are included (Cox, Griffiths, and Cox, 1996):

1. Hazards identification,
2. Assessment of related risk,
3. Appropriate control strategies implementation,
4. Monitoring of control strategies efficiency,
5. Reassessment of risk,
6. Review of training and information necessities of workers exposed to hazards.

Cox and Tait (1998) explained that risk assessment consists of two components; risk analysis and risk evaluation. Risk analysis starts with activity characterization. Analysis of work activities constitutes of organizational analysis, walk through survey,

and analysis by generic activity, geographical area and specific work activity or substance. Second step is the identification of hazards which may be electrical, mechanical, physical, chemical, biological, ergonomic or psychosocial causes.

In the risk evaluation part, the definitions of risk quoted earlier involve two independent factors or dimensions. One is the probability or likelihood, the other is the severity of harm or consequence. A 3-by-3 risk matrix is illustrated in Table 3.1 which involves consequences and likelihood as independent factors to level the risk.

Table 3.1 Three-by-Three Risk Matrix (Cox and Tait, 1998)

	Low	Medium	High
Score	1	2	3
Consequence	First aid required	More than 3 days off work	Death or major injury
Likelihood	Not more than monthly	Every week	More than once per week

The risk evaluation process would be greatly simplified. In Figure 3.1, consequence and likelihood are divided into three categories: ‘high’, ‘medium’, and ‘low’. (Cox and Tait, 1998)

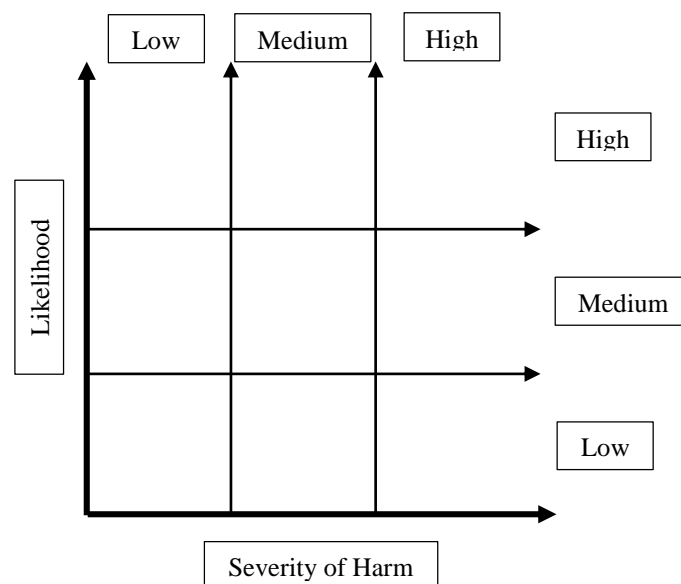


Figure 3.1 Risk Matrix (Cox and Tait, 1998)

High risk: Action within seven days.

Medium risk: Action plan to reduce risk to be drawn up.

Low risk: Reduce risk if practicable.

Another risk matrices including likelihood and consequences classification is shown in Table 3.2:

Table 3.2 Likelihood and Consequences (New South Wales Government, 2009)

Likelihood		Consequences	
L1	Almost Certain (every time)	C1	Catastrophic (fatality)
L2	Likely (often)	C2	Major (permanent disability)
L3	Possible (occasionally)	C3	Moderate (medical/hospital or lost time)
L4	Unlikely (almost never)	C4	Minor (first aid or no lost time)
L5	Rare (never)	C5	Insignificant (no injury)

Once the likelihood L1 to L5 and consequence numbers C1 to C5 are assessed, and then risk rating can be designated from the risk matrix (Table 3.3) below:

Table 3.3 Five-by-Five Risk Matrix (New South Wales Government, 2009)

Risk Rank	L1	L2	L3	L4	L5
C1	1	2	4	7	11
C2	3	5	8	12	16
C3	6	9	13	17	20
C4	10	14	18	21	23
C5	15	19	22	24	25

Risk Rating: High Risk: 1 – 6; Medium Risk: 7 – 15; Low Risk: 16 - 25

Example: If likelihood is L2 and consequence is C2, then risk rating is 5 or ‘high’.

Risk assessment has been conventionally involved in quantifying the risk based on two or more aspects, such as the frequency of a risk (how often) and severity of the risk (impact or consequence) (Table 3.4). In the framework of risk assessment matrix, severity level and likelihood of the risk are multiplied and frequency descriptors is given in Table 3.5 (Azadeh-Fard *et al.*, 2015).

EU-OSHA has developed OSHwiki to assist the sharing of occupational health and safety information, knowledge, and best practices for ensuring safety and health at the workplace. It is mentioned that there are several methods to perform the risk assessment ranging from complex to simple methods (OSHwiki, 2015).

Table 3.4 An Example of Two-Dimensional Risk Assessment Matrix (Azadeh-Fard *et al.*, 2015)

		Frequency				
		Frequent	Probable	Occasional	Remote	Improbable
Severity	Negligible	Medium	Medium	Low	Low	Low
	Marginal	High	Medium	Medium	Medium	Low
	Critical	High	High	Medium	Medium	Low
	Highly Severe	High	High	High	Medium	Medium


Table 3.5 Frequency Descriptors (Azadeh-Fard *et al.*, 2015)

Frequency	Probability
Improbable	<5%
Remote	<35%
Occasional	>35%
Probable	>65%
Frequent	>95%

Good risk analysis is characterized by tested information on the basis of which an accurate problem description can be drawn up. The more objective information collected, the more support can be expected for the decisions and interventions to be implemented (Berg and Pranger, 2005). Besides, reliability of information is an important issue and it is recommended that the risk assessment team always do double-check and look for supportive proof for the data that they collect (Cox, Griffiths, and Cox, 1996).

It is essential that risk control measures are considered in the order providing the greatest result. While controlling the risks following order (Table 3.6) is recommended:

Table 3.6 Risk Control Hierarchy (New South Wales Government, 2009)

<div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 10px;"> Best Control  Worst Control </div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; padding: 5px 10px;"> Elimination </div> </div>	
	Substitution
	Isolation
	Engineering
	Administrative
	Personnel Protective Equipment

3.2 Hazards in Underground Coal Mines

Hazard is the inherent potential to cause illness or injury. Hazards faced with in coal mining make it unique in the field of occupational health and safety (Mahdevvari *et al.*, 2014). Mine sector-specific occupational health and safety hazards (ILO, 2006) are given below:

- Explosions,
- Premature or improper detonation of explosives,
- Outbursts of rock, coal or gases released from the earth under extreme pressure,
- Fires,
- Inundations of dangerous gases,
- Excessive temperatures/heat,
- Water or other free-flowing materials from old mine,
- Inhalation of respirable coalmine
- Unguarded machinery,
- Dust,

- Noise-induced hearing loss,
- Shock, burns and electrocution,
- Crushing of a miner between machineries,
- Ignitions of methane,
- Workings or geological faults,
- Exposure to harmful chemicals and harmful agents used in mines,
- Slips, trips and falls,
- Falls of the roof, face and sides (ribs),
- Handling materials,
- Falls from heights,
- Vibration,
- Automation and remote movement,
- Ergonomics,
- Insufficient prevention and inspection,
- Poor first aid, emergency assistance, medical attention,
- Insufficient training.

3.3 Previous Risk Assessment Studies

In the past years, several investigators made researches on about occupational health and safety risk assessment in numerous sectors.

Eratak (2014) developed a model for severity component using regression, neural network and fuzzy logic techniques. These techniques conducted each mine data and decision analysis was made to select the most appropriate technique by comparing the results. To conclude, future accident estimation models were developed with regression and neural network techniques based on the data, such as number of deaths, accidents, total working hours, and total raw coal production of those mines. Those past data are used to estimate the future.

Sari (2002) conducted a risk assessment approach in order to analyze the underground coal mine safety and in GLI-Tuncbilek mine and ELI-Eynez mine. He determined the risks by analyzing the past accident/injury experience data statistics. It is designed the

methodology for mentioned mines including the occupational accidents data between the years 1996 and 2000. In this research, after identifying hazards, the magnitude of harmful effect was determined by finding the frequency of different kind of accidents. After that, level of risk were determined by the proposed risk matrix was shown in Table 3.7.

Table 3.7 The Proposed Risk Matrix for the GLI-Tuncbilek Mine (Sarı, 2002)

Accident / year	Cumulative probability	Days – lost / accident			
		0 – 4	4 – 8	8 – 16	16 +
		0.0 – 0.25	0.25 – 0.50	0.50 – 0.75	0.75 – 1.0
162+	0.75 – 1.0	0.250 Moderate	0.500 High	0.750 Very high	1.000 Severe
154-162	0.50 – 0.75	0.1875 Low	0.375 Moderate	0.5625 High	0.750 Very High
146-154	0.25 – 0.50	0.125 Very Low	0.250 Low	0.375 Moderate	0.500 High
0-146	0.00 – 0.25	0.0625 Very Low	0.125 Very Low	0.1875 Low	0.250 Moderate

In 2011, Wu and Liu conducted a study for risk assessment of fire development in underground coal mines at Xinjiang Uyghur Autonomous Region. Coal fields are largely distributed over the region and expected to comprise up to 2.19 trillion tons of coal that constitute nearly 40 % of China's whole coal resources. Three factors, which are coal exposure to air, spontaneous combustion tendency in a coal seam, and a fire cause or trigger, the basis for the risk assessment methodology developed in this study. Results demonstrate that 61.54 % of fire zones in Xinjiang Uyghur Autonomous Region lie within high and extremely high coal fire risk areas.

Shahriar and Bakhtavar (2009) conducted a quantitative approach and decision tree in order to assess and manage roof fall risks as a key geotechnical problem in Iranian underground coal mines.

Kinilakodi and Grayson (2011) developed a methodology for high risk for major-hazard events in order to assess the underground coal mines. It was concentrated on

main hazard-related violations of safety standards associated with high risk circumstances.

Zhu and Xiao-ping (2009) investigated safety evaluation of human accidents in coal mines using data mining approach. They employed ant colony optimization and support vector machine algorithms for feature extraction of influencing factors and evaluation model of human accidents. Also, a methodology is also proposed toward development of an uncertainty model that contains randomness in the occurrence of days-lost accidents in a coal mine.

Khanzode *et al.* (2011) developed a methodology in order to evaluate and monitor of recurrence characteristics of hazards in underground coal mines. It contains Weibull-distribution based hazard rate functions, Poisson-distribution based cumulative risk functions, and Weibull-distribution based control charts. Result of the case study illustrate that hazards related to materials, machinery, housekeeping, ground-fall, and roadways are more commonly occurring.

Business electronic Safety Management and Risk assessment Tool (BeSMART, 2016) developed by Health and Safety Authority in Ireland to help small businesses' (bakery, book shop, cinema, flower shop, museum, post office, tailor, etc.), agribusinesses' (fruit/vegetable market stall, farm machinery repairs, farm machinery sales, etc.), construction businesses' (carpentry, demolition, insulation, painting and decorating, scaffolding, etc.) employers to prepare risk assessments for their workplaces. BeSMART.ie is a free, easy to use and online tool.

Online Interactive Risk Assessment (OiRA, 2015) is lead by the European Agency for Safety and Health at Work (EU-OSHA). OiRA is a sectoral online risk assessment tool for micro and small companies. The OiRA tool is used by sectoral social partners (employees' and employers' organizations) and national authorities (ministries, occupational health and safety institutes, labour inspectorates, etc.) to produce sector-specific (cleaning, hair dressing, sport sector, manufacture of food products, office work, catering, hotels and restaurants, etc.) risk assessment tools targeting small businesses.

CHAPTER 4

RISK ASSESSMENT TOOL FOR UNDERGROUND COAL MINES

4.1 Basic Features of the Risk Assessment Tool

Risk assessment is a fundamental process to ensure a necessary level of safety and health protection of workers at workplaces. Besides, risk assessment provides both continuous improvement and safety culture. Since, the purpose of conducting a risk assessment is to enable the employer to effectively take the essential control measures for the health and safety of the workers.

On the other side, it is a legal obligation for workplaces in Turkey. According to the Occupational Safety and Health Law No 6331, the employer shall carry out or get one conducted a risk assessment for health and safety of workers in every aspect related to work, working conditions and environment if the workplace is under the scope of this Law. The principles and procedures of risk assessment in the workplace in terms of occupational health and safety were regulated by the Regulation on Occupational Health and Safety Risk Assessment.

As known, there are several risk assessment methods, but there is no method implied in this Regulation instead of this, risk assessment phases are defined for all workplaces in the Regulation. In this study, risk assessment is considered as including six steps (Figure 4.1) adopted from Regulation on Occupational Health and Safety Risk Assessment. Firstly, risk assessment starts with the planning part. Actually, planning is not directly implied in the Regulation but it is thought that planning part is a very crucial step to conduct a well-organized and systematic risk assessment. Afterward, it continues with the identification of hazards, following phase is determination and analysis of the risks, next part is comparison of the risk control measures, final phase is documentation, and when necessary risk assessment revision phase is done.

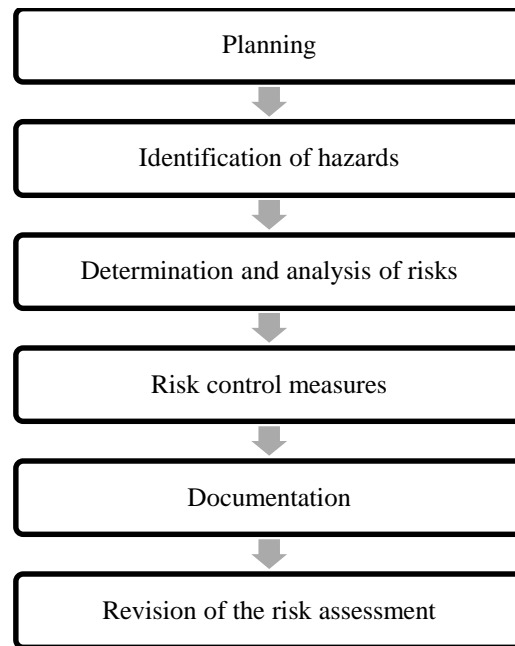


Figure 4.1 Risk Assessment Steps Adopted from Regulation on Occupational Health and Safety Risk Assessment

4.1.1 Planning

Planning step provides to conduct a systematic and structured risk assessment. In this study, it is advised that planning step consists of three parts shown in Figure 4.2:

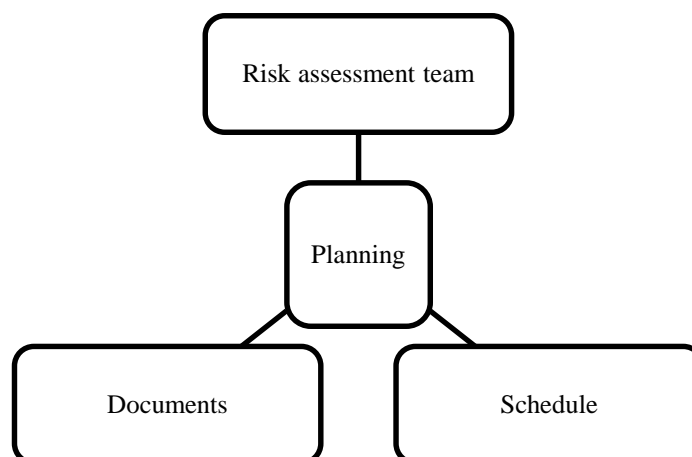


Figure 4.2 Parts of Planning

Risk assessment team

According to Regulation on Occupational Health and Safety Risk Assessment, risk assessment should be carried out by a team which is formed by the employer. The team at least consists of:

- Employer or employer's representative,
- Occupational safety expert,
- Occupational physician,
- Workers' representative in the workplace,
- Support staff,
- Worker(s) who are determined to represent all units in the workplace and have knowledge about works being executed in the workplace, current or possible hazard sources and risks.

It is also important to consult with workers and provide their participation while performing risk assessment.

Documents

If the following documents are available in the workplace, it is suggested to keep ready:

- Work permission documents to be received before starting work pursuant to relevant legislation;
- Education, age, gender, and similar characteristics of the workers and health surveillance records;
- Inspection results of the workplace;
- Occupational disease records;
- Occupational accident records;
- Records of near miss events;
- Material safety data sheets;
- Measurement results of environment and personal exposure level;
- Previous risk assessment studies, and
- Emergency plans.

Schedule:

In the planning part of the risk assessment, approximately commencement and completion date of the risk assessment is suggested to be decided.

4.1.2 Identification of Hazards

Hazard identification is the most important step in the occupational health and safety risk assessment process. All kinds of hazards in the workplace should be addressed comprehensively including rarely faced conditions or cases, too. While hazards are identifying, workplace and processes are observed; all the documents, such as reports, records, measurements which are collected in the planning step are examined.

