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SAFETY OF CRITICAL FACILITIES

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ABSTRACT
THE WORK DEALS WITH CRITICAL FACILITIES INTEGRAL SAFETY. ON THE BASIS OF PRINCIPLES OF STRATEGIC SAFETY MANAGEMENT IN DYNAMICALLY VARIABLE WORLD IT GIVES HISTORICAL DEVELOPMENT OF WORK WITH RISKS IN ENGINEERING DISCIPLINES AND PRESENT MODEL OF MANAGEMENT AND TRADE-OFF WITH RISKS USED IN CRITICAL FACILITIES. IT CHARACTERIZES PRESENT PROCESS MODEL OF CRITICAL FACILITY SAFETY MANAGEMENT, ITS PROCESSES AND PROGRAMME FOR CRITICAL FACILITY SAFETY UPGRADING IN A CONTEXT OF INTEGRAL SAFETY DIRECTED TO EXISTENCE, SECURITY AND DEVELOPMENT OF HUMANS.

KEY-WORDS:
CRITICAL FACILITY, RISK, SAFETY, SAFETY MANAGEMENT MODEL, SAFETY CULTURE.

INTRODUCTION

The main goal of all human effort is ensuring the human life, i.e. all human needs, interests, and wishes. Human needs, interests and wishes are fulfilled by intangible and material goods that have a utility value. Unfortunately, in the world is not just a human society, but also other systems, which are not subject to the human society. Therefore, conflicts originate: man vs. the environment; technology vs. the environment; man vs. technology; man vs. man, etc. Because human kind is based on its education, as well as in the present case, must realize that, in a given situation must be based on knowledge, which accumulated science and historical experience of life, which shows that there is a limit for the activities of the people, which cannot be exceeded, in order to prevent the destruction of mankind.

The starting point is to accept the need for the co-existence of several systems and search conditions and ways of controlling it. The sustainable development strategy is comparable with other systems of values, which do not have the final form (e.g. the system of human rights and freedoms). It leads to ensure the highest attainable quality of life for the present generation and to create conditions for quality of life of future generations, even knowing that the ideas of the quality of life of future generations can be compared to our different. The man knew during his development, for your life and development needs the nature and a number of other assets. He understood that the most valuable asset is its existence, security and development potential, and that the safe world is disturbed by harmful phenomena (disasters). From the evaluation of credible data, knowledge and experience, e.g. [1], it follows that the human knowledge and abilities are:

- small to avert disasters, which are the manifestation of the evolution of the planetary system of the Earth,
- adequate to mitigate the impact of disasters, which are the manifestation of the evolution of the planetary system of the Earth,
- and sufficient to prevent disasters that are associated with the activities of humans and with the development of human society.

To use the knowledge and skills the humans consciously create a comprehensive system tool, which is called the ***safety management*** and also specific targeted tools to deal with emergency and critical situations, which are emergency management and crisis management; in the professional literature can be found, as well as other tools such as disaster management [2]. For qualified management of entities, according to the present knowledge and experience is considered a strategic safety management of entities in the dynamically varying world, which means the skilled management of disasters [2], which is based on the approach of "All Hazard Approach" that was introduced by FEMA in 1996 [3] and it is used by EU and OCHA [1,2]. Having regard to the complexity, many disciplinary and the interdisciplinary nature of the solved problems, understanding of the situation and find solutions for the humans´ security and development, the critical installations safety is based on the systems approach, a comprehensive concept of safety and proactive way of safety management, because the environ / space is dynamic, i.e. it is variable in the space and time in particulars and as well as in a whole [1, 4].
On the basis of current knowledge the reasonable human negotiates with the risks so that systematically carries out preventive, mitigating, reactive, and recovery measures and activities in order to avert unacceptable impacts that affect and cause the losses to both, the humans and the public assets that they need to their life. Because of their knowledge, capabilities and possibilities are limited in the subject area, so on the basis of the experience they constantly prepare to cope with the situations, which are caused by an occurrence of a variety of phenomena, with harmful impacts on them and on the vital assets.

Journal of Environmental Protection, Safety, Education and Management
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The aim of human effort is to construct the technical works that fulfil the prescribed function after specified time period and do not threaten human health and the environment, i.e. are safe. In order to ensure the safety of the technical works they are created since the beginning of the cultural evolution of the human species the legislation, technical standards and norms. There are processed procedures of good practice in cases in which there is not enough data for the standard or norm. At each stage of the development, the legal rules (directives, regulations) of a different legal force reflect the level of knowledge and experience of the company. Norms and standards for the current period reflect the knowledge level at the time of the present.

