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RISK MANAGEMENT IN HAZARDOUS MATERIALS TRANSPORT

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***Abstract**: The paper gives the basic principles of risk management, with emphasis on the transport of hazardous materials by means of road traffic, which often and in large quantities appear on the roads. In doing so, the risk is reckoned as the probability of accident emerging with a prospect of harmful consequences regarding life, health, property and the environment.*

Key words: *Transport, Hazardous materials, Risk, Accidents, Management, Consequences, Prevention measures, Preparedness and Rehabilitation.*

INTRODUCTION

Of the total amount of freight transport, about 20% make up freights which can be classified in the category of dangerous substances. Transport of hazardous substances is the high risk process that carries a range of potential threats to people, property and the environment. Risks are particularly pronounced in the case of incidents (accidents-emergency events) during transport. Transport is based on a series of complex and inter-dependent technical, technological and organizational components.

In Europe and worldwide, more and more cargo that is being transported belongs to the category of hazardous materials. According to statistical data on the transport of hazardous substances, flammable liquid substances make up about 80% of the total transport volume of hazardous substances. About 63% of hazardous substances are transported by road transport, about 14% by maritime transport, about 12% by river, about 10% by railway, and about 1% of hazardous substances is being transported by air.

In the last decades of the last century, as a result of accelerated development of industry and the chemical sector, in addition to many positive effects, there were negative consequences on the environment with great human and material sacrifice. Negative consequences have occurred mainly in the incidents with hazardous substances such as: explosive materials, petroleum and petroleum derivatives, chlorine, ammonia, pesticides, acids, artificial fertilizers and the like.

Absolutely safe transportation of hazardous substances, in order to minimize the risk of accidents, imposes on the shipper a large number of constraints and conditional procedures. The shipper must adapt to conditions imposed by such transportation in order to protect and preserve health, life, environment and material goods. All persons who participate in the transport process as well as other persons who can be found in the area of potential effects of hazardous substances during their transporting are exposed to possible adverse consequences.

In order to avoid risks and associated consequences, it is necessary to manage the risks which cannot be entirely eliminated. The process of transport of hazardous substances involve loading, transport and unloading, accompanied by the risks related to the sources of danger to the health and lives of workers (professional risks), the risk of traffic incidents and the risk of chemical incidents, fires and explosions.

The paper points out the fundamental principles of risk management with regard to the transport of specific hazardous materials. Prior to transport, it is necessary to assess risks and determine the safety preventive measures, as well as measures of preparedness, response to the

accident and repair the consequences of possible incidents, from the standpoint of all the identified risks that may occur during the normal business activities or in case of accidents.

1. The importance of risk management in the transport of hazardous materials

The risk is now taken for a serious economic, public and social problem, especially the protection of persons who work in workplaces with increased risk and protection of the environment and working environment. The assessment of professional risk and the risk of incidents during the transport of hazardous substances allows the establishment of a series of preventive measures and activities for reducing the likelihood of accidents - incidents and their possible consequences. Prescribing preventive measures of protection, and response plans to repair the consequences of accidents and is a comprehensive system of risk management that encourages the elimination (avoiding) of all risks or reducing them to the minimum acceptable level.

General philosophy of risk management in the work processes and transport is based on the principles given in the standard requirements of OHSAS 18001. Compliance with the structure of ISO 9001 and ISO 14001 indicates that the certainty of success is concentrated in the integrated management systems. System of risk management is based on the famous PDCA cycle, which for each process requires effective planning, effective implementation plans, the development of verification processes and continuous improvement.

Specific requirements of the standards OHSAS 18001 and ISO 14001, which contribute to the coverage and documentation of control processes relate to:

- Strong influence of legislation through monitoring and complying with the current regulations,
- Managing the risks that the organization faces, risk analysis and risk assessment of work and impact on the environment,
- Incident emergency preparedness and response.

Transport of hazardous substances is often manifested as an international problem, that led to the making of The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), the railway transport (RID), inland waterway transport (ADn), maritime transport (IMDG Code), and air transport (ICAO TI or IATA). States Parties ratify agreements with the aim of creating safe conditions for the transport of hazardous cargo. States Parties have an obligation to adapt their national regulations to these agreements.

2. The methodology of risk management

Risk in the transport of hazardous substances is the likelihood of incidents with the potential harmful consequences to life, health, property and the environment. The significance of accidents during the transport of hazardous substances, with respect of the risk and potential consequences, impose the need for risk management.