In the light of the collected information, also by considering the provisions in the relevant occupational health and safety legislations, hazards arising from physical, chemical, biological, psychosocial, ergonomics, etc., and their interactions are determined. Also, following hazards shall be taken into consideration:

- Hazards that may arise from factors, such as working principles, shift pattern, team work, organization, hierarchical order, visitor or another individuals who are not the worker of the workplace, during all kind of activities to be carried out in the mine workplace including maintenance and repair works;
- Hazards that may arise from execution of the work, mine production techniques, used substances, work equipment and their inappropriate design or usage;
- Hazards that may arise from electricity, noise, vibration, temperature, drainage;
- Hazards that may arise from processing, usage, carriage, storage or destruction of the substances which have possibility of combustion, explosion or flaming;
- Hazards that may arise from hygiene conditions of the mine working environment and personal hygiene habits of the workers;
- Hazards that may arise from the transportation;
- Hazards that may arise due to the location of the mine workplace;
- Hazards that may arise due to the inappropriate placement of workplace buildings and premises according to the plan in the selected area;
- Hazards that may arise because of the insufficient occupational health and safety training of the workers, not informing workers, not giving appropriate instructions to the workers or working without work permit in cases when the work permit is necessary.

On the other hand, occupational accidents and occupational diseases occurred in other workplaces with similar production methods and techniques can also be evaluated while collecting information related to the hazards.

4.1.3 Determination and Analysis of Risks

In this step, all determined hazards are separately considered and how often these hazards may occur, who, what and how will suffer from damage, and which level of damage will be suffered are decided. Then, determined risks in the light of collected data and made observations are analyzed to define the level of risk.

There are several methods to analyze the risk. In this study, five-by-five risk matrices is used which involves severity and probability as independent factors to level the risk (Table 4.1).

Table 4.1 Five-by-Five Risk Matrices Used for the Risk Assessment Tool

R=Probability x Severity			Severity				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	3	4	5
Probability	Rare	1	1	2	3	4	5
	Unlikely	2	2	4	6	8	10
	Possible	3	3	6	9	12	15
	Likely	4	4	8	12	16	20
	Almost	5	5	10	15	20	25

Multiplication of the severity and probability is divided into three categories: ‘high risk’, ‘medium risk’, and ‘low risk’ (Table 4.2). It has to be decided whether or not and how fast actions need to be taken in order to eliminate or minimize the risk and prioritize action bearing in mind the risk level.

For instance, if there is no sufficient ventilation in an underground coal mine, its severity is ‘catastrophic’ which equals to five and if its probability is ‘almost’ which also equals to five. Then, multiplication of the severity and probability equals to 25

which means high risk level according to the Table 4.2 and it is vital to take action for the ventilation immediately.

Table 4.2 Risk Prioritization Used for the Risk Assessment Tool

Severity * Probability	Risk Level	Evaluation
1-6	Low risk	Reduce these risks if practicable. No need for emergency.
8-15	Medium risk	Make a plan and start to take action for these risks as soon as possible.
16-25	High risk	Immediately take action for these risks.

4.1.4 Risk Control Measures

The aim of the occupational health and safety risk assessment process is to decrease the risk to an acceptable level. Depending on the level of the assessed occupational risk, it is necessary to plan and implement effective preventive control measures. A control measure is simply take to remove a hazard or at least minimize it to a low level. As it has mentioned in Chapter 3, following the risk control hierarchy is important. Also, following two questions are essential since it is critical that the risk is not transferred, in other words providing a solution to one problem should not cause another hazard or problem:

- Will the undertaken actions lead to expected lowering of occupational risk level?
- Will the applied solutions not generate new hazards?

For the implementation of these determined control measures, a responsible person is assigned and due date is determined.

4.1.5 Documentation

According to the Regulation on Occupational Health and Safety Risk Assessment, record of the risk assessment is documented by covering minimum of the following issues:

- Title and address of workplace and name of employer;
- Name and titles of the individuals who performed the risk assessment, and certificate information of occupational safety expert and occupational physician;
- Commencement and completion date of risk assessment;
- Expiry date of risk assessment;
- Determined hazards;
- Detected risks;
- Method used in the risk assessment;
- Analysis results of the detected risks including importance and priority sequence of the risks;
- Control measures, execution dates and detected risk level after control measures performed.

Pages of the risk assessment document are enumerated; every page is initialed and the last page is signed by the individuals who perform the risk assessment and it is saved in the workplace.

4.1.6 Revision of the Risk Assessment

Risk assessment must be revised every two years at the latest in an underground coal mine workplace in accordance with the Regulation on Occupational Health and Safety Risk Assessment because of the hazard class of the underground coal mining workplaces which are very hazardous workplaces. However, according to the Regulation considering new risks that may arise in the following cases affect workplace completely or partially, the risk assessment is revised fully or partially:

- Moving of the workplace or making changes on the buildings.

- In case there are changes in the workplace made in the technology implemented or used material and equipment.
- In case there are changes in the production method.
- In case occupational accident, occupational disease or near miss event occurred.
- In case there is a legislation change related to the limit values of working environment.
- Considering necessary working environment measurements and health surveillance results.
- Arising a new hazard from outside of the workplace that can affect the workplace.

4.2 Developed Computer-Based Risk Assessment Tool

Occupational Health and Safety Law requires to secure and to improve health and safety conditions of the workers at the workplace through occupational health and safety measures. Health and safety conditions are conducted in a preventive and protective manner, before any occupational accidents occur or any specific risks arise. One of the most essential demand of this law is for employers to conduct a risk assessment. Hence, risk assessment has the chief issue of importance.

In this study, a computer-based risk assessment tool for proactive measure is prepared for underground coal mines in order to provide a sectoral-based risk assessment in that workplaces. The tool is prepared by using Microsoft Access which is a database management system from Microsoft. Risk assessment tool is designed to simplify the complexity as it is possible. Also, it is moving in a systematic way and easy-to-handle, storable, and updatable that makes things easier, and provides receiving an increasing amount of records.

At first, user is welcomed to the home page (Figure 4.3) by reading the name and aim of the tool. There are two options in this page: user may click on 'Exit' button in order to close the program or user may click on 'NEXT' button to continue.

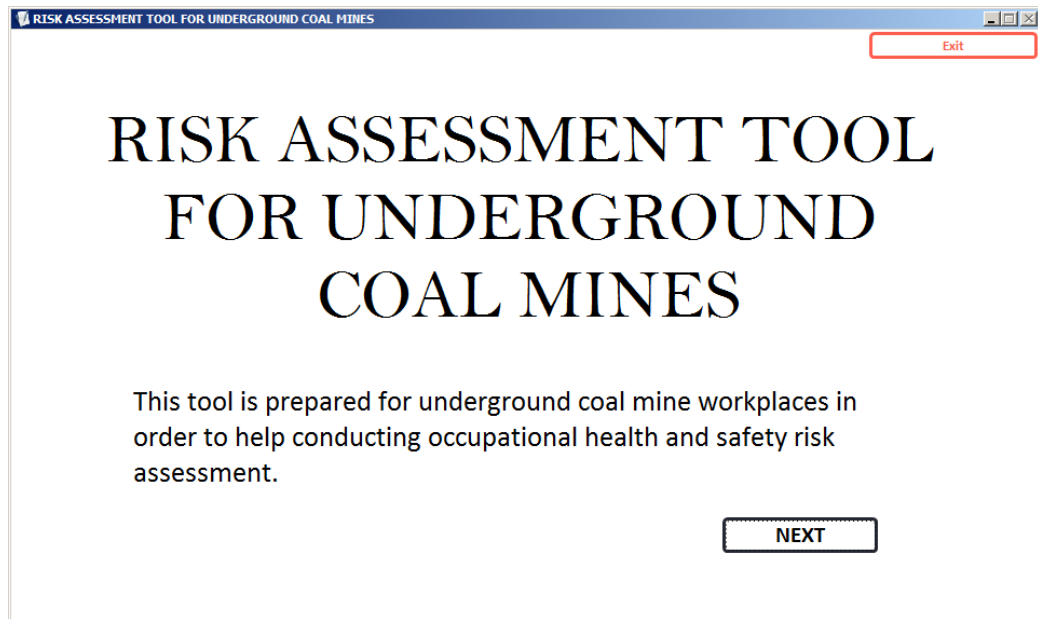


Figure 4.3 Home Page of the Risk Assessment Tool

When user clicks on 'NEXT' button, following page appears (Figure 4.4). In this page, main parts of the risk assessment tool are purely introduced.

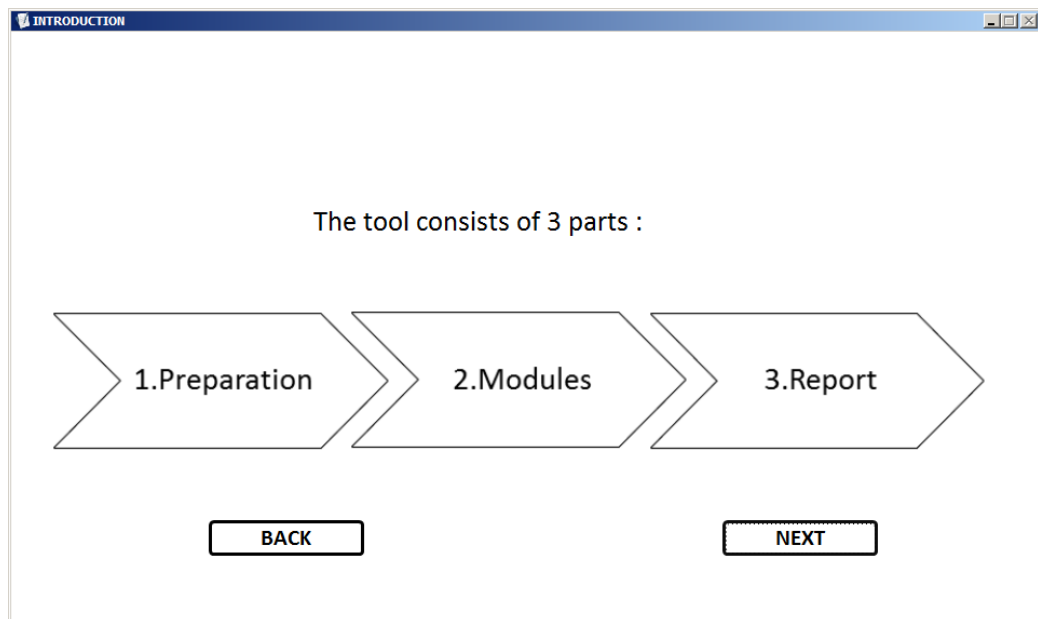


Figure 4.4 Main Parts of the Risk Assessment Tool

Algorithm of the risk assessment tool is demonstrated in Figure 4.5 and details of it explained in the following sections.

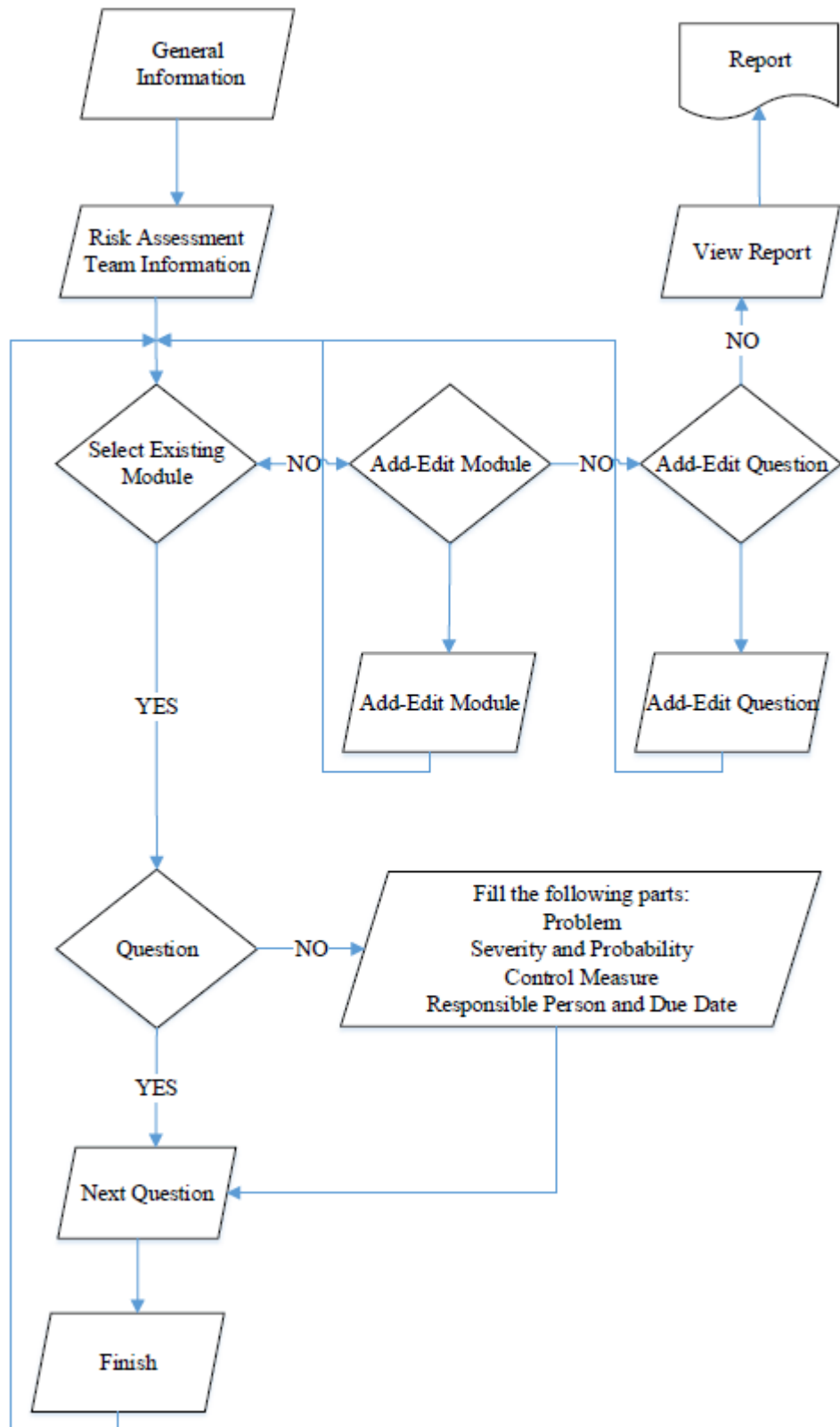


Figure 4.5 Risk Assessment Tool Algorithm

4.2.1 Preparation

In this part, user fills the blanks (Figure 4.6). Preparation part includes two pages:



Figure 4.6 Preparation Part

First page is for general information about the workplace which are title and address of the workplace, commencement, completion and expiry date of the risk assessment. Filling these blanks are compulsory except the risk assessment revision date blank. Since there may not be any revision date. A filled sample of the general information page is shown in Figure 4.7.

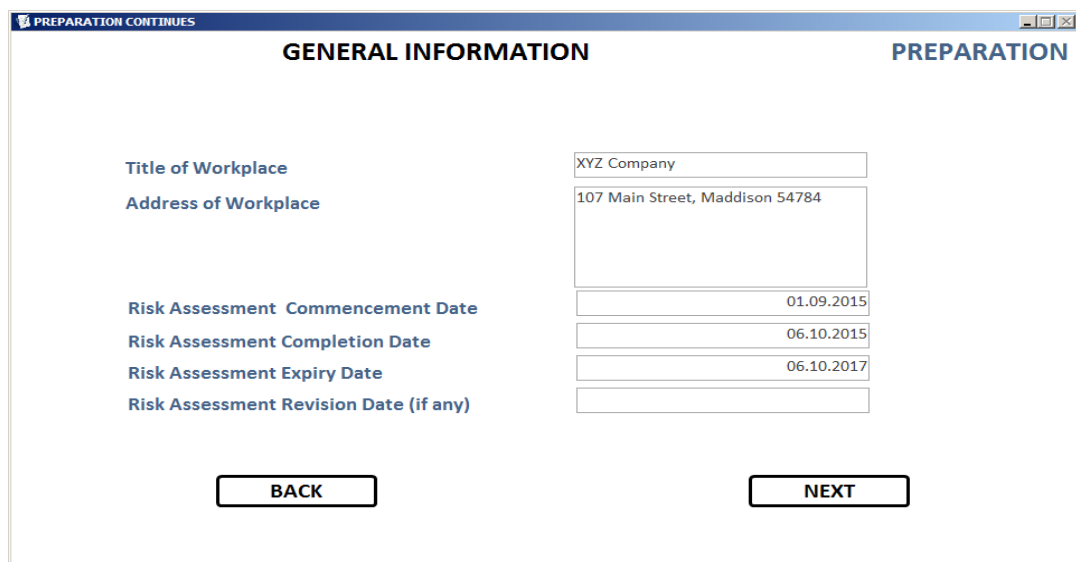


Figure 4.7 General Information

In the second page, user fills the risk assessment team members name who are employer, employer's representative (if any), occupational safety expert, occupational physician, workers' representative, support personnel, and if any other worker or person. It is also necessary to fill certificate information of occupational safety expert and occupational physician. A filled sample of the risk assessment team page is shown in Figure 4.8.

RISK ASSESSMENT TEAM		PREPARATION	
Employer	<input type="text" value="Fatih Buyukkara"/>		
Employer Representative (if any)	<input type="text"/>		
Occupational Safety Expert	<input type="text" value="Charles Champell"/>	Certificate No	<input type="text" value="110051"/>
Occupational Physician	<input type="text" value="Eleanor Nelson"/>	Certificate No	<input type="text" value="3214"/>
Support Staff	<input type="text" value="David Morrison"/>		
Workers' Representative(s)	<input type="text" value="Nancy Frank"/>		
Other (if any)	<input type="text"/>		
<input type="button" value="BACK"/>		<input type="button" value="NEXT"/>	

Figure 4.8 Risk Assessment Team

4.2.2 Modules

This step is the core of the risk assessment tool. In this study, 14 modules were developed for the underground coal mines which are:

- General module,
- Training module,
- Emergency module,
- First aid module,
- Ventilation module,
- Support module,
- Explosives module,
- Transportation module,

- Electricity module,
- Work equipment module,
- Noise/Vibration/Temperature module,
- Psychosocial hazards module,
- Ergonomics module, and
- Lighting module.