THE DEVELOPMENT OF MANAGEMENT AND TRADE-OFF WITH THE RISKS

The basis of human effort in creating a safe space is to handle the (tame) risks. The term "*risk*" has its origin in the Middle Ages and our present knowledge about trade-off with the risks has been systematically collected since the 1930s. The acquired knowledge and experiences have been gradually applied in risk management and designated measures and activities have been introduced gradually into the practice by engineering disciplines [5, 6]. In the present work with the risk, the risk is seen as the potential that a given action or activity (including the option of doing nothing) originates loss (the undesirable outcome). In today's practice, it uses the five concepts of risk management and risk engineering, i.e.: a classic risk-management and risk engineering; the classic risk management and risk engineering involving the human factor; management and engineering focused on security (security management and security engineering); management and engineering focused on safety, i.e. such control and trade-off with risks, that ensure both, the secure system and its safe surroundings; and management and engineering focused on the safety of system of systems (SoS) [5, 6], Figure 1. It is obvious that the more advanced the concept of the use, the higher are the demands on the knowledge, the tools, time, finances, qualifications of personnel, etc.

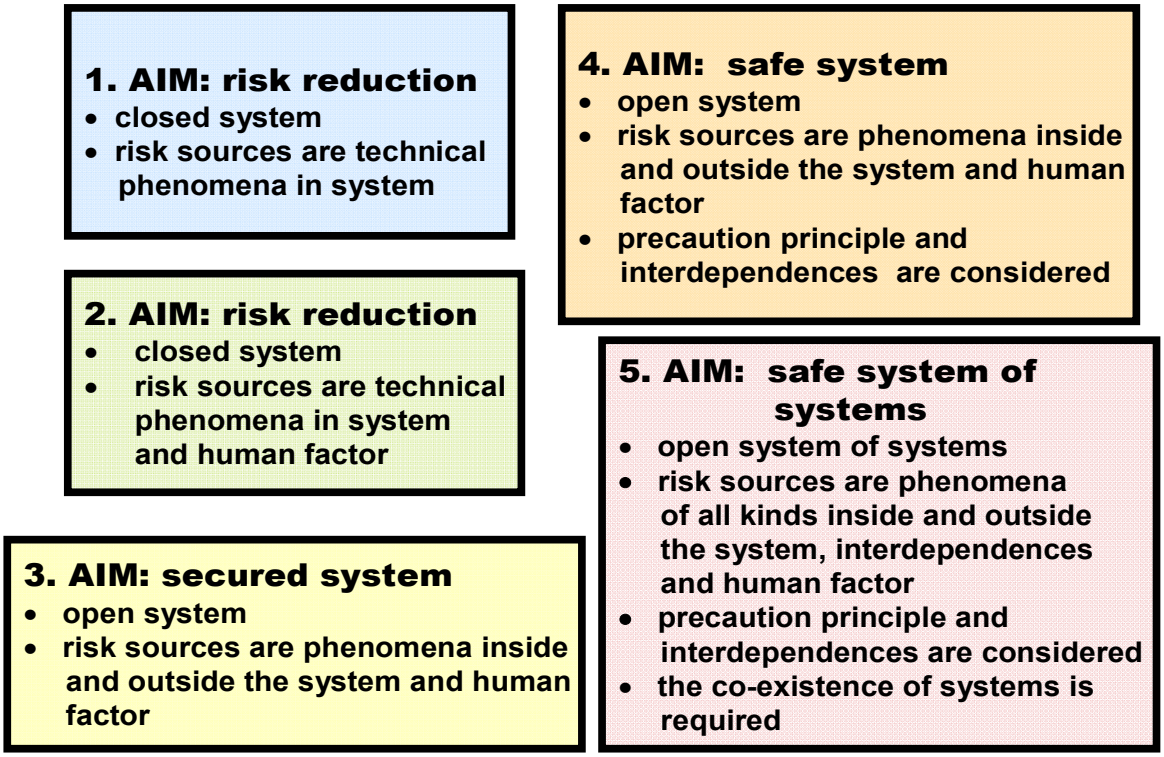

Fig.1 - Concepts of management and engineering trade-off with risks and their goals, arranged in chronological order according to the time of their introduction to engineering practice.

For each concept, management and engineering was developed by a certain set of standards and norms for its use in practice, [6], which amends and supplements in conjunction with the development of knowledge. Due to different assumptions of concepts the results of their application in practice are not the same. Because the reality that the higher the concept of risk management and risk trade-off is used, the greater the demands are on the resources, forces and means, it is necessary to choose the concept according to the targets in the field of safety [7]. The basis is the awareness of the

2014, Number 3, Volume 2, date of issue 28th Juni 2014 ISSN 1339-5270

targets of the work with the risks, i.e. whether the object comprehended as a system to be a secure system or a safe system. Since the accident, the Three Mile Islands in the critical field it is used the target "safe object". Basic terms from safety domain specified for the critical facilities are listed in [1, 2].