According to the OHSAS 18001, a danger is a source, situation or act with a potential for harm in terms of human injury or ill health, property damage, harm to the working place environment or a combination of them, while a risk is a combination of the likelihood and severity of consequences of hazardous events that are happening.

Risk management is a process that allows people and organizations to deal with the uncertainty of consequences of adverse events, plan and perform activities that will protect their values and vital resources. The risk management itself implies the evaluation of the risk of incidents, planning and implementation of adequate policies and procedures, prevention, preparedness and response to the accident and rehabilitation, in order to decrease the likelihood of possible consequences, which provides adequate protection of life, health of people, material goods and environment.

It aims to create conditions under which the risk is acceptable, and acceptable risk is considered to be the risk that can be managed under certain prescribed conditions.

The risk management methodology consists of:

- risk analysis and
- risk control

3. Risk analysis

Risk analysis as the first phase of the process of risk management begins with a general plan for each process, which consists of the following phases:

1. Analysis of dangers,
2. Risk assessment,
3. Deciding on the acceptability of risk
4. Defining preventive measures.

Analysis of dangers involves determining the sources and causes of risks and hazardous events (accidents), persons and environment exposed to risks, the severity of accident, as well as the likelihood of damage to lives, health and the environment. While doing so, the adequacy and effectiveness of applied measures of protection should be taken into account. In order to provide sufficiently objective risk analysis, it is necessary to use the best sources of information and methods of their processing. Sources of information may include past records, the experience, observation of the process, talk with the workers, industrial practice, relevant literature, testing and market research, experiments and simulations, the appropriate models and opinions of experts and specialists.

Risk assessment is the characterization and determining the degree of risk for each identified risk. Characterization of risk is a synthesis of information on risk provided by the risk analysis, which refers to the needs and interests of the decision-making and vulnerable parties. The responsible for risk assessment should apply or develop adequate methods for the assessment of risk. In practice, several dozens of developed general and specific methods (AUVA, BG, KINNY, PILC ...) adapted to various technological processes are being used. There are qualitative methods, semi-quantitative methods and quantitative methods. Qualitative methods for assessing the risk are descriptive in determining the level of risk (e.g., slight, small, medium, high ...). Quantitative risk assessment uses numerical values for the evaluation of risk. One form of quantitative risk rating matrix is given in Table 1.

Deciding on the acceptability of risk or risk categorization is sorting of the acceptable, conditionally acceptable and unacceptable risk, in relation to the rated levels. For the evaluation and categorization of risk are often used risk matrices. In the matrix, the shaded categories are those of acceptable risk, which are risks that can be managed under certain conditions, while risks that fall into category which is not shaded are in the category of unacceptable risk. Unacceptable risks require the definition of corrective measures to eliminate or control risk or to provide for disaster risk reduction to an acceptable level. Risks that are not ranked are considered to be vague and require measures that will provide additional information needed to solve their lack of definition.

Likelihood / Consequences		Doubtless 5	Very probably 4	Probably 3	Unlikely 2	Almost impossible 1
Death	5	25	20	15	10	5
Serious injury	4	20	16	12	8	4
Injury	3	15	12	9	6	3
Minor injury	2	10	8	6	4	2
Delay time	1	5	4	3	2	1

Table 1 - Quantitative risk rating matrix

Defining preventive measures for a certain process is the obligation of employer - shipper in accordance with the valid national regulations. If the risk assessment, due to inadequacies of measures applied, determine the existence of unacceptable risk, the employer is required to implement the measures which reduce unacceptable risks to an acceptable level by application of modern technical achievements, avoiding danger at the source, substitution of hazardous for less hazardous dangers, using the collective and personal protection, etc.

4. Risk control

Risk control in the technological process or transport of hazardous substances include:

1. Preventive measures,
2. Measures of readiness and response to the accident,
3. Measures for dealing with the consequences of incidents (rehabilitation).

Prevention is a set of measures and actions that is taken in order to avert and reduce the likelihood of incidents and the possible aftermath.

Readiness is an attained state of preparedness of all subjects (human and material) for an adequate response to the accident with minimal consequences.