Each module consists of various number of yes-no questions (Table 4.3). In the modules part (Figure 4.9), user has to answer all questions in each module. In addition, user has a right to add a question(s) in the related modules in case of any specific hazard related to that workplace and not mentioned any of the question in the module. Moreover, user may add a new module(s) in case of absence of the corresponding module related to the workplace hazard.

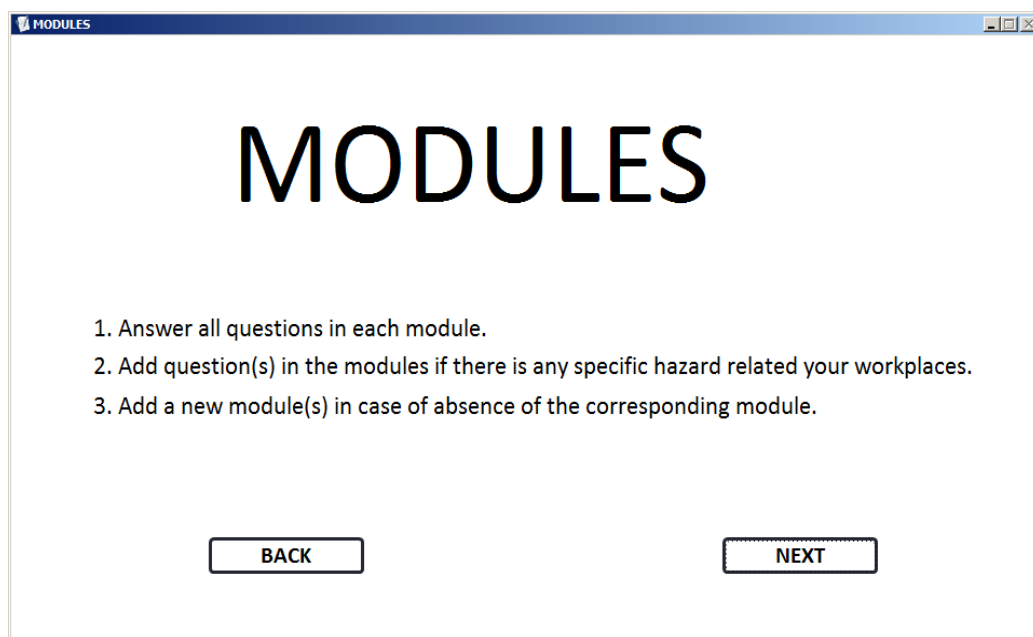


Figure 4.9 Modules Part

Table 4.3 Questions of Modules

GENERAL	
1	Are entries into and exits from the mine recorded?
2	Are workers' locations within the mine recorded?
3	Does the workplace have a health and safety document?
4	Is there a three-dimensional, digital and scaled underground operation plan?
5	Is the underground operation plan updated at least once every month?
6	Are there at least two separate connections to the surface?
7	Is health surveillance of workers carried out?
8	Do workers use proper personal protective equipment when and where necessary?
9	Is a communication system available throughout the workplace?
10	Are materials used in accordance with their relevant safety data sheets?
11	Are hazardous or waste materials at the workplace disposed of?
12	Are dressing rooms adequate in terms of health and safety?
13	Are showers and washing facilities adequate in terms of health and safety?
14	Is the information regarding the shift communicated at the change of shifts?
TRAINING	
1	Are workers trained periodically on health and safety?
2	Are theoretical and practical training sessions organized so as to make it easier for workers to understand the matter at hand?
3	Is the effectiveness of training sessions evaluated at the end of the session?
4	Do workers receive on-the-job training?
5	Do workers' representative/representatives receive dedicated training?
6	Do workers who are assigned to tasks requiring vocational training hold vocational training certificates?
7	Do workers who had an occupational accident/disease and/or those who were away from work for longer than six months receive training before they resume work?
8	Are workers trained on what to do in case of an emergency?
9	Do support staff receive theoretical and practical training that is in compliance with the task at hand?
10	Is training provided for the support staff documented?
11	Is training provided for the support staff refreshed periodically?
12	Are drills carried out periodically to assess the training and skill level of workers who have specific responsibility in case of emergencies?
13	Are workers provided with hands-on training on the use of personal protective equipment?

Table 4.3 Questions of Modules (Continued)

EMERGENCY	
1	Have emergency situations been defined?
2	Are measures in place to prevent and limit negative effects of emergency situations?
3	Are relevant measurements and assessments carried out to protect against negative effects of emergency situations?
4	Has an emergency plan been prepared?
5	Are periodic drills conducted for emergency preparedness?
6	Is adequate first aid equipment available?
7	Has an adequate number of support staff been put in charge?
8	Are there written instructions for emergency situations?
9	Are workers/workers of subcontractors/clients/visitors etc. informed about emergency situations?
10	Are there arrangements in place to ensure communication with agencies outside the workplace in case of an emergency?
11	Is it possible to de-energize all energy sources in case of an emergency?
12	Is there a communication/information system ensuring communication with the surface during an emergency?
13	Is there emergency signage?
14	Is the search, rescue and evacuation equipment kept easily accessible and readily available in appropriate locations?
15	Is there a rescue plan?
16	Is there an appropriate rescue station?
17	Is periodic maintenance done on the equipment available in the rescue station?
18	Have appropriate escape routes been identified to ensure safe and sound evacuation of workers in case of an emergency?
19	Are portable breathing apparatuses providing clean air in emergencies kept easily accessible and readily available?
20	Are appropriate escape and rescue tools available in case of an emergency?
21	Are necessary measures in place against gas outbursts?
22	Are control drillings performed to check for potential inrush of water and/or gas?
23	Are measures in place against the risk of firedamp?
24	Are measures in place against spontaneous combustion?
25	Are measures in place against inrush of water?

Table 4.3 Questions of Modules (Continued)

FIRST AID	
1	Is first aid equipment made available where appropriate?
2	Is a first aid room(s) available?
3	Are first aid supplies and equipment in the first aid room(s) adequate?
4	Is there an adequate number of support staff available?
VENTILATION	
1	Is there an adequate ventilation system in place?
2	Are there two ventilation groups available so that the secondary ventilation can be activated immediately in the event that the primary one stops working for any given reason?
3	Is ventilation ensured with at least one mechanical system?
4	Does the ventilation system in place have the capacity to reverse the direction of the air flow?
5	Is healthy respirable air provided?
6	Is ventilation adequate?
7	Is uninterrupted ventilation provided?
8	Is the ventilation system continuously monitored?
9	Are there automatic alarm systems in order to indicate the unscheduled stoppages of the ventilation system?
10	Are ventilation values regularly measured?
11	Are ventilation measurement results recorded?
12	Is an up-to-date ventilation plan indicating the mine ventilation system available at the workplace?
13	Is the air velocity of the ventilation adequate?
14	Does oxygen constitute more than 19% of the mine atmosphere?
15	Does methane constitute less than 2% of the mine atmosphere?
16	Does carbon dioxide constitute less than 0.5% of the mine atmosphere?
17	Is carbon monoxide in the mine atmosphere less than 50 ppm (0.005%)?
18	Is there a ventilation directive?
19	Is the ventilation directive posted where it is visible to workers?
20	Has it been identified by whom, how often and where air measurements are to be performed?
21	Has it been identified which gas measurements are to be performed?
22	Are the main fan and auxiliary fans connected to two separate energy sources that are independent from each other?
23	Is temperature measured regularly?

Table 4.3 Questions of Modules (Continued)

24	Is the humidity measured regularly?
25	Is accumulated dust in and around intake shafts cleaned periodically?
26	Are necessary measures in place for abandoned workings/areas?
SUPPORT	
1	Is support adequate?
2	Are hanging walls, sidewalls and support inspected regularly?
3	Is support installed in accordance with plans and written instructions?
4	Are galleries checked regularly in terms of reliability and durability of the ground?
5	Are adequate safety measures taken during repair, change, moving forth and removal of support?
6	Are empty areas forming behind face, ceiling or sidewalls filled in?
7	Is there a support directive?
EXPLOSIVES	
1	Are the explosives used appropriate for the mine?
2	Is adequate care taken when transporting explosives?
3	Is adequate care taken when storing explosives?
4	Is there a record kept for explosives stored in explosive material storages?
5	Are explosives handled exclusively by authorized and competent persons?
6	Are explosives used appropriately?
7	Is there a directive for explosive materials?
8	Is the ban on using explosives in atmospheres which contain 1% or greater methane complied with?
9	Is the ban on using explosives in old or new workings with empty air pockets or cracks, where firedamp checks cannot be performed, complied with?
10	Is the ban on using explosives for opening clogged coal, staple shafts and silos complied with?
11	Is the ban on using explosives for opening closed off fire stoppings complied with?
TRANSPORTATION	
1	Are all transportation routes used by pedestrians and/or vehicles adequate in terms of health and safety?
2	Is adequate safety distance for pedestrians provided in material transport routes?
3	Is there an appropriate signaling system in place on the routes?
4	Is transportation of persons done in accordance with written instructions?
5	Is there a directive for transportation?
6	Are vehicles used to transport persons?

Table 4.3 Questions of Modules (Continued)

7	Are speed limits observed for vehicles transporting persons?
ELECTRICITY	
1	Is there a plan indicating the electrical grid, fixed devices on the grid and the location of facilities?
2	Are measures taken to protect underground facilities and devices against overvoltage?
3	Are the electrical installations equipped with adequate measurement, check, indicator, warning and control devices?
4	Are electric cables in good condition?
5	Is grounding done reliably?
6	Are measures taken against static charges?
WORK EQUIPMENT	
1	Are work equipment used suitable for use in an underground coal mine?
2	Are the checks, maintenance, repair and tests of work equipment carried out by authorized persons?
3	Are records kept for the control and maintenance of work equipment?
4	Are protective parts of safety equipment and machinery kept readily available for use and functioning?
5	Are measures taken against electrical leakage in work equipment?
6	Are all mobile equipment in the mine equipped with signage to ensure visibility and distinguish direction of their movement?
7	Are there written instructions on how to use the work equipment?
PSYCHOSOCIAL HAZARDS	
1	Are measures taken to mitigate the negative effects of shift work on workers?
2	Can workers communicate disturbing situations/incidents to their supervisors?
3	Are supervisors being fair to workers?
NOISE/VIBRATION/TEMPERATURE	
1	Do workers who are exposed to noise undergo hearing tests?
2	Has the level of mechanical vibration to which workers are exposed been identified?
3	Is attention paid to exposure limit values of workers for hand-arm vibration?
4	Is attention paid to exposure limit values of workers for whole body vibration?
5	Are measures taken to prevent temperature from affecting workers' health?
ERGONOMICS	
1	Is attention paid to suitability of workers to their jobs in terms of health and safety?
2	Are workers prevented from working constantly in the same position?
3	Are workers prevented from doing repetitive movements?

Table 4.3 Questions of Modules (Continued)

LIGHTING	
1	Are workers provided with personal lamps?
2	Is there an artificial lighting installation?

Name of the modules, number of the questions in each module and number of answered questions are seen in this page (Figure 4.9). User starts with any modules just clicks on the “NEXT” button. That means, there is no obligatory order for the modules. Moreover, there are some other buttons. For instance, by clicking on the “BACK” button, user may go to the previous pages and make correction or change, if necessary. Additionally, the tool provides a contact information in case of any question of the user. There are “Add-Edit Module” and “Add-Edit Question” buttons and details of them by giving examples will be explained thereafter.

CHOOSE MODULE			
BACK	CONTACT	EXIT	
Add-Edit Module	Add-Edit Question	View Report	
MODULES			
Modules	# of Questions	# of Answers	
Electricity	6		NEXT
Emergency	25		NEXT
Ergonomics	3		NEXT
Explosives	11		NEXT
First Aid	4		NEXT
General	14		NEXT
Lighting	2		NEXT
Noise/Vibration/Tempera	5		NEXT
Psychosocial Hazards	3		NEXT
Support	7	7	NEXT
Training	13		NEXT
Transportation	7		NEXT
Ventilation	26		NEXT
Work Equipment	7		NEXT

Figure 4.10 Module Choosing

As an illustration, when the user chooses the support module, support related questions will be asked. These questions are earlier mentioned under the heading of “Support” in Table 4.3. There is only two answer of these questions which are “yes” or “no”. Also, risk assessment team members acquaint themselves with the related legislation if available in the tool by clicking on the “Related Legal Provision” button (Figure 4.11). Legal provision of the most of the questions are presented in the Appendix A.

The screenshot displays a software interface titled 'QUESTIONS' with a 'Support' module selected. On the left, a question is posed: 'Is support adequate?'. Below it are radio buttons for 'Yes' and 'No'. Further down are sections for 'Problem', 'Severity' (with scales for Insignificant, Minor, Moderate, Major), 'Probability' (with scales for Rare, Unlikely, Possible), and 'Risk'. A 'Related Legal Provision' button is located at the top left. A central window titled 'LEGAL PROVISION' is open, showing text from the 'REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES ANNEX- 3', specifically section 7.1 on support requirements. An 'OK' button is at the bottom of this window. On the right, a 'MODULES' panel shows a list of modules with the 'Support' module highlighted. A 'Previous Question' button is at the bottom right.

Figure 4.11 Related Legal Provision

For example, if there is support directive in the underground mine workplace, user clicks on the “Yes” button and continues with the next questions or modules (Figure 4.12).

QUESTIONS **MODULES**

Support

Related Legal Provision

QUESTION 7 Is there a support directive?

☒ Yes ☐ No

Problem

Severity

Insignificant <i>No injury</i>	Minor <i>First aid or no lost time</i>	Moderate <i>Medical/hospital or lost time</i>	Major <i>Permanent disability</i>	Catastrophic <i>Fatality</i>
1	2	3	4	5

Probability

Rare <i>Once a year</i>	Unlikely <i>Once in a three month</i>	Possible <i>Once in a month</i>	Likely <i>Once in a week</i>	Almost Certain <i>Once in a day</i>
1	2	3	4	5

Risk

Measure

Responsible Person

Due Date

Finish

Previous Question

Figure 4.12 If the Answer of the Question is “Yes”

However, if there is not a support directive in the underground mine workplace, user clicks on the “No” button (Figure 4.13) and firstly defines the problem to determine the risk (Figure 4.14).

QUESTIONS **MODULES**

Support

Related Legal Provision

QUESTION 7 Is there a support directive?

☐ Yes ☒ No

Problem

Severity

Insignificant <i>No injury</i>	Minor <i>First aid or no lost time</i>	Moderate <i>Medical/hospital or lost time</i>	Major <i>Permanent disability</i>	Catastrophic <i>Fatality</i>
1	2	3	4	5

Probability

Rare <i>Once a year</i>	Unlikely <i>Once in a three month</i>	Possible <i>Once in a month</i>	Likely <i>Once in a week</i>	Almost Certain <i>Once in a day</i>
1	2	3	4	5

Risk

Measure

Responsible Person

Due Date

Finish

Previous Question

Figure 4.13 If the Answer of the Question is “No”

QUESTIONS **Support** **MODULES**

Related Legal Provision

QUESTION 7 Is there a support directive?

☐ Yes ☒ No

Measure

Problem There is no support directive.

Severity

Insignificant <small>No injury</small>	Minor <small>First aid or no lost time</small>	Moderate <small>Medical/hospital or lost time</small>	Major <small>Permanent disability</small>	Catastrophic <small>Fatality</small>
1	2	3	4	5

Probability

Rare <small>Once a year</small>	Unlikely <small>Once in a three month</small>	Possible <small>Once in a month</small>	Likely <small>Once in a week</small>	Almost Certain <small>Once in a day</small>
1	2	3	4	5

Risk

Responsible Person

Due Date

Finish

Previous Question

Figure 4.14 Defining the Problem

Afterwards, risk analysis is done by considering severity and probability of the risk. Both severity and probability range from one to five (Table 4. 4).

Table 4.4 Severity and Probability

Probability		Severity	
1	Rare (once a year)	1	Insignificant (no injury)
2	Unlikely (once in a three month)	2	Minor (first aid or no lost time)
3	Possible (once in a month)	3	Moderate (medical/hospital or lost time)
4	Likely (once in a week)	4	Major (permanent disability)
5	Almost Certain (once in a day)	5	Catastrophic (fatality)

For this question, risk assessment team members evaluated that the lack of support directive could cause death and probability of the risk was once in a week for their mine. Therefore, severity is selected as five and probability is selected as four. Then, risk assessment tool automatically multiplies these two and calculates the risk rate as twenty (Figure 4.15).

QUESTIONS

Support

MODULES

Related Legal Provision

QUESTION 7

Is there a support directive?

☐ Yes
☒ No

Problem

There is no support directive.

