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EMERGENCY RESPONSE PLAN IN HIGH-RISK INDUSTRIES

Abstract: *In order to eliminate, control and minimize causes of risk and potential effects of risk events, it is necessary to establish a management system whose goal is the planning, control and reduction of accidents. Planning is an essential aspect of disaster management, which prevents the spread of accidents and minimize its impact. The use of interactive planning in emergency situations, allowing fast, efficient, effective and reliable data exchange. In this way, better coordination and communication is achieved among teams composed to respond emergency situations. In this paper we propose a structure plan for reactions in emergency situations. The problems and failures that organizers might be confronted with are also analyzed.*

Key words: planning, emergency, risk.

INTRODUCTION

Modern civilization is facing with serious problem, which is the product of industrial society, and that is the transport and storage of hazardous materials. Given the importance of this issue, and that is with us all the present and possible failures during storage of hazardous materials, it is important to respect certain procedures. The break down of fixed facilities and vehicles are classified in those production systems, warehouses, storage tanks, pipelines, conveyor belts, primarily in the context of a production system. Two basic characteristics of disaster are that they do not know the exact location and time.

Hazardous accidents represent sudden and uncontrolled release hazardous and harmful substances in working and living environment. Fires, explosions, high pressure and sudden release of contaminants causing heavy casualties, injuries, destruction, damage to property and environmental degradation in the long time with unforeseeable consequences.

Condition when the risks and threats or the consequences of disasters, emergencies and other threats to the population, the environment and material goods such extent and intensity to their occurrence or consequences can not be prevented or eliminated by regular operation of the competent authorities and services, which is to mitigate and removal necessary to use special measures, power and resources with enhanced mode called emergency situation.

In the last few decades, there have been several fatal accidental situation on the facilities with hazardous chemical substances, which have resulted in fires, explosions and release a variety of toxic fumes, and resulted in a large number of lives lost and property, as well as the widespread damage caused to life environment. The reason for such large losses can be found in an irregular coordination and communication in emergency situations.

Also, many serious incidents worldwide have resulted in the cancellation of the control system, uncoordinated responses, human error and so on. In these situations, it is not enough to only depend on the preventative measures, it is necessary to have a well-defined response in emergency situations, which will be carried out when necessary. Emergency planning is the process of adoption and implementation of procedures to identify predictable situations using systems analysis and preparation, testing and audit plans of emergency response. The procedure of planning in complex systems, in accordance with the real impacts of hazards, including: planning under normal conditions (strategic planning) and planning in extreme conditions (operational planning). Strategic planning defines preventive activities, and implemented logistics processes (regulation, protection, maintenance, inspection, education). Operational planning defines specific actions in terms of appearance and development of emergency.

In addition, emergency planning is an integral and essential part of the strategy of prevention and security consists of taking the right steps to mitigate the effects of the resulting crash. Emergencies require crystal clear hierarchy of command and organizational and procedural guidelines without any ambiguity.

Table 1 presents the major chemical accidents in the world with data about the cause the accident, the value of lost property and statistics about the number of injured people and victims.

Table 1. Major chemical accidents in the world at facilities with hazardous chemical substances

Date	Plant Type	Event type	Location	Property loss (US \$ million)	Injuries/Fatalities
08.04.1970.	Subway	Gas explosion	Osaka, Japan	-	420/92
11.07.1978.	Traffic accident	Explosion of propylene	Los Alfaques, Spain	-	-/217
06.07.1988.	Oil Platform	Gas explosion	North see		-/166
25.06.2000.	Refinery	Vapor cloud explosion	Mina Al-Ahmadi, Kuwait	600	50/5
21.09.2001.	Petrochemistry	Explosion	Tuluz, France	610	3000/30
19.01.2004.	Gas plant	Fire/Explosion	Skikda, Algeria	580	74/27
23.03.2005.	Refinery	Fire/Explosion	Texas, USA	1500	170/15
11.12.2005.	Gasoline warehouse	Fire/Explosion	Hertfordšir, Engleska	1443	43/0
29.10.2009.	Gasoline warehouse	Fire/Explosion	Jaipur, Indija	32	150/11
25.08.2012.	Refinery	Fire/Explosion	Venezuela	1000	100/50
23.08.2013.	Refinery	Fire/Explosion	Visakhapatnam, India	-	14/37

Reasonable establishment of priorities and develop a plan of emergency becomes a significant concern throughout the world. The main focus in the management of emergency situations is on resources and logistics. In other words, at any time, to have what you need, where and when it's needed in order to be in the shortest possible time to prevent further spread of the accident.