Response to the accident begins by obtaining information about the accident and it is carried out through a range of activities: assessment of the scope of the incident and its consequences; continuous monitoring and observation of endangered area; further informing and giving instructions about the process; decision-making concerning the evacuation and redeployment; coordination of help services; informing the high authorities and giving estimation of possible responses to the accident.

All this requires the development of appropriate protection plans, before the start of business activities, which include the application of all necessary measures to combat risks or reduce them to acceptable levels. For making the necessary plans, their comprehensiveness, applicability, efficiency and effectiveness, the number of norms at the international level is country as a whole. Protection plans are coordinated and interdependent.

Plan to protect the security of participants in the process of transportation includes all identified threats to persons who participate in certain activities and general and specific measures to remove the risk. Head of the task that monitors the transport and security measures in the transport of dangerous goods is responsible for the implementation of this plan.

Plan to protect the security of environment defines the measures to remove the risk of the established risk for the environment. Head of the task that monitors the transport and security measures in the transport of oil and oil products is responsible for the implementation of this plan.

Response to the accident is a process that begins by getting the information about the accident. Information should be as thorough as possible, to include data on: time and place of the incident; kind of hazardous materials at the scene of the accident; estimation of possible course of the incident and risk to the environment and people, as well as other elements important for effective response to the accident.

Response to the accident occurred in the transport of hazardous materials, in fact, includes a set of measures and procedures, which should be included and elaborated by appropriate protection plans. In addition, in the response to the accident, it must be done: assessment of the scope of incidents and consequences; establishment of permanent monitoring of the endangered area and implementation of necessary measurements; precise and thorough informing about the accident with instructions regarding further procedures; providing elements for making decisions about necessary evacuation; co-ordination of the appropriate professional services and informing relevant high authorities.

Measures and actions arise on the basis of conducted analysis and estimation of the risk of incidents and their consequences. They should, in accordance with the plan of protection in case of an accident, stop and isolate dangerous process occurred during the incidents, limit the effects, minimize the consequences and create conditions for tracking post-incident situation, reconstruction and rehabilitation of the environment.

In response to the accident, depending on its severity and scale according to the adjusted protection plans, relevant bodies and institutions that are competent and above all provided with assets and trained personnel need to participate. This primarily refers to: the service of the internal affairs, the communication, transport and utility companies, fire department and specialized technical services, health institutions, civil protection authorities and other departments of Defense (Army).

Measures to remedy the consequences of incidents (rehabilitation) aim at monitoring the post-incident situation, recovery and rehabilitation of the environment and removing the risk of re-emergence of incidents. Rehabilitation includes the plan of rehabilitation development and development of reports on the accident.

6. Conclusion

In order to secure the performance of the entire process of the transport of hazardous substances, special attention should be paid to the identification of potential hazards and risk assessment, from the standpoint of determining all sources of risk, likelihood of hazardous events and possible consequences in the course of normal business activities, transportation incidents, chemical incidents, fires, explosion and so on. Since the execution of such a task - process, starting from loading, transportation, unloading, including temporary storaging due to changes in the ways and means of transportation, and reloading, present a number of potential threats to people and the environment, the process should be managed with the existing risks .

Risk management is viewed as a process that includes assessment of the risk of incidents, planning and implementation of adequate policies and procedures. Applied measures include a set of concrete and correctly defined measures, procedures and activities of prevention, preparedness and response to the accident, as well as rehabilitation, in order to decrease the likelihood of possible consequences, which provides adequate protection of life, health of people, material goods and environment.

Risk management should set a goal of creating suppositions under which a risk is acceptable, which means that it can be run under certain prescribed conditions. Risk management is a documented process based on the principles of PDCA cycle (plan, do, control, act), which is based on risk analysis, risk assessment and implementation of preventive measures of protection.

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УПРАВЛЕНИЕ НА РИСКА ПРИ ТРАНСПОРТА НА ОПАСНИ МАТЕРИАЛИ

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Ключови думи: *транспорт, опасни материали, риск, катастрофи, управление, последствия, превантивни мерки, подготовка, възстановяване*
Анотация*: Статията разглежда основните принципи на управление на риска, наблягайки на пътното транспортиране на появяващите се често и в значителни количества опасни материали. Така, рискът се третира като възможност за възникване на катастрофа с вероятни вредни последствия за живота, здравето, собствеността и околната среда. Общите характеристики на подобни катастрофи и възможните последствия налагат нуждата от управление на риска, което в статията предполага анализ и контрол на риска.*