Severity

Insignificant

Minor

Moderate

Major

Catastrophic

No injury

First aid or no lost time

Medical/hospital or lost time

Permanent disability

Fatality

☐ 1
☐ 2
☐ 3
☐ 4
☒ 5

Probability

Rare

Unlikely

Possible

Likely

Almost Certain

Once a year

Once in a three month

Once in a month

Once in a week

Once in a day

☐ 1
☐ 2
☐ 3
☒ 4
☐ 5

Risk

20

Measure

Responsible Person

Due Date

Finish

Previous Question

Figure 4.15 Severity and Probability

Next step is the determining the rational, feasible, and practical control measure for the workplace. Finally, responsible person and due date are defined for the control measures and after finishing those, user clicks on the “Finish” button in order to continue with the other questions or modules (Figure 4.15). If any part is missing or skipped, then the tool gives a warning to fill all the parts.

This process continues until all questions are answered in each module.

QUESTIONS Support MODULES

Related Legal Provision

QUESTION 7 Is there a support directive?

☐ Yes ☒ No

Problem There is no support directive.

Severity

Insignificant <i>No injury</i>	Minor <i>First aid or no lost time</i>	Moderate <i>Medical/hospital or lost time</i>	Major <i>Permanent disability</i>	Catastrophic <i>Fatality</i>
<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input checked="" type="radio"/> 5

Probability

Rare <i>Once a year</i>	Unlikely <i>Once in a three month</i>	Possible <i>Once in a month</i>	Likely <i>Once in a week</i>	Almost Certain <i>Once in a day</i>
<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input checked="" type="radio"/> 4	<input type="radio"/> 5

Risk 20

Measure A support instruction list will be prepared and it will include:
 -Identification of the personnel responsible for the support in all parts of the mine which need to be supported (face, roof etc.),
 -Taking precautions to ensure environmental safety during the installation of the support,
 -Making sure that support material of appropriate quality, amount and size is available in every face line where work is in progress.

Responsible Person Adam Johns

Due Date 02.02.2016

Finish
Previous Question

Figure 4.16 Measure, Responsible Person and Due Date

User also adds question(s) into the modules if necessary. For this process, after clicking on “Add-Edit Question” button user writes the new question and user may add related legal provision of the question if there is any (Figure 4.17).

ADD QUESTION

ADD NEW QUESTION

Module Support

of Question 8

Question

Legal Provision

Save

Figure 4.17 Add Question

On the other side, risk assessment team may be faced with different types of hazards in their underground coal mine which is not a topic of any module. So, tool provides to add a new module (Figure 4.18) by clicking on the “Add-Edit Module” button. New questions are added into this new module similar to the Figure 4.17 and same procedure is applied for new module, too.

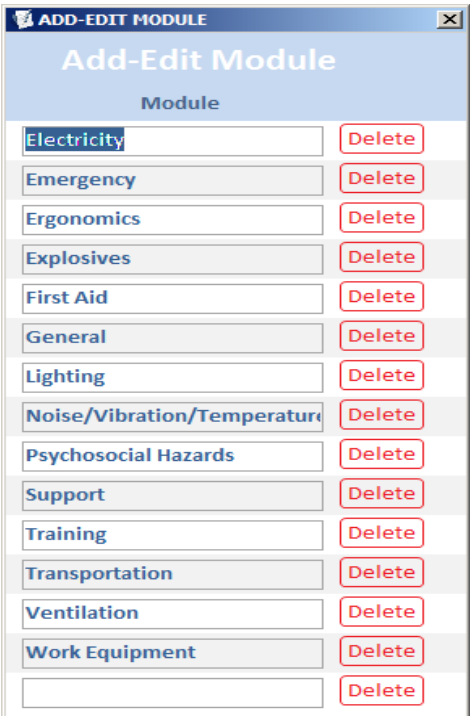


Figure 4.18 Add Module

4.2.3 Report

In the report part, all the filled information about workplace, risk assessment team, and answers of the questions’ will be automatically prepared by the risk assessment tool (Figure 4.19). User may save the report in the electronic environment and print the report to get a hard copy. A slice of report is presented in the Appendix B as a short example. By the risk assessment team members, each page of the report’s hard copy is initialed and the last page is signed.

RISK ASSESSMENT REPORT

Filter Report

29.02.2016

20:39:22

RISK ASSESSMENT REPORT

"Risk Assessment Tool for Underground Coal Mines" is used to carry out occupational health and safety risk assessment in our coal mine workplace.

GENERAL INFORMATION

Title Of Workplace

XYZ Company

Address Of Workplace

107 Main Street, Maddison 54784

Employer

Fatih Buyukkara

Risk Assessment Commencement Date

01.09.2015

Risk Assessment Completion Date

06.10.2015

Risk Assessment Expiry Date

06.10.2017

Risk Assessment Revision Date (if ay)

RISK ASSESSMENT TEAM

Title	Name Surname
Employer	Fatih Buyukkara
Employer Representative (if any)	
Occupational Safety Specialist	Charles Champell Certificate No 110051
Occupational Physicians	Eleanor Nelson Certificate No 3214
Support Personnel	David Morrison
Worker Representative(s)	Nancy Frank

Module	# of Q	Question	Answer	Problem	Risk Level	Control Measure	Responsible Person	Due Date
Support	7	Is there a support directive?	No	There is no support directive.	20	A support instruction list will be prepared and it will include: -Identification of the personnel responsible for the support in all parts of the mine which need to be supported (face, roof etc.), -Taking precautions to ensure environmental safety during the installation of the support, -Making sure that support material of appropriate quality, amount and size is available in every face line where work is in progress.	Adam Johns	02.02.2016
Electricity	1	Is there a plan indicating the electrical grid, fixed devices on the grid and the location of facilities?	No	There is no electrical grid plan.	6	A plan will be prepared indicating the electrical grid.	Tom Jackson	26.10.2015

SIGNATURE OF RISK ASSESSMENT TEAM

Title	Name Surname	Signature
Employer	Fatih Buyukkara	
Employer Representative (if any)		
Occupational Safety Specialis	Charles Champell	
Occupational Physician	Eleanor Nelson	
Support Personne	David Morrison	
Worker Representative(s)	Nancy Frank	

Figure 4.19 Report Part

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CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Every worker has the right to work in a healthful and safe workplace. In Turkey, attention to health and safety in the workplace has grown in recent years by means of the Occupational Health and Safety Law No 6331. Conducting an occupational health and safety risk assessment is one of the significant practice that the Law brings along for all workplaces under the scope of the Law. In addition, risk assessment provides both safety culture and continuous improvement in the workplace. Aim of this study is the preparation of a computer-based risk assessment tool for underground coal mines both considering mining workplaces' hazards, their unique characteristics and satisfying legal requirements.

The main conclusions and contributions drawn from this study can be listed as:

- Risk assessment tool is prepared for underground coal mines in Turkey and it is also compatible with the Occupational Health and Safety Law, Regulation on Occupational Health and Safety Risk Assessment, Regulation of Occupational Health and Safety in the Mining Workplace and other occupational health and safety related regulations. So, prepared computer-based risk assessment tool is a pioneer one for underground coal mines.
- According to Regulation on Occupational Health and Safety Risk Assessment, risk assessment should be carried out by a team including at least employer or employer's representative, occupational safety expert, occupational physician, workers' representative, and support staff. Therefore, risk assessment tool is prepared as simple as possible and it is user friendly.
- Risk assessment tool is constituted three parts which are preparation, modules, and report. Workplace and risk assessment information are filled in the preparation part. Modules part is the core of the tool and consists of 14

modules, such as ventilation, support, explosives, transportation, and electricity module. Each module includes several number of questions about different hazards in order to identify the hazard. Related legal provision about the most of the questions are generally provided. If there is a risk, analysis of the risk, determination of the control measure, responsible person, and due date sections are filled. After answering all the questions in each module, report of the risk assessment is automatically prepared by the tool.

- Each mining workplaces has its own nature and characteristics. This issue was born in mind to comprise the all underground coal mines while preparation phase of the risk assessment tool. Therefore, a flexible risk assessment tool is developed providing to add or edit any different hazard(s) or question(s) into the tool in order to identify all hazards and assess all risks.
- Risk assessment process may take days, weeks or even months depending on the workplaces. Therefore, risk assessment tool provides to save risk assessment before not completed.
- Risk assessment may need revision because of different reasons, such as occurrence of an occupational accident, arising a new hazard, changes in the production method, and moving of the workplace. Then, risk assessment tool provides to update the risk assessment any time.
- Risk assessment tool can be used in any computer that Microsoft Access is installed.
- Last but not least, risk assessment tool is used even regulations are changed because of the fact that the Tool is designed to allow making changes.

At the end of this study, it is recommended that:

- The number of studies and projects about the implementation of the risk assessment should be increased.
- Turkish version of the prepared computer-based risk assessment tool may be shared in the webpage of the Ministry of Labour and Social Security to inform the interested person.
- Similar tools may be prepared for other mining workplaces and also other sectors.

- Risk assessment tool shall be more developed and adopted as an application which can be used by smart phones.
- It is suggested to separate underground coal mining workplaces from other mining workplaces, under the scope of a new regulation or under the heading a new annex in the Regulation for Occupational Health and Safety at Mining Workplaces.
- It is suggested to add “the transfer of knowledge of the shift shall be ensured at the shift changes” into the related part of the Regulation for Occupational Health and Safety at Mining Workplaces.
- It is suggested to add ‘planning’ part as a first phase of the risk assessment into the Regulation on Occupational Health and Safety Risk Assessment.

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APPENDIX A

LEGAL PROVISIONS OF THE QUESTIONS

GENERAL MODULE

Q1. Are entries into and exits from the mine recorded?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX-1

1. Organization and surveillance

1.1. Organization of workplaces

1.1.6. Records must be kept for workers at workplaces. Any entry to and exit from the mine, as well as the workers' locations within the workplace shall be recorded.

Q2. Are workers' locations within the mine recorded?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX-1

1. Organization and surveillance

1.1. Organization of workplaces

1.1.6. Records must be kept for workers at workplaces. Any entry to and exit from the mine, as well as the workers' locations within the workplace shall be recorded.

Q3. Does the workplace have a health and safety document?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

General responsibility of the employer

ARTICLE 5– (2) The employer shall ensure;

a) a health and safety document covering the relevant requirements laid down in Articles 4, 10, 14 and 16 of the Law, is drawn up and kept up to date.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

1.8. Health and safety document

1.8.1. Without prejudice to the provision contained in line (b) of the paragraph two of the article 5 of this Regulation, the employer shall ensure that all measures which are needed to be taken to safeguard the health and safety of the workers in both ordinary and extraordinary situations are included in the health and safety document.

1.8.2. The health and safety document shall be regularly updated and kept at the workplace for inspection. Operations at the workplace shall take place in accordance with the health and safety document.

Q4. Is there a three-dimensional, digital and scaled underground operation plan?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

1. Underground operation plans (production map)

1.1. A scaled and three dimensional underground operation plan clearly indicating underground operations shall be prepared. Roads, production areas as well as other aspects that might have an impact on operations and safety shall be indicated on the plan and these plans shall be kept in easily accessible places. Plans are kept as long as it is required in terms of health and safety. Also, this plan is prepared with a scale as three dimensional in electronic environment.

Q5. Is the underground operation plan updated at least once every month?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

1. Underground operation plans (production map)

1.2. Underground operation plans shall be updated at least once a month and kept in the workplace.

1.3. All information related with old mine workings, strata that might contain water inside and around the quarry, faults, state, width and depth of natural water resources and ponds shall be indicated in detail on production maps.

Q6. Are there at least two separate connections to the surface?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

2. In all underground operations, there shall be at least two separate connections to the surface, safe and easy to reach by workers and not interconnected. Pillar between these routes shall not be less than 30 meters, exit of these routes shall not be under the same roof.

Q7. Is health surveillance of workers carried out?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Health surveillance

ARTICLE 15 – (1) The employer shall;

a) ensure that workers receive health surveillance appropriate to the health and safety risks they incur at work.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

Health surveillance

ARTICLE 11 – (1) Without prejudice to the provisions in the Article 15 of the Law;

a) It shall be ensured that workers receive health surveillance appropriate to the health and safety risks they incur at work.

b) Workers shall undergo health surveillance before being assigned to duties and subsequently at regular intervals.

Q8. Do workers use proper personal protective equipment when and where necessary?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Workers' obligations

ARTICLE 19 – (1) It shall be the responsibility of each worker to take care as far as possible of his own safety and health and that of other persons affected by his acts or commissions at work in accordance with his training and the instructions related to occupational health and safety given by his employer

(2) To this end, workers must in particular, in accordance with their training and the instructions given by their employer:

a) make correct use of machinery, apparatus, tools, dangerous substances, transport equipment and other means of production; use such safety devices correctly and refrain from changing or removing arbitrarily safety devices fitted.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

5. Protection from explosion risks, fire hazards and harmful atmospheres

5.3. Protection from harmful atmospheres

5.3.3. Without prejudice to the provisions of the Regulation on the Use of Personal Protective Equipment at Workplaces, published in the Official Journal dated 2/7/2013 and numbered 28695, appropriate and sufficient breathing and resuscitation equipment must be available in areas where workers may be exposed to atmospheres which are harmful to health. A sufficient number of workers trained to use such equipment must be present in such areas. The equipment must be suitably stored and maintained.

REGULATION ON USE OF PERSONAL PROTECTIVE EQUIPMENTS IN THE WORKPLACES

Assessment and selection of personal protective equipment

ARTICLE 7 - (1) The employer shall determine the necessary personal protective equipment to be used with the occupational health and safety measures to be taken as a result of risk assessment.

(2) Personal protective equipment to be used in the workplace shall be assessed by considering the following issues;

a) Employer shall assess whether these equipment are compatible with the requirements specified in (a) and (b) clauses of article 6 of this Regulation, before selecting them. This assessment shall include the following issues;

1) Analysis and assessment of risks which cannot be prevented by other means,

2) By considering the risks arising from personal protective equipment itself, identification of the characteristics that can be effective against the risks specified in the sub-clause (1) of clause (a) of this article,

3) Comparison of characteristics of personal protective equipment to be selected and characteristics determined according to sub-clause (2) of clause (a) of this article.

b) In case any change has been made in any item of the personal protective equipment, assessments in the clause (a) of this article shall be reviewed.

Q9. Is a communication system available throughout the workplace?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

Communication, warning and alarm systems

ARTICLE 9 – (1) The employer shall set up any information and communication systems necessary for the entire workplace.

(2) The employer shall ensure that the necessary warning and other communication systems are available to enable assistance, escape and rescue operations to be launched immediately if the need arises.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

1. Organization and surveillance

1.1. Organization of workplaces

1.1.5. Workplaces must be provided with the necessary means of communication and information including, if applicable, the pit.

Q10. Are materials used in accordance with their relevant safety data sheets?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

7. Chemical and radioactive substances

7.1. Articles of this Regulation as well as Regulation on Health and Safety Measures in Operations with Chemicals published in Official Gazette no. 28733 on 12/8/2013 shall be applied in order to ensure health and safety of workers in workplaces where chemicals are used.

REGULATION ON HEALTH AND SAFETY MEASURES IN WORKING WITH
CHEMICAL SUBSTANCES

General responsibility

ARTICLE 5 - (1) The employer is obliged to take all the necessary measures in works involving chemicals to protect the employees from the hazards of these substances, prevent their exposure to chemical substance and decrease the exposure to the minimum level in case preventing is not possible.

Q11. Are hazardous or waste materials at the workplace disposed of?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

1. Organization and surveillance

1.1. Organization of workplaces

1.1.1. Workplaces must be so organized as to provide adequate protection against hazards. They must be kept in good order, with any hazardous substances or deposits removed or controlled in order not to endanger the health and safety of workers.

Q12. Are dressing rooms adequate in terms of health and safety?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

20. Sanitary installations

20.1. Changing rooms, lockers for clothes

20.1.1. Appropriate changing rooms shall be provided for workers who have to wear special outfits during work. Changing rooms shall be easily accessible and big enough; there shall be seats in these rooms.

20.1.2. Changing rooms shall be big enough and there shall be lockers for each worker so that he/she can put his/her clothes during working hours. Lockers for clothes in workplaces, where humid, dusty, dirty or similar operations are involved or work with hazardous substances is carried out, shall have two shelves one next to another or workers shall be provided with two lockers each in order to store working outfits and out-of-work outfit separately. There shall be necessary facilities to be able to dry wet working gear.

Q13. Are showers and washing facilities adequate in terms of health and safety?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

20.2. Showers and washbasins

20.2.1. Suitable shower facilities shall be provided when the nature of the job or health reasons require to have a shower. Shower facilities for men and women shall be separated.

20.2.2. Shower facilities shall be big enough for workers to have a shower and be in line with hygienic conditions. Showers shall have hot and cold running water.

20.2.3. In workplaces where there is no need for shower facilities, there shall be washbasins close to the working areas and changing rooms, which have running hot

water as well when necessary. Washbasins shall be separate for male and female workers.

20.3. There shall be adequate number of toilets and washbasins close to working areas, restrooms changing rooms, showers and washing stations. Toilets and washbasins shall be separated for male and female workers. Sanitary installations of underground mines mentioned in this part may be located above the ground.

TRAINING MODULE

Q1. Are workers trained periodically on health and safety?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Training of workers

ARTICLE 17 – (1) The employer shall ensure that each worker receives safety and health training. This training shall be provided on recruitment, in the event of a transfer or a change of job, in the event of a change in equipment or introduction of any new technology. The training shall be adapted to take account of new or changed risks and repeated periodically if necessary.