In high-risk industries, the organizers for emergency must focus on designing better and safer equipment and training employees, reduction response time in emergency situations, increased training of rescue teams, and developing evacuation plans that are consistent with the safety regulations. Urgent and effective response to the accident scene is essential to minimize the impact of accidents, loss of life and property loss industry. When planning in emergency, it is necessary to consider many types of possible accidents in order to increase the level of prevention effective preparation, response and subsequent rapid return to normality.

OBJECTIVES OF EMERGENCY PLANNING

The main objective of planning in emergency situations is establishing systems and resources for the protection of people, material resources and the environment, and thus reduce the severity of possible accidents. The objectives of planning in emergency situations must be more comprehensive. The main objectives of the of planning are:

- Maintaining a high level of readiness;
- Urgent and effective response to prevent the spread the influence of an accident;
- Management and coordination in emergency situations until the arrival of the relevant services;
- Support the relevant services in the form of necessary information, knowledge, skills and equipment.

COMPONENTS OF EMERGENCY PLANNING

Safety procedures in high-risk industries include several levels of protection, control measures, absorption of released fluids, accumulation of fluid released by dams / dikes and protective barriers. These levels of protection are intended to preventing the spread of unintended consequences, the possible occurrence of a domino effect, which may arise due to variations in normal operation. Canceling the above security measures need to take all steps for emergency situations such as a final layer of protection. Plan of emergency consists the following major components:

- Risk assessment in the event of a partial or complete system failure;
- Develop plans for different accident situations;
- Study the availability of resources and capabilities and prioritization;
- Developing strategies in response in fires and explosions, the release of hazardous substances, rescue, evacuation;
- Development of appropriate medical infrastructure;
- Training teams for emergencies and employed;
- Developing methods for assessing the degree of risk;
- Study plans in emergency situations to adjacent buildings and the local community.

EMERGENCY ANNOUNCING LEVEL

Areas defined in the plans for emergency should be applicable to various incidents throughout the year, 24 hours a day. The level of notification is an important part of the planning in emergency situations. There are three levels of notification, and they will be applied depending on which phase accident is forge ahead. The incident commander formed respond team for emergency in a safe location.. During the first or

second phase, incident commander takes the place of the accident, collect all the necessary information. Formed accident in the first two phases can be controlled by internal teams for emergency situations, if they are adequately trained. The training of operating personnel is required for these activities, but the emergency response can be special, because of the wide spectrum of possible uncertain events and urgency. Details of notification levels are shown as follows::

- Level 1: Accident can be controlled within the department where the accident occurred;
- Level 2: It is necessary to mobilize a team to respond to emergency;
- Level 3: At this stage it is necessary to hire a professional rescue units, and the following are possible events that pose a threat to the safety and health workers:
 - Fire or explosion;
 - Leakage of toxic gases and liquid chemicals.

ELEMENTS OF EMERGENCY PLANNING

Centre for Emergency Management

Center for emergency is a nodal point of all processes in the emergency response. Location and operational procedures of the center for emergency play a vital role in its effectiveness. Location of the center for emergency should be presented in the plan, with possible alternative locations in case you need it. It must be located at a safe distance from the place of accident resulting to avoid being influenced by its effects. This center should have the option to shut down the entire system at the facility, access to the entire video surveillance complex and personal protective equipment. Center must be immediately activated in case that accident is not under the control of staff on site.

Team members for emergency management, which are integral members of the center, have three main responsibilities:

- Determination of personnel for ground surveillance;
- Formulating strategies for the initial response and effects in emergency situations, tactical decisions and action plans for preventing further incidents;
- Applying commands received from the firefighters, police, medical personnel and traffic police.