On their basis in accordance with the concepts of the UN [8], the OECD [9, 10], and the EU [11] it holds:

- *secured critical facility* is a system that is protected against all disasters, the sources of which are inside and outside the system, including the human factor;
- and *safe critical facility* is a system that is protected against all disasters, the sources of which are inside and outside the system and it does not affect their surroundings in its normal, abnormal and critical conditions.

MANAGEMENT OF SAFETY OF CRITICAL FACILITIES

The safety is a set of anthropogenic measures and activities, which lead to ensure security and development. Since the world is dynamically changing, so the management of the safety of critical installations is focused on priorities. In the first place, it means the application to access All Hazard Approach [3], determining the hazards posed by individual disasters, and according to the assessment of the size of the threat from real disasters and vulnerabilities of a site and of critical installations against real disaster the separation of disasters into the following groups:

- the disasters, which cannot have impacts on critical facility,
- disasters that have only an acceptable impacts on critical facility, for which we use the designation “relevant disaster”,
- disasters that have on a critical facility only impacts that are manageable at performance of the prepared prevention and mitigation measures, for which we use the designation “specific disaster”,
- and disasters that have an unacceptable impacts on the critical facility and, therefore, it is necessary to carry out essential preventive measures in the field of technical, organizational, legal and educational and it is necessary to have the possibility to activate all of the resources and the means to cope with their impact and jump-start further development, for which we use the designation “critical disaster”. These disasters have the potential to cause extreme emergency situations and for their defeat it is necessary to use the tools for crisis management.

Problem areas in safety management according to [1, 12] are in 14 different sectors, the list of which is in [1, 12]. The strategy for ensuring the security and sustainable development of the critical facility consists in:

- the application of the system and pro-active management, which relies on the knowledge and experience obtained for the critical facility from qualified data,
- a qualified trade-off with the risks in a benefit of security and sustainable development of critical facility,
- settlement of risks by help of prevention, mitigation, insurance, reserves, preparedness for response and recovery, and compilation of a plan for trade-off with unforeseen situations (with contingency plan),
- the application of the correct procedure, in which the interconnected safety management, emergency management and crisis management,
- building a program to increase the safety in critical facility and in its surroundings,
- the determination of the assessment the safety rate in sense of effectiveness of the secured system (indicators),
- the fulfilment of the program by linked interconnected projects + fulfilment projects by linked interconnected processes; directly specified allocation of tasks and responsibilities to all concerned,
- and the implementation of the relevant activities and measures, that is associated with a qualified and consistent monitoring.

The basic principle is qualified interconnection of technical, organizational, financial, personal, social, knowledge domains; and clear roles and responsibilities of all those involved. The safety management system of critical facility, therefore, covers a number of areas, i.e. technical, military, legislative, financial, economic, social, ecological, educational, research, etc. In the field of safety, in terms of current knowledge and current concepts of sophisticated security systems, the tasks have all participants. The tasks of each participating and their interconnection in various situations are prescribed by the laws, moral and other standards and norms.
In the framework of the strategy for ensuring the security and sustainable development [1] it must be in a critical facility set up: a program for increase the safety of critical installation; rates for the assessment of the level of safety in terms of the efficiency of the security system (indicators); a program to ensure the safety that is filled by interlaced projects; and projects filled with interlaced processes.

2014, Number 3, Volume 2, date of issue 28th Juni 2014 ISSN 1339-5270

The critical facility management tools that ensure the security and the development of a critical facility, i.e. in other words, the conservation and protection and development of the protected assets [1] are:

- coherent management system involving the management of strategic, tactical and operational, which is based on the qualified data, expert assessments and good methods of deciding,
- education and training of employees,
- science, research, and TSO (the professional organization to ensure professional support to the operator of a critical installation and to public administration),
- specific education to technical and management personnel,
- technical, medical, environmental, social, cyber and other standards, norms and regulations, i.e. the tools for the control of processes, which can or could lead to the occurrence of (the origination of) a disaster, or to amplify its impacts,
- the inspection,
- a system of cooperation with the public administration, with organizations in the territory and with organizations that use similar technology,
- units for defeat of emergency situations,
- components and systems to cope with critical situations (i.e. after all ways ensured continuity management and crisis management),
- and security, emergency and crisis planning.

That procedure was correct, it is necessary to use the tools competently, i.e.: use the documents obtained on the basis of the qualified data that meet the requirements for representative data files (completeness, valuation and settlement of random uncertainties, settlement of vagueness (epistemic uncertainties) in the data using a specific mathematical approaches) and apply correct methods of decision-making, which are adequate to the problem, which will be decided.

The random uncertainty is related to the scattering of observation and measurements. It can be incorporated into the assessment and prediction using the apparatus of mathematical statistics.

