The Development of a Risk Management System in the Field of Industrial Safety in the Republic of Kazakhstan

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Abstract

Background: The purpose of the work is to develop a system that allows processing of information for analysis and industrial risk management, to monitor the level of industrial safety and to perform necessary measures aimed at the prevention of accidents, casualties, and development of professional diseases for effective management of industrial safety at hazardous industrial sites.

Methods: Risk assessment of accidents and incidents is based on expert evaluations. Based on the lists of criteria parameters and their possible values, provided by the experts, a unified information and analytical database is compiled, which is included in the final interrogation questionnaires. Risk assessment of industrial injuries and occupational diseases is based on statistical methods.

Results: The result of the research is the creation of Guidelines for risk management on hazardous industrial sites of the Republic of Kazakhstan. The Guidelines determine the directions and methods of complex assessment of the state of industrial safety and labor protection and they could be applied as methodological basis at the development of preventive measures for emergencies, casualties, and incidents at hazardous industrial sites.

Conclusion: Implementation of the information-analytical system of risk level assessment allows to analyze the state of risk of a possible accident at industrial sites, make valid management decisions aimed at the prevention of emergencies, and monitor the effectiveness of accident prevention measures.

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1. Introduction

Analysis of international practice in the field of industrial safety showed that the issues of hazard monitoring and risk prediction of emergencies of natural, natural—technogenic, and technogenic character have a special significance. The assessment of material and financial reserves necessary for localization and liquidation of emergency consequences depends on the reliability of hazard identification and assessment of territorial risks.

Emergencies in industrial projects have particularly dangerous consequences due to the detrimental impact not only on the staff but also, first and foremost, on the environment, due to oil spills and release of highly toxic substances on land and in water. In this way, in 2010 in the Gulf of Mexico the explosion on the Deepwater Horizon oil platform occurred as a result of oil release. The fire that lasted 36 hours happened after the powerful explosion. As a result, the platform sank, the number of casualties amounted to 11 people, and 17 were injured to varying degrees. The result was a damaged pipeline, through which oil flowed from the seabed to the platform board. In total, 4.9 million barrels of crude oil spilled into the waters of the Gulf of Mexico over 86 days. BP has made numerous and mostly unsuccessful attempts to repair the leak. Prior to development of this oil deposit, experts in the BP company evaluated the probability of an oil spill as a result of this well drilling as “low.”

The disaster that occurred August 12, 2015 at Tianjin trade port in North China was named the largest non-nuclear emergency in the history of mankind. It is difficult to imagine a worse place for a fire. Reserves of oil and coal, cyanides, and other toxic substances were kept there. A series of new explosions followed after the first one, the power of which was estimated as equivalent to 3 tons of TNT; the largest one was estimated as 21 tons of TNT. As a result of the explosions, at least 145 people were killed and more than 800...
were injured. The cause of the explosions is considered to be a
detonation of explosives in one of the containers. The explosion
destroyed the hazardous chemicals warehouse. The Chinese au-
thorities found about 700 tons of sodium cyanide in the epicenter
of the destruction zone. This chemical, used to extract precious
metals from ore, is not flammable, but it is extremely harmful for
human health; its impact on the body is comparable to the toxicity
of potassium cyanide. The emergency caused an ecological disaster
in the area.

The current international normative framework in the field of
risk assessment and management contains, as its basis, the general
principles and directions, which have an advisory character for use
in practice. The principles contained therein give an idea of the
selection and application of systematic techniques for risk assess-
ment; however, they do not present specific criteria for deter-
mining the need for risk analysis, and do not define the type of risk
analysis method necessary for special application [1–7].

The increased technological complexity of accidents, the
development and implementation of industrial and international
standards, and a steady trend of transition of activities from
emergency liquidation to their prevention and risk management
were prerequisites for the development of the risk management
information system in the field of industrial safety.

Development of measures to prevent emergencies, reduce the
risk of accidents, improve safety and working conditions require
from enterprises’ managers the ability to manage industrial safety,
to implement organizational action on the system human being—
industrial process with the aim of achieving a safe level of enterprise
functioning. In solving industrial safety management issues, a lot of
information, expressed by a number of indexes of different nature
and structure, is used. It is necessary to use a well-developed system
that allows organization and processing of information for analysis
and industrial risk management, to monitor the level of industrial
safety in order to respond rapidly to changing factors affecting the
protectiveness state of hazardous industrial sites, and fulfillment of
necessary measures aimed at the prevention of accidents, casualties,
and development of professional diseases for effective management
of industrial safety on hazardous industrial sites.