Emergency Management Computation System

Emergency management computation system can use to assess the severity of the accident using different dispersion models (ALOHA, CAMEO, BREEZE Risk Analyst, SEVEX View), and the data collected from the field. This information is essential for determining the strength and size of the event and determine the needs and ways of evacuation within the complex and

its immediate surroundings. The processes involved in the management of safety with a well-developed system of emergency management can be linked to various alarm systems, local and state authorities.

EMERGENCY RESPONSE PROCEDURES

The emergency response team, discipline of employees and rescue procedures should be adapted to the real situation in the plant. With this approach, employees may need to be rapidly mobilized to take real and effective steps in emergency situations, in order to reduce losses to a minimum.

Emergency response planning must contain some basic steps such as:

- Reporting and assessment of emergency;
- Mapping of vulnerable zones and risk assessment;
- Mapping of resources;
- Organization in response following an accident.

Reporting and evaluation of emergency

When submitting the report about the situation, it is necessary to clearly and precisely specify time and place of accident, give a description of emergency and needed help. Formed accident in the plant can be detected by the operating personnel or security systems such as fire alarm systems and fire detection and control system of the plant, where they observed various irregularities in the operation of the plant. In the meantime, it is necessary to collect additional information on the preliminary identification of the accident and estimate the development of accident. Rescue team checks the level of danger and seriousness of the situation, in order to allow access during recovery.

Depending on the physical-chemical characteristics of hazardous materials, it is necessary to take certain preventive measures. By taking the right preventive measures it can reduce hazards that may cause hazardous substances. People who want to enter the place accident prevention and perform tasks, they must be protected first personal bulletproof gear, and still act according to clearly defined plan for emergency situations.

Zone mapping

Site zone of plants should be prepared to highlight the affected areas and identify possible sources of accident. Map should show the entire area, inside and outside the complex, in which exist a tendency that human life is at risk, if there is a miraculous situation. Mapping should also point out the possible positions of the formation of the Center for Emergency Response. Figure 1 shows the scheme of the control zones divided into: The Hot Zone, Warm Zone and Cold Zone.

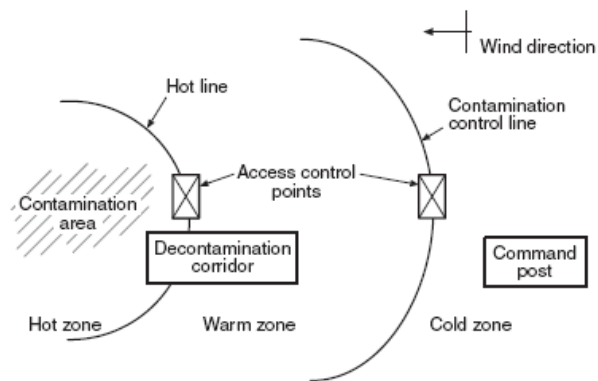


Figure 1. The control zone defined according to Standard NFPA 471

Resource mapping and mobilization

Resource mobilization consists in that the entire manpower and resources should be placed in the right place at the right time in order to achieve efficient and effective response in the minimum time. For quick mobilization of resources, it is essential that in drawing up plans for emergency situations performs mapping resources. Key resources include fire units, safety equipment, transport, transportation, support the local police, military and medical infrastructure.

Organization network and responsibilities

Management in emergency shall take appropriate measures by placing control center in emergency situations, different teams for the firing, rescue team, medical team and a team of security. Fully emergency planning must be efficiently developed and distributed to the appropriate personnel in order to prevent any delay in taking adequate steps. Leader must be able to control and coordinate with his subordinates and all other personnel involved in the process of preventing the spread of accident. How would this be successful, it is essential that the entire team prepared for emergency situations, be familiar with the established hierarchy.

The person in charge of security, liaison officer and information, should assist managers in taking effective and efficient steps and the order to suppress the effect of the accident. Figure 2 shows proposal structure of the organization to respond to emergency situations.