Q2. Are theoretical and practical training sessions organized so as to make it easier for workers to understand the matter at hand?

Legal Provision

REGULATION ON PROCEDURES AND PRINCIPLES OF OCCUPATIONAL HEALTH AND SAFETY TRAINING OF EMPLOYEES

The basic principles of training

ARTICLE 12 - (1) To make the training efficient, attention shall be shown to select the subjects that are needed by the participants. Training shall be implemented in a form that it will be theoretical and hands-on form as it can easily be understood by the employees.

Q3. Is the effectiveness of training sessions evaluated at the end of the session?

Legal Provision

REGULATION ON PROCEDURES AND PRINCIPLES OF OCCUPATIONAL
HEALTH AND SAFETY TRAINING OF EMPLOYEES

The basic principles of training

ARTICLE 12 - (6) Measurement and assessment shall be made at the end of the training given. It shall be determined whether the training is effective according to assessment results and change shall be made in training program or lecturers if needed or training shall be repeated.

Q4. Do workers receive on-the-job training?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Training of workers

ARTICLE 17 – (1) The employer shall ensure that each worker receives safety and health training. This training shall be provided on recruitment, in the event of a transfer or a change of job, in the event of a change in equipment or introduction of any new technology. The training shall be adapted to take account of new or changed risks and repeated periodically if necessary.

Q5. Do workers' representative/representatives receive dedicated training?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Training of workers

ARTICLE 17 – (2) Workers' representatives shall be entitled to appropriate training.

Q6. Do workers who are assigned to tasks requiring vocational training hold vocational training certificates?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Training of workers

ARTICLE 17 – (3) Workers failing to present documents to prove that they have received vocational training on their job might not be employed in jobs classified as hazardous and very hazardous which require vocational training.

Q7. Do workers who had an occupational accident/disease and/or those who were away from work for longer than six months receive training before they resume work?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Training of workers

ARTICLE 17 – (4) Workers who have had occupational accident or disease shall receive additional training on reasons for the accident or disease, ways to protect themselves and safe working methods. Furthermore; workers who are away from work for any reason for more than six months shall receive refresher training before return to work.

Q8. Are workers trained on what to do in case of an emergency?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

14. Search, rescue and evacuation

14.1. Workers shall be trained in how to behave during an emergency in line with the Regulation on Emergencies in Workplaces. Adequate number of support staff shall be assigned for search, rescue and evacuation. Within the scope of first paragraph of Article 11 in the Regulation on Emergencies in Workplaces, at least 10 workers shall be trained in mines where the obligatory number of support staff to be assigned is less than 10. In cases where the number of workers is less than 10, this training is provided to each worker. This trainings are given in accordance with the nature of the work done and included theoretical and practical training provided, certified and this trainings are refreshed every six months. Equipment to be used for search, rescue and evacuation shall be easy to reach and ready to use and marked in accordance with Regulation on Safety and Health Signs at Work.

Q9. Do support staff receive theoretical and practical training that is in compliance with the task at hand?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

14. Search, rescue and evacuation

14.1. Workers shall be trained in how to behave during an emergency in line with the Regulation on Emergencies in Workplaces. Adequate number of support staff shall be assigned for search, rescue and evacuation. Within the scope of first paragraph of Article 11 in the Regulation on Emergencies in Workplaces, at least 10 workers shall be trained in mines where the obligatory number of support staff to be assigned is less than 10. In cases where the number of workers is less than 10, this training is provided to each worker. This trainings are given in accordance with the nature of the work done and included theoretical and practical training provided, certified and this trainings are refreshed every six months. Equipment to be used for search, rescue and evacuation shall be easy to reach and ready to use and marked in accordance with Regulation on Safety and Health Signs at Work.

Q10. Is training provided for the support staff documented?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

14. Search, rescue and evacuation

14.1. Workers shall be trained in how to behave during an emergency in line with the Regulation on Emergencies in Workplaces. Adequate number of support staff shall be assigned for search, rescue and evacuation. Within the scope of first paragraph of Article 11 in the Regulation on Emergencies in Workplaces, at least 10 workers shall be trained in mines where the obligatory number of support staff to be assigned is less than 10. In cases where the number of workers is less than 10, this training is provided to each worker. This trainings are given in accordance with the nature of the work done

and included theoretical and practical training provided, certified and this trainings are refreshed every six months. Equipment to be used for search, rescue and evacuation shall be easy to reach and ready to use and marked in accordance with Regulation on Safety and Health Signs at Work.

Q11. Is training provided for the support staff refreshed periodically?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

14. Search, rescue and evacuation

14.1. Workers shall be trained in how to behave during an emergency in line with the Regulation on Emergencies in Workplaces. Adequate number of support staff shall be assigned for search, rescue and evacuation. Within the scope of first paragraph of Article 11 in the Regulation on Emergencies in Workplaces, at least 10 workers shall be trained in mines where the obligatory number of support staff to be assigned is less than 10. In cases where the number of workers is less than 10, this training is provided to each worker. This trainings are given in accordance with the nature of the work done and included theoretical and practical training provided, certified and this trainings are refreshed every six months. Equipment to be used for search, rescue and evacuation shall be easy to reach and ready to use and marked in accordance with Regulation on Safety and Health Signs at Work.

Q12. Are drills carried out periodically to assess the training and skill level of workers who have specific responsibility in case of emergencies?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

15. Safety exercises: Emergency plans shall be renewed every six months, safety exercises shall be carried out not later than six months and official reports shall be made with recorded images of the exercises with suitable equipments specified in

paragraph 2.1.6 of Annex-1. The aim of these exercises is to check training and skills of workers specifically assigned for emergencies including tasks of use or operation of emergency equipment. Assigned workers shall practice proper use or operation of these equipments in proper places. All emergency equipment used in safety exercise shall be checked, cleaned and refilled or renewed. All mobile equipment used for practice purposes shall be put back in their original places.

Q13. Are workers provided with hands-on training on the use of personal protective equipment?

Legal Provision

REGULATION ON USE OF PERSONAL PROTECTIVE EQUIPMENTS IN THE WORKPLACES

General provisions

ARTICLE 6 - (1)...

g) The employer shall provide hands-on training in the use of personal protective equipment.

EMERGENCY MODULE

Q1. Have emergency situations been defined?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Emergency plans, fire-fighting and first aid

ARTICLE 11 – (1) The employer shall;

a) assess the foreseeable emergency situations which could arise and identify those that might possibly and potentially affect workers and work environment taking into account the work environment, substances used, equipment and environmental conditions present in the workplace and take measures to prevent and limit adverse effects of emergency situations.

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's Responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

a) Evaluate emergencies to occur and to affect the employee and working environment by considering working environment, used materials, work equipment and environmental conditions in advance and determine possible emergencies.

Q2. Are measures in place to prevent and limit negative effects of emergency situations?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Emergency plans, fire-fighting and first aid

ARTICLE 11 – (1) The employer shall;

a) assess the foreseeable emergency situations which could arise and identify those that might possibly and potentially affect workers and work environment taking into account the work environment, substances used, equipment and environmental conditions present in the workplace and take measures to prevent and limit adverse effects of emergency situations.

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's Responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

b) Take preventive and limiting measures against adverse effects of emergencies.

Q3. Are relevant measurements and assessments carried out to protect against negative effects of emergency situations?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Emergency plans, fire-fighting and first aid

ARTICLE 11 – (1) The employer shall;

a) assess the foreseeable emergency situations which could arise and identify those that might possibly and potentially affect workers and work environment taking into account the work environment, substances used, equipment and environmental conditions present in the workplace and take measures to prevent and limit adverse effects of emergency situations.

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's Responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

- b) Take preventive and limiting measures against adverse effects of emergencies.

Q4. Has an emergency plan been prepared?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Emergency plans, fire-fighting and first aid

ARTICLE 11 – (1) The employer shall;

- b) conduct measurement and assessments to afford protection against adverse effects of emergency situations and prepare emergency plans.

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

- ç) Prepare emergency plans, and ensure drills to be made.

Q5. Are periodic drills conducted for emergency preparedness?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Emergency plans, fire-fighting and first aid

ARTICLE 11 – (1) The employer shall;

- c) designate a sufficient amount of persons adequately equipped in prevention, protection, evacuation, firefighting, first aid and other related issues taking into account the size and specific hazards of the undertaking, nature of the activities, number of employees and other persons present in the enterprise. The number of such workers, their training and equipment available to them shall be adequate and the employer shall arrange emergency drills and trainings and make sure that the rescue teams are always available to respond.

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's Responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

ç) Prepare emergency plans, and ensure drills to be made.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

15. Safety exercises: Emergency plans shall be renewed every six months, safety exercises shall be carried out not later than six months and official reports shall be made with recorded images of the exercises with suitable equipments specified in paragraph 2.1.6 of Annex-1. The aim of these exercises is to check training and skills of workers specifically assigned for emergencies including tasks of use or operation of emergency equipment. Assigned workers shall practice proper use or operation of these equipments in proper places. All emergency equipment used in safety exercise shall be checked, cleaned and refilled or renewed. All mobile equipment used for practice purposes shall be put back in their original places.

Q6. Is adequate first aid equipment available?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Emergency plans, fire-fighting and first aid

ARTICLE 11 – (1) The employer shall;

c) designate a sufficient amount of persons adequately equipped in prevention, protection, evacuation, firefighting, first aid and other related issues taking into account the size and specific hazards of the undertaking, nature of the activities, number of employees and other persons present in the enterprise. The number of such workers, their training and equipment available to them shall be adequate and the employer shall arrange emergency drills and trainings and make sure that the rescue teams are always available to respond.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

General responsibility of the employer

ARTICLE 5 – (1) The employer is required to fulfill the following responsibilities:

a) to ensure the safety and health of workers in every aspect related to the work, the employer shall take the necessary measures to ensure that;

5) appropriate first-aid equipment are provided and required safety and evacuation practices are performed at regular intervals and in any case at least once per year in compliance with the Regulation on Emergencies, Fire-fighting and First-aid at Workplaces published on the Official Journal dated 18/6/2013 and numbered 28681.

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's Responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

d) Employ sufficient number of employees who are trained and equipped in matters such as prevention, protection, evacuation, fire-fighting, first aid, etc. and provide them to be always ready, by considering size and special hazards of workplace, the nature of business, the number of employees and other persons present at workplace to respond in case of emergency.

Q7. Has an adequate number of support staff been put in charge?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Emergency plans, fire-fighting and first aid

ARTICLE 11 – (1) The employer shall;

c) designate a sufficient amount of persons adequately equipped in prevention, protection, evacuation, firefighting, first aid and other related issues taking into account the size and specific hazards of the undertaking, nature of the activities, number of employees and other persons present in the enterprise. The number of such workers, their training and equipment available to them shall be adequate and the employer shall arrange emergency drills and trainings and make sure that the rescue teams are always available to respond.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

14. Search, rescue and evacuation

14.1. Workers shall be trained in how to behave during an emergency in line with the Regulation on Emergencies in Workplaces. Adequate number of support staff shall be assigned for search, rescue and evacuation. Within the scope of first paragraph of Article 11 in the Regulation on Emergencies in Workplaces, at least 10 workers shall be trained in mines where the obligatory number of support staff to be assigned is less than 10. In cases where the number of workers is less than 10, this training is provided to each worker. This trainings are given in accordance with the nature of the work done and included theoretical and practical training provided, certified and this trainings are refreshed every six months. Equipment to be used for search, rescue and evacuation shall be easy to reach and ready to use and marked in accordance with Regulation on Safety and Health Signs at Work.

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's Responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

d) Employ sufficient number of employees who are trained and equipped in matters such as prevention, protection, evacuation, fire-fighting, first aid, etc. and provide them to be always ready, by considering size and special hazards of workplace, the nature of business, the number of employees and other persons present at workplace to respond in case of emergency.

Determination of the employees to be assigned

ARTICLE 11 - (1) Employer shall assign at least one each properly-equipped and specially-trained employee as support member for the matters of;

a) Search, rescue and evacuation,

b) Fire-fighting, for up to 30 employees in workplaces in the very hazardous class, up to 40 employees in workplaces in hazardous class, and up to 50 employees in less hazardous class determined in the Notification determining hazard classes in workplaces. In case there are exceeding number of employees in workplaces, the employer shall assign one each support personnel for up to 30, 40 and 50 employees according to hazard class.

(2) The employer shall assign support member for first aid pursuant to principles of the Regulation of First Aid published in 24762 numbered and 22/05/2002 dated Official Gazette.

(3) In workplaces where more than one employee needs to be assigned for every matter, these employees shall carry out their duties coordinately in teams according to their fields. Each team shall have a team leader.

(4) The employer shall assign the employee responsible among the employees to ensure necessary coordination among teams in case of emergency.

Q8. Are there written instructions for emergency situations?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Evacuation

ARTICLE 12 – (1) In the event of serious, imminent and unavoidable danger, the employer shall:

a) take action and give instructions to enable workers to stop work and/or immediately to leave the work place and proceed to a place of safety.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

1.6. Written instructions shall be prepared in every workplace, setting out the rules for safeguarding health and safety of workers, handling and storing explosives, and safely using work equipment. Such instructions shall also include information regarding the use of emergency equipment and how to behave in case of an emergency at or near the workplace.

Q9. Are workers/workers of subcontractors/clients/visitors etc. informed about emergency situations?

Legal Provision

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's Responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

g) Inform employees of sub-contractor and employer who temporary business relationship is established with if exists, and other persons present in workplace such as client and visitor about emergencies.

Q10. Are there arrangements in place to ensure communication with agencies outside the workplace in case of an emergency?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Emergency plans, fire-fighting and first aid

ARTICLE 11 – (1) The employer shall;

ç) make necessary regulations which will provide to contact with establishments outside of workplace in especially matter of first aid, immediate medical response, rescue and fire-fighting.

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's Responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

e) Make necessary regulations which will provide to contact with establishments outside of workplace in especially matter of first aid, immediate medical response, rescue and fire-fighting.

Q11. Is it possible to de-energize all energy sources in case of an emergency?

Legal Provision

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's Responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

f) Make necessary regulations regarding inactivation of energy resources and systems which may hazard by avoiding from adverse situations and effects which may form on protective systems in case of emergency.

Q12. Is there a communication/information system ensuring communication with the surface during an emergency?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

Communication, warning and alarm systems

ARTICLE 9 – (2) The employer shall ensure that the necessary warning and other communication systems are available to enable assistance, escape and rescue operations to be launched immediately if the need arises.

Q13. Is there emergency signage?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

13. Escape routes and emergency exits

13.7. Emergency exit routes and doors shall be marked in accordance with Regulation on Safety and Health Signs at Work.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

14. Search, rescue and evacuation

14.1. Workers shall be trained in how to behave during an emergency in line with the Regulation on Emergencies in Workplaces. Adequate number of support staff shall be assigned for search, rescue and evacuation. Within the scope of first paragraph of Article 11 in the Regulation on Emergencies in Workplaces, at least 10 workers shall be trained in mines where the obligatory number of support staff to be assigned is less than 10. In cases where the number of workers is less than 10, this training is provided to each worker. This trainings are given in accordance with the nature of the work done and included theoretical and practical training provided, certified and this trainings are refreshed every six months. Equipment to be used for search, rescue and evacuation

shall be easy to reach and ready to use and marked in accordance with Regulation on Safety and Health Signs at Work.

Q14. Is the search, rescue and evacuation equipment kept easily accessible and readily available in appropriate locations?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

14. Search, rescue and evacuation

14.1. Workers shall be trained in how to behave during an emergency in line with the Regulation on Emergencies in Workplaces. Adequate number of support staff shall be assigned for search, rescue and evacuation. Within the scope of first paragraph of Article 11 in the Regulation on Emergencies in Workplaces, at least 10 workers shall be trained in mines where the obligatory number of support staff to be assigned is less than 10. In cases where the number of workers is less than 10, this training is provided to each worker. This trainings are given in accordance with the nature of the work done and included theoretical and practical training provided, certified and this trainings are refreshed every six months. Equipment to be used for search, rescue and evacuation shall be easy to reach and ready to use and marked in accordance with Regulation on Safety and Health Signs at Work.

Q15. Is there a rescue plan?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

16. Rescue Plan

16.1. Each mine shall have a plan showing the location of necessary items such as main doors, stopping barriers, air crossings, mechanism adjusting the air current and telephone stations to be used by support staff assigned with rescue, search and evacuation duties.

Q16. Is there an appropriate rescue station?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

14. Search, rescue and evacuation

14.3. A suitable rescue station shall be established in order to fast and effective intervention of search, rescue and evacuation in underground and surface mines. Features and number of materials and equipment and periodic controls and calibration frequencies of these equipment shall be stated in the health and safety document. However, mines within a radius of maximum 50 kilometers may establish a joint rescue station in a central area. This article applies for various quarries of the same mining enterprise. Workplaces shall share set-up and management expenses among themselves based on the number of workers.

Q17. Is periodic maintenance done on the equipment available in the rescue station?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

14. Search, rescue and evacuation

14.3. A suitable rescue station shall be established in order to fast and effective intervention of search, rescue and evacuation in underground and surface mines. Features and number of materials and equipment and periodic controls and calibration frequencies of these equipment shall be stated in the health and safety document. However, mines within a radius of maximum 50 kilometers may establish a joint rescue station in a central area. This article applies for various quarries of the same mining enterprise. Workplaces shall share set-up and management expenses among themselves based on the number of workers.