The vagueness (epistemic uncertainty) is associated with both the lack of knowledge and information, as well as with the natural variability of the processes and events that trigger disasters.

For processing and consideration, the epistemic uncertainty is the device of mathematical statistics insufficient and it is necessary to use a different, more modern mathematical apparatus that provide such as the theory of extreme values, the theory of fuzzy sets, theory of fractals, theory of dynamic chaos, the selected expert methods and suitable heuristics.

Data on epistemic uncertainty follows from the fact that the data are incomplete, non-homogeneous (i.e., their accuracy depends on their size, or on the time of the occurrence) and unsteady. They have considerable variance and are loaded with random and sometimes systematic errors, the distribution functions of which are usually not possible to determine. This means that for:

- strategic management of the organization that is focused on safety management, it is necessary to ***use the verified data files, proven methods for data processing and proven methods for decision making,***
- medium-term management of the organization, which is aimed at readiness a routed to cope with the problems associated with emergency situations (natural disasters, accidents, etc.) in a critical facility, it is possible to use ***less accurate data, data processing method and methods of decision-making*** (less accurate process models, software, estimates, etc.), since each emergency situation is unique due to the variable conditions of its formation and changes in the availability of resources, the forces and capabilities of the organization on the reaction,
- operational management, which decides in the time constraints and at the lack of data (response), it should be ***on the basis of acquired knowledge and experience to use targeted learned and trained procedures*** (e.g. processed in the form of case studies), because rapid response is desirable.

On the basis of current knowledge summarized in the works [1,4-6] it should be noted that each of the targeted management (goal is security and development or intermediate objectives such as competitiveness or just survival) must be based on high-quality work with risks, Figure 2; qualified cope with risks at the current level is described in work [5].

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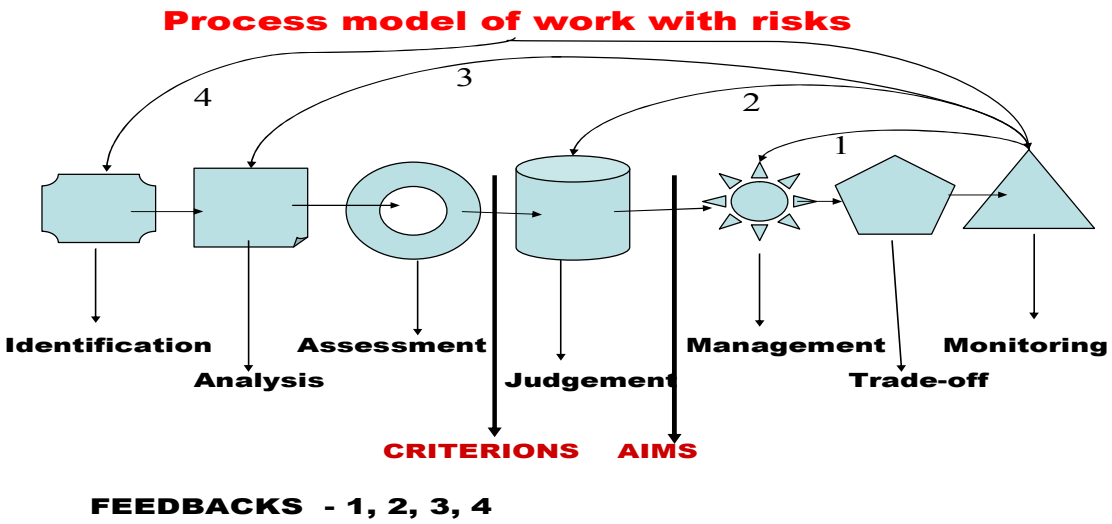

Fig. 2 - Basic procedural model showing the work with the risks. Criteria are conditions which determine when the risk is acceptable, conditionally acceptable or unacceptable. The objectives are the formulations, that denoted: the limit to which we want to reduce the risk; rate of security of a system; or rate of security of a system and its surroundings. Arrows (1, 2, 3 and 4) indicate the feedbacks, which are applied when the risk is unacceptable.

From Figure 2 it is obvious, a major role of monitoring. In the event that it is established that the risk is unacceptable, it is necessary to make changes, as indicated on the feedback on Figure 2. Because the changes require resources, forces and means, so on the basis of ensuring the cost-effectiveness firstly it implements feedback 1, and only when it is not desirable, it realizes the feedback 2; after the feedback 3, and when, even after it is not a desirable outcome, so feedback 4. In the case of the occurrence of extreme phenomena with disastrous impacts it is immediately implemented the feedback 4.