Thus, a complete emergency planning must be efficiently developed and all employees who are involved in the contingency plan must comply with all the steps necessary for the suppression of miraculous situation.

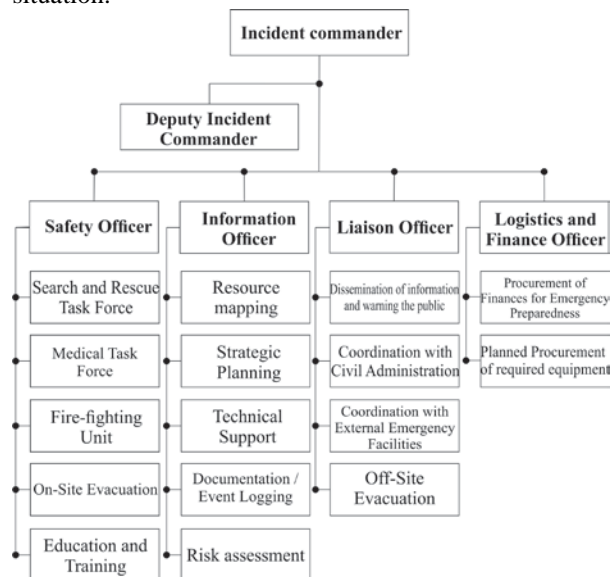


Figure 2. A proposed hierarchic organization for emergency response

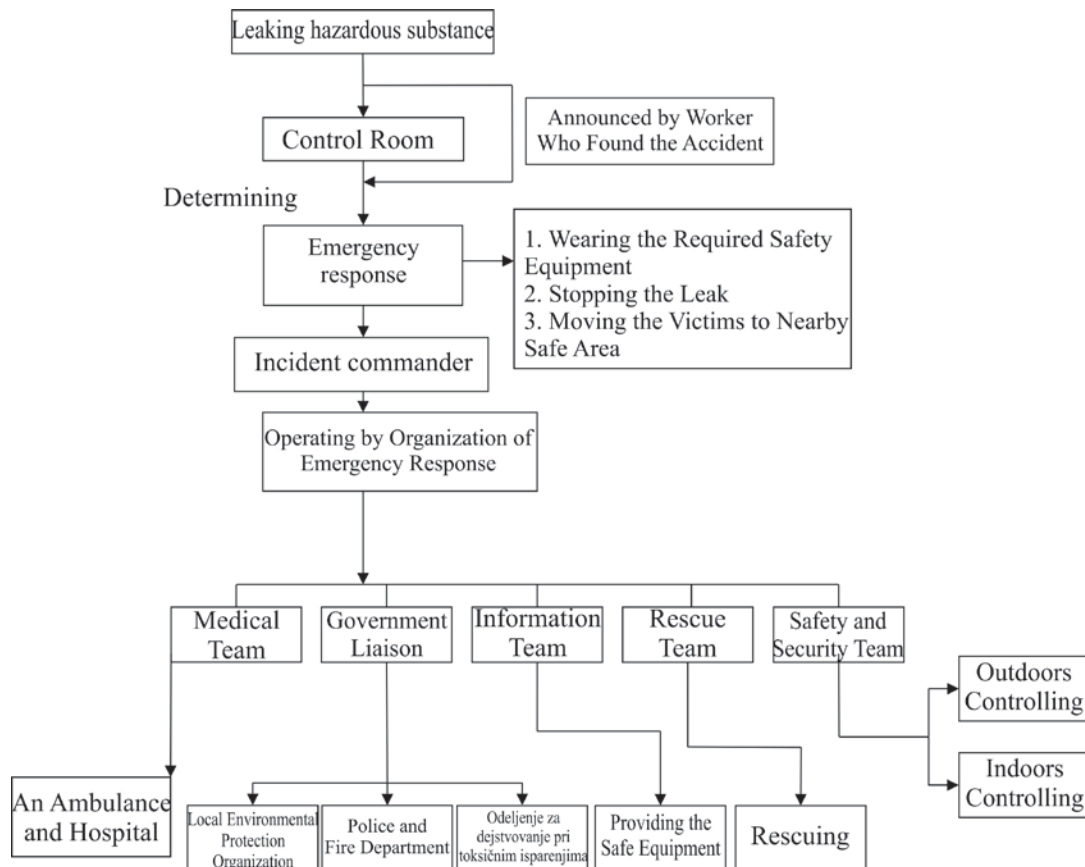
Table 2 shows the tasks of persons responsible for emergency response in case of an accident. The plan is necessary to specify the duties and responsibilities of the employees who are involved in the plan for emergency situations.