Q18. Have appropriate escape routes been identified to ensure safe and sound evacuation of workers in case of an emergency?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ADDED ARTICLE 1–

(1) If an event occurs that might affect occupational health and safety (collapse, gas and dust explosion, arising of toxic or choking gas and so on.) in any place in the field of activity In order to ensure healthy and safe evacuation of all workers in underground coal mines in compliance with the escape routes described in the emergency action plan, the employer must:

a) Set up change or filling station for changing or filling self-contained self-rescuer (SCSR) between workstations and the exit point to the surface. The employer must decide whether or not change or filling station(s) for changing self-contained self-rescuer between the aforementioned two locations are needed; if yes, at which distances the change stations are to be set up, by taking into consideration the specific features of the self-contained self-rescuers which are chosen according to the criteria set in Table-1 and Table-2 below. Self-contained self-rescuer changing or filling station shall be equipped for not to be affected in case of any emergency like collapse, flood, explosion, fire.

b) These escape times identified for underground coal mines may be reduced by taking into consideration issues such as obstacles on the escape route, height and slope of the roadway, geological structure of the mine and the number of people to use the escape route simultaneously.

Table-1: Escape Times in Shafts, Inclines, Roadways and Tailgates

Slope (Degree)	Shaft, Incline, Roadways, Tailgates	
	Escape Time in Exit (m/min)	Escape Time in Descent (m/min)
0->10	40	45
10->20	25	30
20->45	15	20
>45 (Shaft, Staple Shaft)	4	8

Table -2: Escape Times in Production Areas

Slope (Degree)	Seam Thickness (m)	In Production Areas	
		Escape Time in Exit (m/minute)	Escape Time in Descent (m/minute)
0->20	0.50->1.00	8	8
0->20	1.00->1.40	10	10
0->20	1.40->1.80	15	15
0->20	>1.80	20	25
20->45	>1.00	10	15
>45 (Raise, Ore-pass)	>1.00	4	8

c) In the event that the workers who are assigned to work in return airway and other similar roadways, where the used air is conducted, are too far away to travel to the surface in a healthy and safe manner with the chosen self-contained self-rescuers, change stations for changing the self-contained self-rescuers must be set up in suitable locations by considering the specific features of the chosen self-contained self-rescuer and conditions of the return airways.

ç) Breathable compressed-air change stations must be set up every 30 meters in stone drifts, every 20 meters in tail gates, and every 10 meters in raises; and they must be identified on emergency escape plans.

d) The employer must identify the number of equipment and tools to be found in change stations so that the number exceeds the number of workers expected to use the change station in emergencies, at least by 10%.

e) It must be ensured that the measures to be taken in the scope of this article are included both in the mine operation project, which is prepared for the operating license application, and in revision projects for mining operations and that they are approved by the Ministry of Energy and Natural Resources, the Directorate General for Mining Affairs.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

13. Escape routes and emergency exits

13.1. Necessary precautions shall be taken in order to ensure that all workers can exit the workplace safely and immediately in case of an emergency.

Q19. Are portable breathing apparatuses providing clean air in emergencies kept easily accessible and readily available?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

14.2. In places where escape is difficult, will take time or be dangerous for health due to air quality, there shall be mobile respirators providing clean air. These equipments shall be easy to reach in the shortest possible time and be ready to use.

Q20. Are appropriate escape and rescue tools available in case of an emergency?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

Escape and rescue facilities

ARTICLE 8 – (1) The employer shall provide and maintain appropriate means of escape and rescue in order to ensure that workers have adequate opportunities for leaving the workplaces promptly and safely in the event of danger.

Q21. Are necessary measures in place against gas outbursts?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX-3

12. Gas leakage, collapse or flooding

12.5.1. It is essential to take place evaluating the risk of gas degage in underground coal mines in the health and safety document.

FIRST AID MODULE

Q1. Are measures in place against inrush of water?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

16. First aid

16.1. First aid equipment shall be present in every place required by working conditions and shall be fit for the nature of the job. First aid equipment shall be properly marked and be easy to access.

Q2. Is a first aid room(s) available?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

16. First aid

16.2. There shall be one or more than one first aid room based on the size of the workplace, nature of the job and risk of accident in the workplace. First aid instructions indicating what to do in case of an accident shall be visible and placed in an area easy to see in the rooms.

Q3. Are first aid supplies and equipment in the first aid room(s) adequate?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

16. First aid

16.3. First aid rooms shall be equipped with first aid material and equipment and stretches shall be easy to reach. These places shall be marked in accordance with the Regulation on Safety and Health Signs at Work.

Q4. Is there an adequate number of support staff available?

Legal Provision

OCCUPATIONAL HEALTH AND SAFETY LAW

Emergency plans, fire-fighting and first aid

ARTICLE 11 – (1) The employer shall;

c) designate a sufficient amount of persons adequately equipped in prevention, protection, evacuation, firefighting, first aid and other related issues taking into account the size and specific hazards of the undertaking, nature of the activities, number of employees and other persons present in the enterprise. The number of such workers, their training and equipment available to them shall be adequate and the employer shall arrange emergency drills and trainings and make sure that the rescue teams are always available to respond.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

16. First aid

16.4. Support staff shall be assigned in accordance with the Regulation on First Aid published in Official Gazette no 24762 dated 22/5/2002.

REGULATION ON EMERGENCIES IN WORKPLACES

Employer's Responsibilities

ARTICLE 5 - (1) Obligations of the employer regarding emergencies are as follows, the employer shall:

d) Employ sufficient number of employees who are trained and equipped in matters such as prevention, protection, evacuation, fire-fighting, first aid, etc. and provide them to be always ready, by considering size and special hazards of workplace, the nature of business, the number of employees and other persons present at workplace to respond in case of emergency.

REGULATION ON EMERGENCIES IN WORKPLACES

Determination of the employees to be assigned

ARTICLE 11 - (1) Employer shall assign at least one each properly-equipped and specially-trained employee as support member for the matters of;

a) Search, rescue and evacuation,

b) Fire-fighting, for up to 30 employees in workplaces in the very hazardous class, up to 40 employees in workplaces in hazardous class, and up to 50 employees in less hazardous class determined in the Notification determining hazard classes in workplaces. In case there are exceeding number of employees in workplaces, the employer shall assign one each support personnel for up to 30, 40 and 50 employees according to hazard class.

(2) The employer shall assign support member for first aid pursuant to principles of the Regulation of First Aid published in 24762 numbered and 22/05/2002 dated Official Gazette.

(3) In workplaces where more than one employee needs to be assigned for every matter, these employees shall carry out their duties coordinately in teams according to their fields. Each team shall have a team leader.

(4) The employer shall assign the employee responsible among the employees to ensure necessary coordination among teams in case of emergency.

VENTILATION MODULE

Q1. Is there an adequate ventilation system in place?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.1. An appropriate ventilation system shall be installed in all mines prior to the commencement of production. In all underground mine working, the following shall be ensured;

- a) Providing a healthy atmosphere
- b) To keep risks of explosion and respirable dust concentration under control,
- c) To maintain an atmosphere in which working conditions are adequate while work is in progress, having regard to the working methods being used and the physical demands placed on the workers and to provide continuous ventilation to maintain these conditions.

Q2. Are there two ventilation groups available so that the secondary ventilation can be activated immediately in the event that the primary one stops working for any given reason?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

10. Gassy mines

10.13. Every gassy mine shall have two sets of ventilation, each one powerful enough to ventilate the mine. In cases where one set of ventilators stops working, the other shall be readily available for immediate use.

Q3. Is ventilation ensured with at least one mechanical system?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

10. Gassy mines

10.5. Ventilation shall be provided by one or more mechanical fans.

Q4. Does the ventilation system in place have the capacity to reverse the direction of the air flow?

Legal Provision**REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES****ANNEX- 3****10. Gassy mines**

10.22. Ventilation system shall have a feature to turn the air reverse direction in case of emergencies and when necessary.

Q5. Is healthy respirable air provided?

Legal Provision**REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES****ANNEX- 3****8. Ventilation**

8.1. An appropriate ventilation system shall be installed in all mines prior to the commencement of production. In all underground mine working, the following shall be ensured;

- a) Providing a healthy atmosphere,
- b) To keep risks of explosion and respirable dust concentration under control,
- c) To maintain an atmosphere in which working conditions are adequate while work is in progress, having regard to the working methods being used and the physical demands placed on the workers and to provide continuous ventilation to maintain these conditions.

Q6. Is ventilation adequate?

Legal Provision**REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES****ANNEX- 3****8. Ventilation**

8.1. An appropriate ventilation system shall be installed in all mines prior to the commencement of production. In all underground mine working, the following shall be ensured;

- a) Providing a healthy atmosphere,
- b) To keep risks of explosion and respirable dust concentration under control,
- c) To maintain an atmosphere in which working conditions are adequate while work is in progress, having regard to the working methods being used and the physical demands placed on the workers and to provide continuous ventilation to maintain these conditions.

Q7. Is uninterrupted ventilation provided?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.1. An appropriate ventilation system shall be installed in all mines prior to the commencement of production. In all underground mine working, the following shall be ensured;

- a) Providing a healthy atmosphere,
- b) To keep risks of explosion and respirable dust concentration under control,
- c) To maintain an atmosphere in which working conditions are adequate while work is in progress, having regard to the working methods being used and the physical demands placed on the workers and to provide continuous ventilation to maintain these conditions.

Q8. Is the ventilation system continuously monitored?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.2. Where the requirements of 8.1 cannot be met by natural ventilation, the ventilation shall be provided by means of one or more mechanical fans. Steps shall be taken to ensure stable and continuous ventilation. In mines where mechanical ventilation systems are used, the air currents produced by mechanical means shall, as far as possible, be given the same direction as the air currents resulting from natural ventilation. These systems shall be monitored continuously to prevent any stoppage and an automatic alarm system shall be installed to indicate unscheduled stoppages.

Q9. Are there automatic alarm systems in order to indicate the unscheduled stoppages of the ventilation system?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.2. Where the requirements of 8.1 cannot be met by natural ventilation, the ventilation shall be provided by means of one or more mechanical fans. Steps shall be taken to ensure stable and continuous ventilation. In mines where mechanical ventilation systems are used, the air currents produced by mechanical means shall, as far as possible, be given the same direction as the air currents resulting from natural ventilation. These systems shall be monitored continuously to prevent any stoppage and an automatic alarm system shall be installed to indicate unscheduled stoppages.

Q10. Are ventilation values regularly measured?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.3. The ventilation parameters shall be measured periodically and recorded. A ventilation plan containing the pertinent details of the ventilation system shall be prepared, brought up to date periodically and held available at the workplace. The

amount of air in the mine shall be followed by making the necessary measurements by establishing air monitoring stations including fresh air intake and all divided ways. These measurements shall be performed according to the health and safety documents and recorded in the ventilation book. The air velocity shall not be less than 0,5 m/s in any case.

Q11. Are ventilation measurement results recorded?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.3. The ventilation parameters shall be measured periodically and recorded. A ventilation plan containing the pertinent details of the ventilation system shall be prepared, brought up to date periodically and held available at the workplace.

Q12. Is an up-to-date ventilation plan indicating the mine ventilation system available at the workplace?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.3. The ventilation parameters shall be measured periodically and recorded. A ventilation plan containing the pertinent details of the ventilation system shall be prepared, brought up to date periodically and held available at the workplace.

Q13. Is the air velocity of the ventilation adequate?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.3. The ventilation parameters shall be measured periodically and recorded. A ventilation plan containing the pertinent details of the ventilation system shall be prepared, brought up to date periodically and held available at the workplace.

Q14. Does oxygen constitute more than 19% of the mine atmosphere?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.5. It shall not be worked at places where the air contains less than 19 per cent of oxygen, more than 2 per cent of methane, more than 0.5 per cent of carbon dioxide, more than 50 ppm (0.005 per cent) of carbon monoxide and other hazardous gases, except preventive measurements and rescue efforts in order to eliminate the immediate threat by taking the necessary safety measures. The maximum permissible hydrogen sulphide ratio in air is 20 ppm (0.002 per cent) for eight-hour exposure.

Q15. Does methane constitute less than 2% of the mine atmosphere?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.5. It shall not be worked at places where the air contains less than 19 per cent of oxygen, more than 2 per cent of methane, more than 0.5 per cent of carbon dioxide, more than 50 ppm (0.005 per cent) of carbon monoxide and other hazardous gases, except preventive measurements and rescue efforts in order to eliminate the immediate threat by taking the necessary safety measures. The maximum permissible hydrogen sulphide ratio in air is 20 ppm (0.002 per cent) for eight-hour exposure.

Q16. Does carbon dioxide constitute less than 0.5% of the mine atmosphere?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.5. It shall not be worked at places where the air contains less than 19 per cent of oxygen, more than 2 per cent of methane, more than 0.5 per cent of carbon dioxide, more than 50 ppm (0.005 per cent) of carbon monoxide and other hazardous gases, except preventive measurements and rescue efforts in order to eliminate the immediate threat by taking the necessary safety measures. The maximum permissible hydrogen sulphide ratio in air is 20 ppm (0.002 per cent) for eight-hour exposure.

Q17. Is carbon monoxide in the mine atmosphere less than 50 ppm (0.005%)?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.5. It shall not be worked at places where the air contains less than 19 per cent of oxygen, more than 2 per cent of methane, more than 0.5 per cent of carbon dioxide, more than 50 ppm (0.005 per cent) of carbon monoxide and other hazardous gases, except preventive measurements and rescue efforts in order to eliminate the immediate threat by taking the necessary safety measures. The maximum permissible hydrogen sulphide ratio in air is 20 ppm (0.002 per cent) for eight-hour exposure.

Q18. Is there a ventilation directive?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.11. A list of instructions which will include the following details shall be prepared in compliance with the provisions of the related pieces of legislation and posted in places easily visible to all workers in mines. The instructions shall include the following points;

- a) Information regarding if natural or forced ventilation system is used,
- b) Information regarding ventilation plan,
- c) Conditions which may affect ventilation,
- ç) Sections where there is no ventilation provided,
- d) Who, how often and where air measurements shall be conducted,
- e) Gas measurements to be carried out,
- f) Precautions to be taken following the measurements.

Q19. Is the ventilation directive posted where it is visible to workers?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.11. A list of instructions which will include the following details shall be prepared in compliance with the provisions of the related pieces of legislation and posted in places easily visible to all workers in mines. The instructions shall include the following points;

- a) Information regarding if natural or forced ventilation system is used,
- b) Information regarding ventilation plan,
- c) Conditions which may affect ventilation,
- ç) Sections where there is no ventilation provided,
- d) Who, how often and where air measurements shall be conducted,
- e) Gas measurements to be carried out,
- f) Precautions to be taken following the measurements.

Q20. Has it been identified by whom, how often and where air measurements are to be performed?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.11. A list of instructions which will include the following details shall be prepared in compliance with the provisions of the related pieces of legislation and posted in places easily visible to all workers in mines. The instructions shall include the following points;

- a) Information regarding if natural or forced ventilation system is used,
- b) Information regarding ventilation plan,
- c) Conditions which may affect ventilation,
- ç) Sections where there is no ventilation provided,
- d) Who, how often and where air measurements shall be conducted,
- e) Gas measurements to be carried out,
- f) Precautions to be taken following the measurements.

Q21. Has it been identified which gas measurements are to be performed?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.11. A list of instructions which will include the following details shall be prepared in compliance with the provisions of the related pieces of legislation and posted in places easily visible to all workers in mines. The instructions shall include the following points;

- a) Information regarding if natural or forced ventilation system is used,
- b) Information regarding ventilation plan,
- c) Conditions which may affect ventilation,

- ç) Sections where there is no ventilation provided,
- d) Who, how often and where air measurements shall be conducted,
- e) Gas measurements to be carried out,
- f) Precautions to be taken following the measurements.

Q22. Are the main fan and auxiliary fans connected to two separate energy sources that are independent from each other?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.8. Main ventilators and fans shall be connected to two separate sources of power. In the event that one of these power sources. In the event that one of these sources of power fails, the other source of power supply shall be promptly put into operation to ensure that the mine ventilation continues to operate without any disruption.

Q23. Is temperature measured regularly?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.9. Temperature and humidity levels shall be measured regularly in various parts of the mine. Precautions shall be taken to prevent temperature from rising to a level which may be unhealthy, due regard being paid to humidity levels. If the temperature approaches to a degree closer to that level, measurements shall be repeated every day at certain intervals as required. Measurement results shall be noted down in the ventilation logbook. In the event that such conditions constitute hazard to the health of workers, operations shall be stopped temporarily.

Q24. Is the humidity measured regularly?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.9. Temperature and humidity levels shall be measured regularly in various parts of the mine. Precautions shall be taken to prevent temperature from rising to a level which may be unhealthy, due regard being paid to humidity levels. If the temperature approaches to a degree closer to that level, measurements shall be repeated every day at certain intervals as required. Measurement results shall be noted down in the ventilation logbook. In the event that such conditions constitute hazard to the health of workers, operations shall be stopped temporarily.