Timely planning and implementation of measures to reduce
risks and mitigate the consequences of accidents and casualties at
hazardous industrial sites is impossible without analysis of statisti-
cal data on the casualties, theoretical research of the technological
processes’ reliability, modeling of risk situations, assessing the risk
of casualties. All this is an important part of the measures aimed at
improving protection of population and territories from emergen-
cies of technogenic character.

Currently in the Republic of Kazakhstan, increasing attention is
paid to the issue of improving control of the safety level at indus-
trial sites of various branches of industry. Modern requirements of
the legislation of the Republic of Kazakhstan, harmonization with
the international system of labor safety standards, and the develop-
ment and implementation of regulatory documentation allow to
increase the level of industrial safety.

According to the Decree of the President of the Republic of
Kazakhstan from February 27, 2014 No. 757 On cardinal measures to
improve conditions for entrepreneurial activity in the Republic of
Kazakhstan, a transition to organizing inspections of industrial
enterprises based on risk assessment is necessary.

There is an active effort in the Republic of Kazakhstan in this
direction, to create a unified system of risk control in the field of
industrial safety.

For many years, our research team has carried out a retrospec-
tive analysis of statistical data in the field of industrial safety and
professional sickness rate in the Republic of Kazakhstan. The
amount of data obtained (statistical data for the last 10 years were
analyzed) allowed us to reliably reveal the number of regularities
that formed the basis of the represented methodology, which was
reflected in the articles and conference materials devoted to the
problems of accidents [8–11], industrial trauma [12–14], and pro-
fessional sickness rate [15–18].

According to the data of the Emergency Management Commit-
tee of the Republic of Kazakhstan, in 2016 in the Republic of
Kazakhstan, the share of technogenic emergencies of the total
number of emergencies was 88%. Enterprises of the mining and
metallurgical complex take the second place after the building in-
dustry in terms of the number of traumatized employees. The is-
sues of occupational safety, accident rate, and high level of
occupational trauma are especially important for mining industry
because about 35% of all registered victims of casualty in the course
of labor activity in the country worked in the coal and mining in-
dustry. In this regard, despite the need to create a universal
methodology for enterprises in various industries, research was
focused primarily on the mining industry.

This article summarizes the research carried out and presents
the main principles of the methodology for risk management at
hazardous industrial sites of the Republic of Kazakhstan. The basis
of the methodology is monitoring, allowing to assess the state of
accident rate, trauma and professional sickness rate at industrial
sites, and to make a motivated and objective conclusion about the
degree of hazard and insularity of an enterprise.

2. Method of assessment of the state of industrial sites safety

Risk assessment of accidents and incidents is based on expert
evaluations, the essence of which is an organized collection of
opinions and assumptions of experts with the subsequent pro-
cessing of their answers and compiling of results. The method of
expert evaluations is less sensitive to inaccuracies and imprecise-
ness of the input data and promotes simultaneously the ability to
consider dozens of disparate input parameters. Based on the lists of
criteria parameters and their possible values, provided by the ex-
erts, a unified information and analytical database is compiled,
which is included in the final interrogation questionnaires.

A rating system in the form of universal linguistic scale is used
for questionnaire survey and represented in Table 1. The scale al-
 lows us to unify both qualitative and quantitative initial data. The
experts use their own experience, intellect, and represented scale
spread criterial parameters according to degree of their influence
on the possibility of accident beginning.

Risk assessment of industrial injuries and occupational diseases
is based on statistical methods.

An integrated analysis and assessment of the risk of a possible
accident, injury, and labor conditions’ insularity of an industrial
enterprise is performed based on calculation results.

The main objective of the analysis and assessment of hazard
levels at the industrial site is to provide:

- objective information about the state of industrial safety and
  occupational safety;
- information about the most dangerous, “weak” spots from the
  point of view of industrial safety and labor protection;
- evidence-based recommendations for risk reduction.

A consolidated analytical report, which includes detailed infor-
mation on the state of industrial safety and labor protection, at
separate industrial subdivisions, and at the industrial enterprise as
a whole, is formed according to the results of the calculations. Each
section of the report contains tables that allow to provide clear and
detailed information for the development of risk reducing
measures.

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