The incident commander is responsible in complete planning, management and coordination in emergency response. It is important that in case of emergencies incident commander decides on the need for a complete shutdown of the system and determines the degree of evacuation. The incident commander has a deputy, who takes on the role and responsibility in the absence of the main leaders. In order to reduce the level of confusion and uncertainty, it is important that the roles and responsibilities of governing bodies and staff are clearly defined and displayed.

Table 2. Job duty of each related-staff during an accident in a process plant

No.	Responsible personnel	Work assignment
1.	Incident commander	<ul style="list-style-type: none"> - Execution of action planning in emergency situations; - Risk assessment; - Coordination teams; - Issuing orders to evacuate, if it is necessary; - Allocation of resources to the people;
2.	Deputy incident commander	<ul style="list-style-type: none"> - Coordinate between the incident commander and other teams for emergency response; - Coordinate with the team for the rescue and gives suggestions for response measures;
3.	Safety and security officer	<ul style="list-style-type: none"> - Evacuation of personnel and vehicles within the complex; - Monitors the rescue operations; - Helps Firefighters;
4.	Information officer	<ul style="list-style-type: none"> - Documents a folder rescue; - Assists in the analysis of accidents; - Public Relations and Media;
5.	Liaison officer	<ul style="list-style-type: none"> - Coordinate with the local administration, ministries and the military for local evacuation;
6.	Rescue team	<ul style="list-style-type: none"> - Protection of operating personnel and coordinating the evacuation of within the complex; - Organizing the necessary resources required for the rescue in emergency situations;
7.	Logistic and Finance officers	<ul style="list-style-type: none"> - Provides financial resources for the resources necessary to prevent the spread of the accident.

Figure 3 shows the role of each team member in respond to emergency in case the leakage of hazardous materials.

**Figure 3.** Emergency procedure in case leakage of hazardous materials

COMMON PROBLEMS DURING EMERGENCY RESPONSE

In addition to investigating the cause of the incident, it is necessary the whole process of emergency response analyze, discuss orders issued in response to the accident, procedures, measures of good and bad steps, in order to improve the quality of the response in similar situations. The following text presents the general problems and failures with which the organizers can be encountered when developing plans for emergency response:

- *Assessment of accidental situations:* competent people who are responsible in the affected area must immediately determine whether incurred fortunes can be controlled or not. If not possible, it is necessary to form a team for emergency response rescue.
- *Incident commander does not give precise instructions:* depending on the accuracy of order depends further course of the emergency response, ie. will depend the success of the action. However, wrong commands incident commander may endanger people's lives and property. Team members for emergency (deputy, safety and security officer, information officer, liaison officer, rescue team, logistic and finance officers) must gather the latest information, analyze and estimate the most effective approach to reduce the impact of accidents.
- *A failure in forming a team for response in emergency:* in the cause of the accident, a person caught in the area take the first steps. If the formed situation can not be controlled, it is necessary to submit a report to the incident commander as to assemble the main center for emergency situations. If you still can not control the accident, it is necessary to engage the local rescue units. At this stage it is very important to never allow the further development of disaster.
- *Unclear authoritative of the responsible person:* the biggest problem in emergency situations is that people have no idea about what to do and what are their duties. In such situations, given the chaotic situation at the plant, responsible staff can not carry out their tasks in full when you do not know their responsibilities, and thus leading to a longer process of prevention.
- *Missout in setting incident commander for emergency response:* incident commander plays the most important role in these situations. If there is an accident, and the incident commander is not set, the problems will only get bigger. In this case, the development progress of emergency will not be stopped promptly, despite sufficient staff are available to provide the necessary support.
- *Poor use of communications equipment:* Reporting requires the use of different communication devices. With reporting the real situation on the

ground in the control center, incident commander may issue necessary instructions and commands. At this point, the equipment may cancel due to improper operation. Therefore, staff must be familiar with the functioning of communications equipment, as well as daily check the correctness of communication channels.