The safety and risk together in some way related (in more detail in [1, 4-6] and in the works that are cited in them), ***it's not about complementary phenomena***. On the basis of current knowledge, summarized in the works [1, 4-6,13], the safety management system (the so-called SMS) of a critical facility is based on the process management and it includes the organizational structure, responsibilities, practices, rules, procedures, and resources for determining and implementing the prevention of disasters, or at least mitigating their unacceptable impact in the territory. Usually refers to a number of questions, inter alia, the organization, workers, the identification and assessment of hazards and risks resulting from them, the management of the organization, the management of changes in the organization, emergency and crisis planning, monitoring the safety, audits and reviews [1, 13]. On the basis of the cited works, the SMS of critical facility consists of processes:

- Process of concept and management, which is further divided into sub-processes, which ensure: the overall concept; partial safety objectives; leadership/management of safety; the safety management system,; the staff, which is further divided into sections: human resources management, training and education, internal communication/awareness, working environment; and review and evaluation of the implementation of the objectives in the safety.
- Process of administrative procedures, which are further divided into sub-processes, which ensures: identification of hazards from potential disasters and risk assessment; documentation; procedures (including work permits); the changes; safety in conjunction with the contractors; and supervision under safety of products.
- Process of technical issues, which are further divided into sub-processes, which ensures: research and development; design and assembling; inherently safer technical and technological processes; industry standards; storage of dangerous substances; maintenance of the integrity and maintenance of equipment and buildings.
- Process for external cooperation, which is further divided into sub-processes, which ensures: cooperation with the administrative authorities; cooperation with the public and other stakeholders (including academic institutions); and cooperation with other enterprises.
- Process of the emergency preparedness and response, which is further divided into sub-processes, which ensures: planning of internal (on-site) preparedness; facilitating the planning of external (off-site) preparedness

Journal of Environmental Protection, Safety, Education and Management
2014, Number 3, Volume 2, date of issue 28th Juni 2014 ISSN 1339-5270

(to which the public administration corresponds); the coordination of the activities of the departmental organizations at emergency preparedness and response.

- Process of reporting and investigation of accidents / accidents almost, which is further divided into sub-processes, which ensures: reports on accidents, incidents, near-misses and other lessons learned; investigation of near-misses, incidents and accidents; and responses and follow-up after the incidents and accidents, including the application of lessons learned and information sharing. Processes must be coordinated so that they are targeted to the objectives set, i.e. the safe operation of critical facilities.

On the basis of analyses of the existing safety management systems, which are described in the professional literature, for which the data are summarized in the works [1,4-6,13], and in particular the knowledge collected by the OECD [9, 10, 14, 15] the author compiled by the method of analogy to existing safety management models the general process safety management system of real entity and she verified it on the data collected in the archive [16], and by the method of analogy she has transferred to critical facility, Figure 3.

Method of compilation of model is based on system conception of the entity; it considers it as a system of systems [5, 6], which means that its complex behaviour, functionality and development depend on both, the quantity and characteristics of the partial systems and on the varieties of their links, i.e. their linkages and flows among them and also across them. Linkages and flows going across the partial systems are the originators of the internal dependencies (the interdependences).

In Figure 3 the black block indicates basic decisions to ensure a safe entity – specification of the essential processes of a critical facility, that predispose a safe critical facility, i.e. its existence, safe operation and development. Then there follow the sequential steps aimed at the security and development of the entity. As the entity and it's environ dynamically develops it considers with corrections and changes. In case of the need for corrective measures there are indicated the basic feedbacks, by which it is corrected the set of measures and activities; the dotted line — feedback 1, dash-dot line — feedback 2 dashed line-feedback 3, full line – feedback 3.

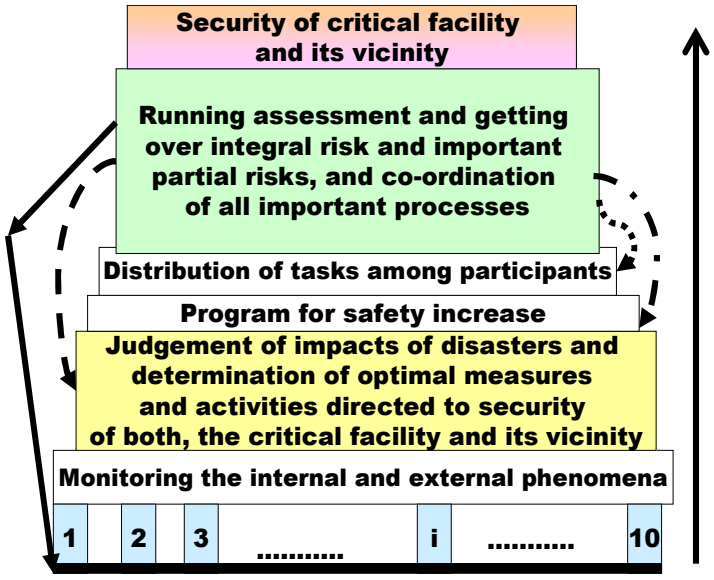

Fig. 3 - Process safety management model of a critical facility. Black block specifications the essential processes of the entity; the dotted line — feedback 1, dash-dot line — feedback 2 dashed line-feedback 3, full line – feedback 4.