Q25. Is accumulated dust in and around intake shafts cleaned periodically?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.10. Precautions shall be taken at the surface to prevent coal dust from entering the downcast shaft. The shafts and their approaches shall be cleared of any dust accumulation periodically. No plant for screening or sorting shall be situated within 80 meters of a downcast shaft outside the pit unless precautions required to prevent dust from mixing with air are taken.

Q26. Are necessary measures in place for abandoned workings/areas?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8.6. Abandoned or insufficiently ventilated roadways and workings shall be blocked up to make them inaccessible to the workers and warning signs shall be placed on them. Pillar or gastight stopping barriers shall be erected to isolate mined-out and abandoned areas from working sections and airways. In cases where this is not practicable, intoxicated air originating from such places shall be conducted to the surface by giving direction to the airway with the shortest route possible. These sections shall be supervised by authorized persons at each shift.

SUPPORT MODULE

Q1. Is support adequate?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

7. Support

7.1. All underground workings shall be properly and sufficiently supported in order to prevent falling and slipping of materials such as rock, soil, coal and ore etc. Roofs, sides and the supports shall be tested and examined on a regular basis. Precautions shall be taken to ensure safe installation of supports in every working place in the mine, their repair, replacement or strengthening whenever necessary.

Q2. Are hanging walls, sidewalls and support inspected regularly?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

7. Support

7.1. All underground workings shall be properly and sufficiently supported in order to prevent falling and slipping of materials such as rock, soil, coal and ore etc. Roofs, sides and the supports shall be tested and examined on a regular basis. Precautions shall be taken to ensure safe installation of supports in every working place in the mine, their repair, replacement or strengthening whenever necessary.

Q3. Is support installed in accordance with plans and written instructions?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

7. Support

7.2. Supports shall be installed in accordance with plans and written instructions.
These instructions shall be entered in the register which is kept by responsible persons.

Q4. Are galleries checked regularly in terms of reliability and durability of the ground?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

7. Support

7.3. Galleries shall be inspected regularly for ground stability and solidity and support maintained regularly.

Q5. Are adequate safety measures taken during repair, change, moving forth and removal of support?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

7. Support

7.4. When repairing, changing, withdrawing or removing supports, safety precautions shall be taken as is necessary.

Q6. Are empty areas forming behind face, ceiling or sidewalls filled in?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

7. Support

7.5. Cavities in the roof and sides shall be filled up and tamped down. Precautions shall be taken for roadways which are not planned to be used any more.

7.6. If there is firedamp content in the air of the mine or in mines subject to spontaneous combustion, cavities in roofs, sides and long walls shall be filled up as tightly as possible and other health and safety precautions shall be taken.

Q7. Is there a support directive?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

7. Support

7.7. It is obligatory in all open spaces of underground mines to support the roofs which are not strong enough to carry its own weight. A list of instructions which include the following details and take into account the provisions of the related pieces of legislation shall be prepared and posted in places easily visible to all workers in mines where it is obligatory to use supports. These instructions shall include:

- a) Identification of the personnel responsible for the support in all parts of the mine which need to be supported (face, roof etc.),
- b) Taking precautions to ensure environmental safety during the installation of the support,
- c) Making sure that support material of appropriate quality, amount and size is available in every face line where work is in progress,
- ç) Precautions required to be taken to ensure that the features of the working section, its geological and tectonic structure, physical and chemical properties and strata are taken into account when support is being installed,

- d) Precautions required to be taken when supports are installed in mines to spontaneous combustion and those which include firedamp in its air,
- e) Precautions related to spacing between the face entry and heads and ends to ensure safe working conditions,
- f) Recovery of roof support,
- g) Taking down the hanging wall strata.

EXPLOSIVES MODULES

Q1. Are the explosives used appropriate for the mine?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

10. Gassy mines

10.16. Only explosives and initiating devices specifically for gassy mines shall be used.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

11. Mines containing flammable dusts

11.2. Precautions shall be taken to prevent dust explosion in mines where flammable dust is present and only explosives and ignition appliances which are fit for such mines shall be used.

Q2. Is adequate care taken when transporting explosives?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

1. Organization and surveillance

1.6. Written instructions shall be prepared in every workplace, setting out the rules for safeguarding health and safety of workers, handling and storing explosives, and safely

using work equipment. Such instructions shall also include information regarding the use of emergency equipment and how to behave in case of an emergency at or near the workplace.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

6. Explosives and detonating devices

6.4. Explosives shall be conveyed in special boxes and no other material shall be stored in these boxes. Detonators and other explosives shall neither be stored nor conveyed in the same cases.

Q3. Is adequate care taken when storing explosives?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

1. Organization and surveillance

1.6. Written instructions shall be prepared in every workplace, setting out the rules for safeguarding health and safety of workers, handling and storing explosives, and safely using work equipment. Such instructions shall also include information regarding the use of emergency equipment and how to behave in case of an emergency at or near the workplace.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

6. Explosives and detonating devices

6.3. Underground explosive storage facilities shall be placed in such a way not to damage the areas where workers are operating, roadways and main ventilation way in case of an explosion, far enough not to pose any hazard to workers, cause any fissures and falls, leak water, damage operations in upper or lower floors and be exposed to damage from operations. Health and safety precautions shall be taken in order to prevent any fire and explosion when working close to explosive storage facilities and

no ignition source shall be used. Entrance to explosive storage facilities shall be through one bend of 90 degrees for storage facilities with less than 50 kilograms of explosives and two bends of 90 degrees for storage facilities with more than 50 kilograms of explosives; explosives shall be located at the end of the storage area. There shall be decelerator manholes at least 3 meters deep than these bends across explosive storage facilities against any possibility of explosion. It shall be ensured that the temperature in underground storage facilities is not below 8 and above 30 degrees. Distribution of explosives shall be done in a special manhole in the exit of the storage facilities and necessary precautions shall be taken here against discharge of static electricity.

Q4. Is there a record kept for explosives stored in explosive material storages?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

6. Explosives and detonating devices

6.6. Register of explosives and consumption of explosives shall be kept in explosive storage facilities.

Q5. Are explosives handled exclusively by authorized and competent persons?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

6. Explosives and detonating devices

6.1. Only authorized and qualified people shall store, carry and use explosives and ignition devices for this purpose. These operations shall be organized and implemented without posing any risks to workers.

6.8. Shot firer shall personally clear and connect shot firing lines and fire them. Shot firer shall be the last person to leave the blasting place. When more than five shots are to be fired simultaneously, they shall be fired electrically. Shot firing with fuses shall

not be allowed in mines where there are flammable and combustible gases as well as risk of dust burning or exploding.

Q6. Are explosives used appropriately?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

6. Explosives and detonating devices

6.7. Explosives shall be charged only after blast hole is thoroughly cleared, filling material is placed when necessary and they shall be detonated after tamping. Tamping material for cartridges up to 40 cm shall be 35 cm. For each extra cartridge, tamping material of half the cartridge length shall be added. Length of explosive shall not exceed half of the blast hole depth. The remaining space shall be filled with tamping material. Authorized people shall keep tamping material and devices close to the detonation place. Charging and tamping of blast holes shall be done by shot firer himself or by a worker experienced in shot firing under shot firer's supervision and responsibility. Cartridges shall be placed in blast holes without forcing and paying attention to avoiding deformation. Tamping shall be done by special non-conductive sticks. Fuses and detonators shall be tightened by using special detonator clip. Detonators shall be fitted in cartridges only when shot firing will be done and blast holes shall not be charged until immediately before use.

6.8. Shot firer shall personally clear and connect shot firing lines and fire them. Shot firer shall be the last person to leave the blasting place. When more than five shots are to be fired simultaneously, they shall be fired electrically. Shot firing with fuses shall not be allowed in mines where there are flammable and combustible gases as well as risk of dust burning or exploding.

6.9. Pneumatic and mechanical tools used to fill technical ammonium nitrate in blast holes shall be properly grounded in places where electrical detonators are used for shot firing. The number of blast holes to be charged shall not exceed half of detonators an electrical shot firer can fire. All shot firing lines shall be checked and circuit control shall be done with special measurement devices before shot firing.

6.10. Shot firing shall be done only after necessary environmental safety measures are taken.

6.11. No person shall be allowed to enter in blasting area at least for 5 minutes in the case of electrical detonation, for 1 hour in the case of detonation with fuses or similar devices until authorized people carry out a thorough examination and ensured that there is no hazard. In case there is a misfire or in case there is a suspicion about misfire then, no person shall enter into blast area until safety is ensured. Any remnant of explosives shall be shot fired by opening a parallel hole at least 30 cm far from unexploded blast hole if possible by the same worker who drilled the first hole under supervision of an authorized person. No unauthorized person shall be allowed in working area during drilling, charging, shot firing and removing waste. Waste shall be manually removed and searched against the risk of presence of any unexploded cartridge and detonator, if there is none, the car filled with waste shall not be connected to the rest. Such cars shall be marked with a warning, taken out of the mine in safety on its own, emptied carefully and any explosives to be found in shall be submitted to storage. If the shot firer fails to make unexploded remnants of explosives, he shall cease the operations in the raise, he shall inform the shot firer of the next shift and personally provides responsible people with relevant information.

Q7. Is there a directive for explosive materials?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

6. Explosives and detonating devices

6.12. Instruction list for explosives: A list of instructions including the details below shall be prepared for handling, storing and use of explosives by taking into consideration relevant articles in the legislation. Such a list shall include;

- a) Plans indicating the location of explosive storage facilities,
- b) List of shot firers and workers authorized to enter explosive storage facilities,
- c) Measures for protecting explosives against humidity, deterioration and freezing,
- ç) Usage plan for explosives,

- d) Isolation measures,
- e) Ventilation,
- f) Measures against explosion and fire,
- g) Evacuating gas and smoke in case of fire,
- ğ) Rules regarding conveying explosives and relevant issues.

Q8. Is the ban on using explosives in atmospheres which contain 1% or greater methane complied with?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

9. Prohibition of the use of explosives

9.1. Explosives shall not be used;

- a) In any place where methane is indicated by the lowered flame of the safety lamp or where a methane detector shows methane content of 1% or more,
- b) At any place where firedamp is likely to be found or places where there are new or old workings or cracks and there are no firedamp controls,
- c) To reopen the blocked coal, staple shafts and silos,
- ç) To reopen the airtight fire stopping barriers.

Q9. Is the ban on using explosives in old or new workings with empty air pockets or cracks, where firedamp checks cannot be performed, complied with?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

9. Prohibition of the use of explosives

9.1. Explosives shall not be used;

- a) In any place where methane is indicated by the lowered flame of the safety lamp or where a methane detector shows methane content of 1% or more,

- b) At any place where firedamp is likely to be found or places where there are new or old workings or cracks and there are no firedamp controls,
- c) To reopen the blocked coal, staple shafts and silos,
- ç) To reopen the airtight fire stopping barriers

Q10. Is the ban on using explosives for opening clogged coal, staple shafts and silos complied with?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

9. Prohibition of the use of explosives

9.1. Explosives shall not be used;

- a) In any place where methane is indicated by the lowered flame of the safety lamp or where a methane detector shows methane content of 1% or more,
- b) At any place where firedamp is likely to be found or places where there are new or old workings or cracks and there are no firedamp controls,
- c) To reopen the blocked coal, staple shafts and silos,
- ç) To reopen the airtight fire stopping barriers

Q11. Is the ban on using explosives for opening closed off fire stoppings complied with?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

9. Prohibition of the use of explosives

9.1. Explosives shall not be used;

- a) In any place where methane is indicated by the lowered flame of the safety lamp or where a methane detector shows methane content of 1% or more,
- b) At any place where firedamp is likely to be found or places where there are new or old workings or cracks and there are no firedamp controls,

- c) To reopen the blocked coal, staple shafts and silos,
- ç) To reopen the airtight fire stopping barriers

TRANSPORTATION MODULE

Q1. Are all transportation routes used by pedestrians and/or vehicles adequate in terms of health and safety?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

8. Means of access

8.1. Means of access and egress shall be provided in order to access the workplaces safely and leave fast and safely in case of an emergency.

8.2. All means of access including ladder ways, loading platform and ramps shall be measured, sized and built in such a way not to pose any hazards for workers and they shall be easy to use, safe, ensure proper passage and have the suitable incline for pedestrians and vehicles.

8.3. Ways used by pedestrians and/or used for material transport with vehicles shall be in dimensions appropriate for the characteristics of the work and the number of workers. Necessary equipment, tools and vehicles shall be provided for workers to access place of operations in line with the production management and technical specifications of the mine. An adequate distance of safety shall be allocated for workers on material transport ways.

8.4. Adequate distance shall be kept between roads used for vehicles and gates, galleries and ladders.

8.5. Vehicle roads and passages shall be clearly marked and properly illuminated in order to protect workers.

8.6. If there are motor vehicles and vehicle traffic in working area, proper traffic arrangements shall be applied.

8.7. It shall be ensured that there are no obstacles and material remnants which will complicate access and egress on all transport ways including workers ways and transport roads.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

3. Underground working areas and routes

3.1. Places where underground operations are carried out shall be designed, operated, equipped and maintained in such a way to cause minimum risks for workers and to ensure adequate space for them.

3.2. Routes shall be marked in order for workers to find the way easily.

3.3. If transport is done manually or with a mechanical tool, walking ways shall be at least 180 cm high from the gallery base and there shall be at least a distance of 60 cm between the vehicle and one side wall of the gallery.

3.4. If it is impossible to have walkways and access-egress or operation of workers is allowed during transport, there shall be manholes big enough for at least two people inside walls of the routes with proper distances in between. These manholes shall be kept clean and easily visible. This article shall not apply to roads where transport is done through bands.

3.5. Areas where cars are hooked or unhooked as well as loading and unloading stations shall be sufficiently illuminated and gallery sections shall not cause hazard for operations.

3.6. Necessary health and safety precautions shall be taken in transport roads in order to prevent derailing of main and tail as well as similar vehicles used for material transport in shafts, in particular the rolling stock with an aim to ensure protection of workers.

3.7. Proper signaling systems shall be established in underground facilities.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

4. Transport

4.1. Transport facilities shall be installed, operated and maintained in such a way as to ensure the safety and health of drivers, users and other persons in the vicinity. Slope shall not exceed 18 degrees at inclined galleries where human transportation is done.

In the inclined main roads where this condition is not achieved, mechanical means provided with suitable braking system, and protectors.

4.2. Mechanical facilities used for the transport of persons shall be properly installed and used in accordance with written instructions.

4.3. It is forbidden to transport materials while man-winding is in progress in shafts with one winding installations. In shafts with two winding installations, one compartment may be used for material winding while the second one may be used for man-winding.

4.4. Electric locomotives shall not be kept in use on haulage roads where the coal dust content is sufficient to cause explosion or firedamp content in the general body of the air exceeds 0.3 per cent or in sulfur mines where sulfur dust is available.

4.5. It is forbidden to use gasoline powered locomotives or other gasoline powered vehicles in coal and sulfur mines. Appropriate systems shall be used in order to eliminate the hazard connected with exhaust gases emitted by diesel locomotives.

4.6. Workers shall not be provided with means of access and egress to the path which is used for haulage with cranes and main and tail while haulage with double drum reversible haulage system and cranes is in progress. Only when the haulage with double drum reversible haulage system and cranes are stopped and when the signaller approves can workers use cranes and main and tail. Relevant safety precautions shall be taken in advance in such cases.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

8. Ventilation

8.4. The air velocity shall not exceed 8 m per second in shafts, stone drifts, main airways and inclined and level roadways which are used for the transport of materials and people.

Q2. Is adequate safety distance for pedestrians provided in material transport routes?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

8. Means of Access

8.3. Ways used by pedestrians and/or used for material transport with vehicles shall be in dimensions appropriate for the characteristics of the work and the number of workers. Necessary equipment, tools and vehicles shall be provided for workers to access place of operations in line with the production management and technical specifications of the mine. An adequate distance of safety shall be allocated for workers on material transport ways.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

3. Underground working areas and routes

3.4. If it is impossible to have walkways and access-egress or operation of workers is allowed during transport, there shall be manholes big enough for at least two people inside walls of the routes with proper distances in between. These manholes shall be kept clean and easily visible. This article shall not apply to roads where transport is done through bands.

Q3. Is there an appropriate signaling system in place on the routes?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

3. Underground working areas and routes

3.7. Proper signaling systems shall be established in underground facilities.

Q4. Is transportation of persons done in accordance with written instructions?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

4. Transport

4.2. Mechanical facilities used for the transport of persons shall be properly installed and used in accordance with written instructions.

Q5. Is there a directive for transportation?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

4. Transport

4.7. A list of instructions shall be drawn up taking into account of the provisions of the related legislation and including the following details which elaborate on mechanical haulage system, the way this system functions, special signposting rules, management and stoppage of trolleys, rules to be followed by couplers who are allowed to get on trolleys, principles to be followed in case of derailment and rollover and warning signs to be displayed. The instruction list and warning signs defined by the relevant legislation shall be displayed at appropriate locations and all the mine workers shall be trained. They shall be displayed in locations clearly visible to workers. This list of instructions shall include:

- a) Safety precautions to be taken during man-winding,
- b) Rules to be followed in places where haulage is provided, persons assigned,
- c) Routes to be used while haulage with manual or mechanical vehicles is in progress,
- ç) Persons to be assigned in case of repair and maintenance,
- d) Arrangement of the movements of haulage vehicles in obligatory cases, tools and equipment needed to attach, detach and stop hooks,
- e) Issues related to deciding on the suitable path with suitable cross sections, size and inclines,

- f) Velocity,
- g) Safety precautions applicable to workers' access and egress while haulage with cranes is in progress,
- ğ) Number of workers to be carried in each cage or each level of cages and safety precautions regarding cages and ropes.