- *Passing people in the affected area:* after zoning vulnerable areas to cold, warm and hot zone, these safety and security must control the entry of people in the affected area.
- *Delays in notification and reporting of accident:* reporter should provide detailed information about the accident to the control center, event type, time and place, so the team members have sufficient informations with which to take initial steps to respond in emergency.
- *Failure to execute the incident commander's instructions:* If personnel fails to fulfill received commands, incident commander can't control the progress of the accident and implement the process of evacuation of people and property.

Common defects emergency response team are:

- When people first take part in emergency response, are usually quite anxious to give accurate information about the resulting accident.
- *Using the wrong equipment:* adequate equipment for emergency response is a key tool for the resulting disaster.
- *To slow a response in properly putting on protection equipment:* before going to the field, the team members for emergency respond must be provided with personal protective equipment.
- *Lack of training of employees:* with the arrival of new employees in plant, they must receive adequate training and procedures for emergency, as well as the use of personal protective equipment.
- *Immediate response team members to emergency respond:* team members are obliged to go to the place of accident for rescue and mitigate the impact of the accident. If they have not gone through systematic training, they can not perform these tasks, and can endanger their lives. Accordingly, the team members must understand their responsibilities and duties.

CONCLUSION

Emergency response plan in high-risk industries is an integral and essential part of the strategy for prevention of adverse events. All teams participating in emergency response (incident commander, deputy commander, safety and security officer, information officer, liaison officer, rescue team, logistic and finance officers) need to be forked certain responsibilities are defined plan for emergencies. In this paper, the accent is put on the proper establishment of a methodology for the development of plans in solving hazardous situation, which can be applied in various industries, which perform bandwidth, storage, production of hazardous substances. Also, this work has enabled understanding critical points that may arise in applying the plans, which may be the result of a shell error, system failure, and other factors, then determine the procedure for responding in emergencies, ensuring adequate communication equipment and the availability of equipment for emergency. The success of the actions is reflected in the fact that all members of the team sticking to pre-defined procedures and execute the commands of their superiors.

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BIOGRAPHY

Nikola Mišić is an associate on the project of the Ministry of Education, Science and Technological Development of Republic of Serbia at the Faculty of Occupational Safety in Nis. He graduated at the same faculty, on department of Fire Protection. He is currently on PhD studies on department Safety engineering at work. The main interests are in the areas of monitoring environmental pollution, risk analysis in the working environment when handling hazardous materials, evaluation of the likelihood of accidents of hazardous materials, the impact of spills of hazardous substances to the environment; making scenarios during the release hazardous substances into the environment.



IZRADA PLANOVA U VANREDNIM SITUACIJAMA ZA INDUSTRIJE VISOKOG RIZIKA

Nikola Mišić

Rezime: *Da bi se uzroci rizika i potencijalni efekti rizičnih događaja eliminisali, kontrolisali i minimizirali, potrebno je uspostaviti sistem upravljanja, čiji je cilj planiranje, kontrola i redukcija udesa. U ovom radu predstavljena je struktura plana za regovanje u vanrednim situacijama. Takođe, sagledani su problemi i neuspesi sa kojima se mogu susresti organizatori koji izrađuju planove. Planiranje je bitan aspekt upravljanja vanrednim situacijama, gde se sprečava dalje širenje udesa i minimalizuje njegov učinak. Primena interaktivnog planiranja u vanrednim situacijama omogućava brze, efikasne, efektivne i pouzdane razmene podataka. Na taj način ostvaruje se bolja koordinacija i komunikacija među oformljenim timovima zaduženim za reagovanje u vanrednim situacijama.*

Ključne reči: planiranje, vanredne situacije, rizik.