At least it is necessary to keep track of ten processes:

- Risk management for ensuring the secured critical facility in a system concept.
- ***Process 1*** ensures the risk management, the sources of which are inside and outside of critical facility plus human factor; i.e. it follows critical facility and parameters of vicinity in which critical facility operates. It is composed of: assessment of expected disasters´ sizes; determination of occurrence probability of important disasters; judgement of critical facility vulnerabilities at important disasters; determination of impacts of important disasters on critical facility. It creates a base for ensuring the secured critical facility, i.e. critical facility secured against all disasters.
- Realisation of measures and activities for ensuring critical facility in a system concept.

- ***Process 2*** ensures designing and planning the measures and activities for ensuring the critical facility security at considering all important disasters; i.e.: critical facility layout (structure, function, sitting, building, operation); performing the measures and activities for ensuring the critical facility security; plan of renovation of critical facility after disaster; plan of training the personnel performing the critical facility; critical facility activities´ monitoring; and correcting measures and activities for a case of important deviations in critical facility operation.
- Realisation of measures and activities necessary for ensuring the safe vicinity of a critical facility at its conditions normal, abnormal and critical.
- ***Process 3*** ensures designing and planning the measures and activities for ensuring the critical facility vicinity security at considering all important disasters; i.e.: critical facility layout by a way that it may not threaten vicinity, i.e. all public assets; performing the measures and activities for ensuring the critical facility vicinity security; plan of renovation of critical facility vicinity after disaster; plan of training the personnel performing the critical facility; critical facility activities´ monitoring; and correcting measures and activities for a case of important deviations in critical facility operation.
- Realisation of measures and activities necessary for ensuring the safe operation of critical facility.
- ***Process 4*** ensures the harmony among the main activities connected with critical facility commodities, i.e.: electric energy (its manufacture, transport and distribution); following the deviations in a process of commodity management; and operating loops. It goes on ensuring the stabilities of processes, the minimisation of delays, the quality and the other critical aspects connected with the operation of critical facility.
- Realisation of measures and activities necessary for ensuring the safe assets of critical facility.
- ***Process 5*** that ensures the safe assets of critical facility, i.e. problems connected with: services, equipment or services; vehicles; shipping; products; and data systems. It goes on averting of insiders activities.
- Realisation of measures and activities necessary for ensuring the safe human sources of critical facility that is necessary for safe operation of critical facility.
- ***Process 6*** ensures the safe human sources, i.e. problems connected with: acceptation of employee; understanding the employee behaviour features important for critical facility operation; employee training; employee self-control; implementation of procedures that ensure correct employee behaviour; and employee stimulation.
- Realisation of measures and activities necessary for ensuring the safe trade partners (participants in chain ensuring the operation) of critical facility.
- ***Process 7*** that ensures good business partners, i.e. problems connected with: screening the possible partners; authentication of possible partners; producing the ways of negotiation with partners regarding to their behaviour; monitoring the partners behaviours; and audits of partners.
- Realisation of measures and activities necessary for ensuring the critical facility operation continuity at extreme conditions.
- ***Process 8*** generates the capability of critical facility for overcoming the impacts of extreme disasters that affect critical facility, i.e. problems connected with: business continuity of critical facility; specific response training; investigation of causes of extreme impacts; assembling the evidences; reparation of harms; and court settlement.
- Realisation of measures and activities necessary for ensuring the harmony with the state and protection against criminal practices.
- ***Process 9*** ensures the dislocation of criminal and illegal from critical facility, i.e. problems connected with: formation of base for disruption (ensuring the sources, determination of means, logistics, transport of means, distribution of means); and with support of governments and customers.
- Realisation of measures and activities necessary for ensuring the co-ordination of all processes in critical facility with aim to prevent the organising accident.
- ***Process 10*** ensures integral safety of critical facility, i.e. the coordination of all pillars, i.e. processes directing to critical facility safety (PSM – process safety management).

From Figure 3 it is evident the vital role of monitoring the internal and external processes and phenomena (Note: the phenomenon is a look that is the result of the process of [5]), which is followed by an assessment of the impacts of processes on a critical facility and by determination of optimal measures and actions to ensure safe critical facilities. In the event that the limits and conditions are not complied with, it is necessary to make changes, as indicated on the feedbacks in Figure 3. Because the changes require resources, forces and means, on the basis of ensuring the cost-effectiveness, there is realized in the first the feedback 1, and only when not desirable, it realizes the feedback 2; after the feedback 3, and when, even after it is not a desirable outcome, so feedback 4. In the case of the occurrence of extreme phenomena with disastrous impacts, it is immediately implemented the feedback 4.