Q6. Are vehicles used to transport persons?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

9. Transport

9.1. Workers shall be transported only with vehicles designed for human transport except for specific situations such as rescue purposes. Necessary speed limits shall be identified for these vehicles and obeyed. These vehicles shall be equipped properly in terms of health and safety.

Q7. Are speed limits observed for vehicles transporting persons?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

9. Transport

9.1. Workers shall be transported only with vehicles designed for human transport except for specific situations such as rescue purposes. Necessary speed limits shall be identified for these vehicles and obeyed. These vehicles shall be equipped properly in terms of health and safety.

ELECTRICITY MODULE

Q1. Is there a plan indicating the electrical grid, fixed devices on the grid and the location of facilities?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

2. Mechanical and electrical equipment and plant

2.1. General

2.1.2. A scaled, detailed and up-to-date map showing the power network and the location of all the stationary equipment and installations within the electrical network must be available at the workplace. Notices shall be prepared and kept posted where appropriate, prohibiting any unauthorized person from handling and interfering with the electrical equipment, containing directions as to the procedure in case of fire and containing instructions on how to communicate with the person appointed to cut off the electric power as well as other relevant information.

Q2. Are measures taken to protect underground facilities and devices against overvoltage?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

2. Mechanical and electrical equipment and plant

2.2. Overload protection

2.2.1. Surge arrestors etc. must be placed at the surface, where necessary, to protect the underground machinery and equipment against excessive voltages.

2.2.2. Protection apparatus (switchgear) must be used against the event that, in any system and circuit, the current exceeds the nominal value.

2.2.3. Switchgear must be so selected that they are able to safely and rapidly cut off the power of the circuits to which they are linked. Switchgear must be designed so that

it cannot be closed accidentally when they automatically cut off the power and protected against external impact.

Q3. Are the electrical installations equipped with adequate measurement, check, indicator, warning and control devices?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

2. Mechanical and electrical equipment and plant

2.1.3. Electrical installations must be equipped with appropriate measuring, control, monitor, warning and command apparatuses.

Q4. Are electric cables in good condition?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

2. Mechanical and electrical equipment and plant

2.4. Cables which are identified during tests and controls as damaged or broken to the point of causing hazards shall immediately be repaired or replaced with those in good condition. Damaged or broken cables cannot be reused unless fully repaired and controlled.

Q5. Is grounding done reliably?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

2. Mechanical and electrical equipment and plant

2.1. General

2.1.7. If the operating voltage is above 42 volts, electrical equipment and metal components prone to electrical leakages must be secured through earthing. Earthing conductors within the mine system and other connected systems must be electrically continuous throughout; safe bridging must be provided for cable junction boxes or enclosures. Earthing resistance must be prevented from increasing at joints due to paint, oxidation and corrosion.

2.1.8. Where any point of an underground system is earthed, it must be connected to an earthing system at the surface of the mine, unless laws or regulations regarding the electrical systems permit another equivalent earthing system.

Q6. Are measures taken against static charges?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

6. Explosives and detonating devices

6.3. Underground explosive storage facilities shall be placed in such a way not to damage the areas where workers are operating, roadways and main ventilation way in case of an explosion, far enough not to pose any hazard to workers, cause any fissures and falls, leak water, damage operations in upper or lower floors and be exposed to damage from operations. Health and safety precautions shall be taken in order to prevent any fire and explosion when working close to explosive storage facilities and no ignition source shall be used. Entrance to explosive storage facilities shall be through one bend of 90 degrees for storage facilities with less than 50 kilograms of explosives and two bends of 90 degrees for storage facilities with more than 50 kilograms of explosives; explosives shall be located at the end of the storage area. There shall be decelerator manholes at least 3 meters deep than these bends across explosive storage facilities against any possibility of explosion. It shall be ensured that the temperature in underground storage facilities is not below 8 and above 30 degrees. Distribution of explosives shall be done in a special manhole in the exit of the storage facilities and necessary precautions shall be taken here against discharge of static electricity.

6.5. Keys of detonators, magnetos and boxes shall be kept upon them. Necessary precautions shall be taken in order to discharge shot firer's body of static electricity. The amount of explosives to be carried by one person shall not exceed 10 kilograms.

WORK EQUIPMENT MODULE

Q1. Are work equipment used suitable for use in an underground coal mine?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

2. Mechanical and electrical equipment and plant

2.1. General

2.1.1. Selection, installation, placement, commissioning, operation and maintenance of mechanical and electrical equipment must take place with due regard for the safety and health of workers, taking into consideration the provisions of this Regulation and of Regulations on Machine Safety (2006/42/EC), published in the Official Journal dated 3/3/2009 and numbered 27158 and on Health and Safety Conditions in Use of Work Equipment, published in the Official Journal dated 25/4/2013 and numbered 28628. If located in an area within which risk of fire or explosion from ignition of gas, vapor or volatile liquid exists, equipment must be suitable for use in that area. Equipment must, if necessary, be fitted with suitable protective devices and fail-safe systems with harmonized national standards.

2.1.6. Equipment and systems to be used underground coal mines and components used on surface facilities which could create possible hazards due to firedamp and/or flammable dusts present in such mines must be compliant with Group I Equipment category stipulated in the Regulation on Equipment and Protective Systems Used in Possible Explosive Atmospheres published on the 4th duplicate Official Journal dated 30/12/2006 and numbered 26392 (94/9/EC).

Q2. Are the checks, maintenance, repair and tests of work equipment carried out by authorized persons?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

3. Maintenance and repair

3.1. A suitable scheme must be set up providing for the systematic examination, maintenance and, where appropriate, testing of mechanical and electrical equipment and plant. All maintenance, examination and testing of any part of the plant and equipment must be carried out by a competent person. The equipment and plant must be examined before use following maintenance and repair work. Records of examinations and tests must be made and kept in an appropriate manner.

Q3. Are records kept for the control and maintenance of work equipment?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

3. Maintenance and repair

3.1. A suitable scheme must be set up providing for the systematic examination, maintenance and, where appropriate, testing of mechanical and electrical equipment and plant. All maintenance, examination and testing of any part of the plant and equipment must be carried out by a competent person. The equipment and plant must be examined before use following maintenance and repair work. Records of examinations and tests must be made and kept in an appropriate manner.

Q4. Are protective parts of safety equipment and machinery kept readily available for use and functioning?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

3. Maintenance and repair

3.2. Safety equipment and protective devices of the machinery must always be kept ready to use and functioning and periodically examined. Maintenance of such equipment must be carried out considering the operation in question.

Q5. Are measures taken against electrical leakage in work equipment?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

2. Mechanical and electrical equipment and plant

2.1. General

2.1.7. If the operating voltage is above 42 volts, electrical equipment and metal components prone to electrical leakages must be secured through earthing. Earthing conductors within the mine system and other connected systems must be electrically continuous throughout; safe bridging must be provided for cable junction boxes or enclosures. Earthing resistance must be prevented from increasing at joints due to paint, oxidation and corrosion.

Q6. Are all mobile equipment in the mine equipped with signage to ensure visibility and distinguish direction of their movement?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

9. Transport

9.2. All mobile equipment in the mine with necessary shall be fitted with signal lamps in order to ensure visibility and direction of mobility. Locomotives shall be equipped with white or yellow lamps in the front and an easily visible red signal lamp on the last car in the back.

Q7. Are there written instructions on how to use the work equipment?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

1. Organization and surveillance

1.6. Written instructions shall be prepared in every workplace, setting out the rules for safeguarding health and safety of workers, handling and storing explosives, and safely using work equipment. Such instructions shall also include information regarding the use of emergency equipment and how to behave in case of an emergency at or near the workplace.

NOISE/VIBRATION/TEMPERATURE MODULE

Q1. Do workers who are exposed to noise undergo hearing tests?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

18. Noise, vibration and dust

18.1. Articles in Regulation on Protection of Workers Against Risks Related to Noise published on Official Gazette no 28721 dated 28/7/2013, in Regulation on Protection of Workers Against Risks Related to Vibration published on Official Gazette no 28743 dated 22/8/2013 as well as in relevant legislation on fight against dust published by the Ministry shall apply in order to protect workers against harmful effects of noise, vibration and dust.

REGULATION ON THE PROTECTION OF WORKERS FROM THE RISKS
REGARDING NOISE

Health Surveillance

ARTICLE 13 - (1) In order to make an early diagnosis in case there is any kind of hearing loss due to noise, and to preserve the hearing function.

b) For the workers who are exposed to noise that exceeds the upper exposure action values specified in article 5, hearing tests shall be carried out under the responsibility of employer.

c) Audiometric testing shall also be available for workers whose exposure exceeds the lower exposure action values, where the assessment and measurement provided for in Article 5 indicate a risk to health.

REGULATION ON THE PROTECTION OF WORKERS FROM THE RISKS REGARDING NOISE

Exposure action values and exposure limit values

ARTICLE 5 - (1) Exposure action values and exposure limit values shall be given below in terms of implementation of this Regulation:

a) Lower exposure action values: (LEX, 8h) = 80 dB(A) or (Ppeak) = 112 Pa [135 dB(C) re. 20 µPa] (calculated as 135 dB (C), when 20 µPa taken as a reference value).

b) Upper exposure action values: (LEX, 8h) = 85 dB(A) or (Ppeak) = 140 Pa [137 dB(C) re. 20 µPa].

c) Exposure limit values (LEX, 8h) = 87 dB(A) or (Ppeak) = 200 Pa [140 dB(C) re. 20 µPa].

Q2. Has the level of mechanical vibration to which workers are exposed been identified?

Legal Provision

REGULATION ON THE PROTECTION OF WORKERS FROM THE RISKS REGARDING VIBRATION

Determination of Exposure

ARTICLE 6 - (1) Employer shall consider the mechanical vibration value that is exposed by the workers while they carry out the risk assessment, if necessary, determine the exposure to the mechanical vibration by making measurements. These measurements shall be performed according to Regulation on Laboratories That Make Occupational Hygiene, Test and Analysis which was published in 20/08/2013 dated and 28741 numbered Official Gazette.

Q3. Is attention paid to exposure limit values of workers for hand-arm vibration?

Legal Provision

REGULATION ON THE PROTECTION OF WORKERS FROM THE RISKS
REGARDING VIBRATION

Exposure Limit Values and Exposure Action Values

ARTICLE 5 - (1) Exposure limit values and exposure action values shall be given below in order to implement this Regulation:

a) For hand-arm vibration;

1) Daily exposure limit value for an eight hour working time: 5 m/s².

2) Daily exposure action value for an eight hour working time: 2,5 m/s².

Q4. Is attention paid to exposure limit values of workers for whole body vibration?

Legal Provision

REGULATION ON THE PROTECTION OF WORKERS FROM THE RISKS
REGARDING VIBRATION

Exposure Limit Values and Exposure Action Values

ARTICLE 5 - (1) Exposure limit values and exposure action values shall be given below in order to implement this Regulation:

b) For whole body vibration;

1) Daily exposure limit value for an eight hour working time: 1,15 m/s².

2) Daily exposure action value for an eight hour working time: 0,5 m/s².

Q5. Are measures taken to prevent temperature from affecting workers' health?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

8. Ventilation

8.9. Temperature and humidity levels shall be measured regularly in various parts of the mine. Precautions shall be taken to prevent temperature from rising to a level which may be unhealthy, due regard being paid to humidity levels. If the temperature approaches to a degree closer to that level, measurements shall be repeated every day

at certain intervals as required. Measurement results shall be noted down in the ventilation logbook. In the event that such conditions constitute hazard to the health of workers, operations shall be stopped temporarily.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

22.7. Ambient temperature

22.7.2. The temperature in resting facilities, changing rooms, showers and toilets, cafeterias, canteens and first aid rooms shall be suitable for intended use.

ERGONOMICS MODULE

Q1. Is attention paid to suitability of workers to their jobs in terms of health and safety?

Q2. Are workers prevented from working constantly in the same position?

Q3. Are workers prevented from doing repetitive movements?

Legal Provision for These Three Questions

OCCUPATIONAL HEALTH AND SAFETY LAW

General responsibility of the employer

ARTICLE 4 – (1) The employer shall have a duty to ensure the safety and health of workers in every aspect related to the work. In this respect, the employer shall;

ç) take into consideration the worker's capabilities as regards health and safety where he entrusts tasks to a worker.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 1

1. Organization and surveillance

1.1. Organization of workplaces

1.1.2. Workstations must be designed and constructed according to ergonomic principles taking into account the need for workers to be able to follow operations taking place at their workstations.

LIGHTING MODULE

Q1. Are workers provided with personal lamps?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

17. Natural and artificial lighting

17.4. There shall be back-up illumination system to offer sufficient and immediate light in places where a break out in lighting system might pose a risk for workers. In cases when this is not possible, workers shall be equipped with personal lights.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 3

15. Lighting

15.1. Workers shall be provided with a suitable personal lamp.

Q2. Is there an artificial lighting installation?

Legal Provision

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING
WORKPLACES

ANNEX- 1

17. Natural and artificial lighting

17.1. Every workplace shall be illuminated sufficiently for health and safety of the workers.

17.2. Natural daylight shall be allowed in the workplace as much as possible in order to protect health and safety of workers and workplaces shall be equipped with artificial lighting by taking into consideration weather conditions.

17.3. Illumination equipment in the workplace and passageways shall not pose any risks to workers and be placed properly.

17.5. Lighting system shall ensure continuous illumination in places where operations are checked and commanded, in escape routes, loading areas and hazardous places. In

workplaces where work is not continuous, this system shall be in operation as long as there is work.

REGULATION FOR OCCUPATIONAL HEALTH AND SAFETY AT MINING WORKPLACES

ANNEX- 3

15. Lighting

15.2. Workstations shall be equipped with artificial lighting adequate for the protection of workers' safety and health. Lighting installations shall be placed in such a way that there is no risk of accident to workers as a result of the type of lighting fitting.

APPENDIX B

AN EXAMPLE OF RISK ASSESSMENT TOOL REPORT

RISK ASSESSMENT REPORT

29.02.2016
21:19:52

"Risk Assessment Tool for Underground Coal Mines" is used to carry out occupational health and safety risk assessment in our coal mine workplace.

GENERAL INFORMATION

Title Of Workplace XYZ Company
Address Of Workplace 107 Main Street, Maddison 54784

Employer Fatih Buyukkara
Risk Assessment Commencement Date 01.09.2015
Risk Assessment Completion Date 06.10.2015
Risk Assessment Expiry Date 06.10.2017
Risk Assessment Revision Date (if ay)

RISK ASSESSMENT TEAM

Title	Name Surname
Employer	Fatih Buyukkara
Employer Representative (if any)	
Occupational Safety Specialist	Charles Champell Certificate No 110051
Occupational Physicians	Eleanor Nelson Certificate No 3214
Support Personnel	David Morrison
Worker Representative(s)	Nancy Frank

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Figure B.1 A Slice of Report

<i>Module</i>	<i># of Q</i>	<i>Question</i>	<i>Answer</i>	<i>Problem</i>	<i>Risk Level</i>	<i>Control Measure</i>	<i>Responsible Person</i>	<i>Due Date</i>
Support	7	Is there a support directive?	No	There is no support directive.	20	A support instruction list will be prepared and it will include: -Identification of the personnel responsible for the support in all parts of the mine which need to be supported (face, roof etc.), -Taking precautions to ensure environmental safety during the installation of the support, -Making sure that support material of appropriate quality, amount and size is available in every face line where work is in progress.	Adam Johns	02.02.2016
Electricity	1	Is there a plan indicating the electrical grid, fixed devices on the grid and the location of facilities?	No	There is no electrical grid plan.	6	A plan will be prepared indicating the electrical grid.	Tom Jackson	26.10.2015

Figure B.1 A Slice of Report (Continued)

<u>Module</u>	<u># of Q</u>	<u>Question</u>	<u>Answer</u>	<u>Problem</u>	<u>Risk Level</u>	<u>Control Measure</u>	<u>Responsible Person</u>	<u>Due Date</u>
Ergonomics	1	Is attention paid to suitability of workers to their jobs in terms of health and safety?	No	Some of the workers' jobs are not suitable for them.	12	Workers will settle to the suitable jobs in terms of health and safety.	Jack Harrison	28.11.2015
Ventilation	4	Does the ventilation system in place have the capacity to reverse the direction of the air flow?	No	Ventilation system does not have the capacity to reverse the direction of the air flow.	5	Ventilation system will have the capacity to reverse the direction of the air flow.	Tom Harrison	18.02.2016

Page 3 of 4

Figure B.1 A Slice of Report (Continued)

SIGNATURE OF RISK ASSESSMENT TEAM

Title	Name Surname	Signature
Employer	Fatih Buyukkara	
Employer Representative (if any)		
Occupational Safety Specialis	Charles Champell	
Occupational Physician	Eleanor Nelson	
Support Personne	David Morrison	
Worker Representative(s)	Nancy Frank	

Figure B.1 A Slice of Report (Continued)