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safety management system (SMS) of a critical installation is based on the concept of prevention of disasters, or at least their serious effects [1, 9, 10], which includes the obligation to establish and maintain a management system in which they are taken into account the following issues: roles and responsibilities of persons participating in important hazards management on all organising levels and in ensuring the training; plans for systematic identification of important hazards and risks connected with them that are connected with normal, abnormal and critical conditions, and for assessment of their occurrence probability and severity; plans and procedures for ensuring the safety of all components and functions, namely including the object and facilities maintenance; plans for implementation of changes in territory, objects and facilities; plans for identification of foreseeable emergency situations by systematic analysis including preparation, tests and judgement of emergency plans for response to such emergency situations; plans for continuous evaluation of harmony with targets given in safety concept and in the SMS, and mechanisms for examination and performance of corrective activities in case of failure with aim to reach determined targets; and plans for periodic systematic assessment of safety concept, effectiveness and convenience of the SMS and of criterions for judgement of safety level by top workers group.

The safety of critical facility is a matter for all stakeholders, i.e. the executives, employees, even persons accidentally present. In this context, talking about ***the so-called golden rules of all participating*** [1, 9, 13], which are: according to their possibilities by application of preventive measures to avert disasters and or at least their unacceptable impacts, to ensure preparedness for capability to defeat the unacceptable impacts on protected assets (the interests) of a critical facility and effective response of the critical facility; to communicate and to cooperate with others interested in all aspects of prevention, preparedness and response of critical facilities; know the hazard from disasters and possible risks in critical facility and in its surroundings; to implement and respect the safety culture, which is respected and enforced by all stakeholders in all circumstances; to establish the safety management systems, to monitor and if necessary to correct their activities; to use the principles of inherent safety at project, the design and operation of objects and their equipment; carefully drive the changes in critical facilities; be ready to cope with all the disasters that may occur; help others interested at fulfilment of their roles and responsibilities; carry out continuous improvement of safety; to work in conformity with the safety culture, safe practices, and training; to strive constantly for all awareness and provide information, and to provide feedback to managers; to strive for the development, strengthening and constant improvement of the concept of safety, regulations and directives; lead and motivate all other stakeholders in order to fulfil their roles and responsibilities; know the risks within their own sphere of responsibility, appurtenant to plan measures for its proper management; the use of appropriate and coherent policy of planning and follow-up activities; be aware of the risks in critical facility and to know what to do in case of their realization; and to participate in emergency planning and response.

Safety culture means that the man in all his roles (executive, employee, citizen or victim of the disaster) observes the principles of safety, i.e. he behaves so that alone prevented the realization of the potential risks and when it becomes a participant in the realization of the risks, to contribute to an effective response, stabilization of the protected assets (interests) and their recovery and to kick off their further development. An effective safety culture is an essential element of safety. It reflects the concept of safety and is based on the values, opinions and discussions of key management personnel of the organization, and their communication with all stakeholders. It is a clear commitment to actively participate in addressing issues of safety and advocates that all participants did so safely and to comply with the relevant legislation, standards and norms. Rules of safety culture must be incorporated into all activities in a critical facility. Their basis is not the concentration on the punishment of the offenders / originators of errors, but the lessons learned from the mistakes and the introduction of such remedial measures, in order to not repeat mistakes or at least significantly reduced the frequency of their occurrence.

The tool for ensuring safe critical facility, i.e. such a critical facility, in which there is an effective safety culture, the program for increase the safety of the entity [1, 9]. The procedure for creating a program for enhancing the safety of critical facilities consists of the following steps: define the tasks (targets), and the strategic objectives of critical facility with regard to safety; for each section of a critical facility to select the appropriate target and running indicators for assessing the level of safety; create a dictionary for an integral safety management needs; align standards, methods of good practice and local procedures; edit the list of target indicators according to the requirements of the professional standard organisation and of the conditions in a critical facility; edit the list of running indicators according to the requirements of the professional standard organisation and of the conditions in a critical facility; establish a way to evaluate the target indicators (i.e., the value system) according to the requirements of the professional standard organisation and of the conditions in a critical facility; establish a way to evaluate the running indicators (i.e., the value system) according to the requirements of the professional standard organisation and of the conditions in a critical facility; and specify the scale for the measurement of file/indicators (i.e., the system of values) and the boundary limits according to the requirements of the professional standard organisation and of the conditions in a critical facility.

In practice, this means that for each section in the selected scope there are determined the target and running indicators, which take the form of limits and checklists [1,9,13]. They are assigned in practice the criteria for evaluation and scale with which it specifies when it is achieve target and when not. On the basis of current knowledge, summarized in the above work [1] there are the costs to ensure the security and sustainable development of a critical facility, a summary of

the costs incurred in the negotiation with the risks. I.e., they are the costs for the measures and actions of prevention, preparedness, response and recovery, insurance, and reserve for defeat the unforeseen situation, caused by e.g. a few probable accumulations of adverse phenomena. In terms of efficiency there are the most effective prevention costs [1]. However, they are costly to the knowledge, resources, forces and means, their result is not immediately visible, and is obvious in the future after the disaster, and therefore, for their application the management of the critical facility is typically tilted just in the period after the great disaster. For reasons of ensuring the protection and sustainable development it is, therefore, necessary to enforce the enforceability of essential preventive measures by legal rules.

The safety management of the critical facility is the safety management of system of systems, i.e. the management of mutually interconnected systems (technical, organizational, financial, knowledge, material, cyber, etc.) [4]. The aim of the control is the good coordination of all systems together, in order to avoid conflicts, which under certain conditions can lead to organizational accidents [1,4,6,13]. The proper (good) management of the safety of critical facility admitted due to changes in external and internal conditions of normal, abnormal, and critical and has pre-established instructions on their mastery. At critical facilities following the accident at Chernobyl there are processed measures and activities for response to selected scenarios of beyond design (severe) accidents. After the accident in Fuku-shima in addition, there are ensured the conditions for management of the response to beyond design accidents. The design disaster – the size of the disaster, against which we systematically they are carried out the measures – a hundred disasters. Beyond design disaster – the size of the disaster, against which we measure only sometimes – bridges, tunnels - 1000 years, the critical device 1. Category - 10 000 years. Extreme disasters are the disasters that exceed the size that is expected on the basis of probabilistic hazard assessment.

Safety culture is designed in the right risk management at all levels of management: technological, operative, tactical, strategic and political [5]. It is measured either by using the specific indicators [13-15] or by the criticality rate [7]. Criticality is a threshold value that expresses a state of considerable urgency. It is the result of exposure to risk factors (usually different types of factors are analysed: factors of human activity, decision-making and management, factors in the non-perceptibility of environ). Criticality is linked to the vulnerability and the importance of tracked items, i.e. the public protection in the broadest context. The criticality rate of each concept is given by the level of integral risk, in which the main role has the cross-cutting risks [5].

Conditions in the critical facility are not stable, they depend on both, the internal and the external processes and their dynamics. Since each critical facility is a system of systems (SoS) [5], so the changes give rise to various processes in the system of systems. When changes exceed the limits and conditions of elements, components and systems of facility they are originated processes across systems of critical facilities, which are the cause of a variety of synergy, domino and cascading events.

CONCLUSION

Analysis of the current situation shows that we can systematically handle a range of undesirable processes, i.e. defects and failures that we can detect in advance. Sometimes, however, there is a mutual interlocking a series of seemingly unrelated factors, and as a result of non-linearity in the system there are originated very atypical accidents. Analysis of accidents: breaking plateau Alpha in 1988 in the North Sea; the warehouse of aviation kerosene crashes in Buncefield 11. 12.2005; maritime, railway and unexplained air crash in recent years; the accident at the Fuku-shima is 11. 3.2011 (note – it did not respected calculated scenarios of accidents), showed that the number of experts is affected by the operational requirements of the blindness and after fulfilment of the norms and standards to see the remaining risks, or the risks associated with different bindings and couplings with the surroundings. For example, a simple comparison of intervals used in probabilistic assessments shows that: the interval (μ-σ, μ+σ) covers 68.5% of cases; the interval (μ -2σ, μ+ 2σ) covers the 85.4% of cases; and the interval (μ -3σ, μ+3σ) covers 99.8% of cases [4].

Therefore, we permit that complex systems to which surely include critical facilities, are for various reasons from time to time in an unstable state and they are formed an organizational accidents, cascade of failures without apparent cause, i.e. we recognize the random and epistemic (knowledge) uncertainties in their behaviour. For the protection reasons we are looking for a solution of response for cases that cannot be revealed by the probabilistic approaches and we build for them, alternative sources of water and energy, specific response systems and specific training of rescuers.

To achieve the desired level of safety it is necessary well manage and properly decide. Good management and good decision making is possible only when we have good data, and we can take advantage of the tools that we have available. The data: must be correct, i.e. it is known their size and accuracy; must have explanatory power for the problem, i.e. they must be validated. The data files must be representative, i.e.: complete; contain the correct data; have a sufficient number of data; the data must be spread homogeneously throughout the reference period and must be validated. In the application of models must be properly considered random and epistemic uncertainties in the data.

It should be noted that in the real world we work at ensuring the safety of critical facilities non-trivial problems, i.e.: there is more protected assets, the objectives of which are conflicting; assets varies in time and space; and the environ in which the assets are, i.e. the human system, is in dynamic development.

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