

*Original Research*

# **Integrated Management of the Environment-Safety Risks in the Thermal Power Station**

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## **Abstract**

The proposals are based on an analysis of the current state and methodologies of corporate risk management with an emphasis on management according to internationally recognized ISO 3100X standards and their revision, as well as the requirements of revised ISO standards for quality management, environment, safety, etc. related to risk management. The Deming cycle (Plan-Do-Check-Act) of continuous improvement is a methodological tool for building a management system, whether for a partial aspect or integrated, which greatly facilitates the integration process. Significant support for the integration of management systems is a unified element structure of the latest revisions of ISO standards according to Annex SL for quality ISO 9001, environment, ISO 14001, occupational health and safety ISO 45001, information security ISO 27001, but also others. When implementing management systems according to these standards, it is recommended to use the latest ISO standard 31000: 2019 Risk Management - Guidance in connection with the management of individual risks. Although this standard does not have a 10-chapters structure according to Annex SL as well as other standards, it is fully integrated into the system. It has 6 chapters and chapters 4. Principles, 5. System, 6. The process contains recommendations that can be integrated with the requirements of the chapters of the ISO standards for environmental management, quality, safety and health at work, health and safety, information security. The identification and evaluation of aspects of impacts and risks is an input to building management systems of an organization according to internationally recognized standards, whether for partial aspects or an integrated system. The most important aspects impacts and risks, whether technical, economic, environmental, safety, information and others are reflected in the management system in policies and objectives. In this context, it is useful to draw up a Register of Aspects, Impacts and Risks for organizational processes, and if it is an integrated management system, an integrated register is needed. As part of our research, a generally applicable guide to the preparation of a more exact integrated register was proposed as a basis for building an integrated management system. The register form includes 10 columns with their specification and quantification

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and was applied in the operating conditions of the Vojany thermal power plant in the implementation of the quality and environmental management system according to the relevant international standards. At the end of the paper, the presented solution specifies possible benefits from the implementation of an integrated management system built according to internationally recognized ISO standards.

**Keywords:** process management, risk, register of aspects, sustainability, ISO standardization

## Introduction

Operation of any organization depends on the functionality and cooperation of individual elements (suppliers, customers, material, processes, technical equipment, etc.), where this cooperation is targeted. Due to various connections, goals, and human interests, the functioning of the organization can be integrated with the overall system, in which there is also the risk of malfunction with possible disruptive effects on the company. About risk management, it remains to determine these risks and at the same time adopt strategies that reflect the benefits of dealing with them.

The description of the enterprise is useful in terms of important elements for the smooth course of risk management. In the framework of the detection of serious risks, such a description means the basic framework of the enterprise [1]. By detailed analysis of individual elements, but also their relationships in connection with the mission and goals of the company, we will obtain important data for the identification of risks. This is the methodological essence of identifying the main elements of the enterprise [2, 3]. The use of this approach is also important from a real point of view because it generally determines the approach to the examination of company risks. By business risks, we mean all activities or features of the business, the implementation of which may lead to negative consequences.

The individual risks of the company are compulsorily considered in various standardized management systems, such as the system of environmental management, quality, information security and safety, and health protection at work. These systems include aspects that are most effective to introduce into a single system, which would primarily reduce costs for organizations, ease the administrative complexity associated with the introduction, maintenance and certification of individual systems separately, and thus increase competitiveness in globalized markets and contribute to development sustainability [4, 5].

In fact, businesses must handle every element of their operations in order to thrive in a cutthroat climate, including cost-cutting, employee welfare, and environmental protection. So far, the actuality of each type of integrated system varies from organization to organization and is influenced by a wide range of internal and external circumstances [6].

When operating the often imposed regulations of quality management, environmental management, and occupational health and safety, either concurrently or

sequentially, many businesses encountered significant issues [7].

Due to the lack of alignment between the goals of the Integrated Management System - Quality, Environment, Safety and the strategic management of the company as well as the inadequacy between the improvement processes and the cost of losses, the economic impact of the standard approach of the Integrated Management System - Quality, Environment, Safety remains challenging [8].

## Materials and Methods

### Current State of Business Risk Management

Risk management is the term used to denote a reasonable and orderly method of determining the interrelationships, identification, monitoring, analysis, evaluation, behavior and communication of risks associated with any function, activity or process in such a way as to provide organizations with the opportunity to reduce losses and increase their opportunities. Risk management is directly related to the area of safety and reliability, which represent one of the central features of product quality, but also of technological processes [9, 10].

Risk management should be an important topic in people's lives as well as in organizations. Currently, organizations are aware of the need to manage risks in an integrated way across areas such as environmental, technical, security risks, economic, poor-quality risks and information security risks, etc. The ISO 31000 standard – Risk management, provides a framework for such an integrated approach [11]. Currently, new factors and conditions are emerging that affect the risk management process [12]:

- The concentration of large investments in a given enterprise and the increased alternative of causing a large damage;
- Higher sensitivity (malfunctioning) of new and complicated technologies and devices;
- Damage to the environment and depletion of natural resources;
- Financial compensation cannot always compensate for destroyed material goods.

### *Environmental Risks*

The quality of the environment is a serious factor that affects the health of people and the quality of the

ecosystem. Human activity is considered a serious cause of its deterioration.

The identification of environmental risks in the Slovak Republic focused on selected components of the environment can be demonstrated on the examples in Table 1 and Table 2.

*Economic Risks*

Economic risks contain a wide degree of cost risks caused by changes in cost data, which are mainly related to the growth of the purchase prices of the given raw materials and energy. They also contain inflation, monetary and budget risks. An important part of these risks are also risks related to foreign trade activities (exchange rate risks affecting the income and costs of activities in foreign markets carried out in the currencies of their markets; risks related to the return of receivables etc.) and foreign business (e.g., risks of conversion of the achieved profit) [13, 14].

*Technical Risks*

Factors of uncertainty in the technical field:

- Preliminary determination of the parameters and purpose of the solution, preliminary increasing level of the new solution, level of innovation potential;
- Aspects of research, development and its completion on time;
- Speed of planning and construction;
- Timely completion of investment construction, practice operation;

- Reliability of activities and equipment;
- Many other factors.

Technical risks are mainly related to the realization of the results of scientific and technical growth, they are most often associated with research and development of new products and technologies and with innovations.

*Information Risks*

Among the company's current risks, we include information risks, which we also call the information society. Information means the basis for decision-making processes that determine the meaning of the problem. Processing this information is time-consuming, and in most cases, it is impossible to solve it without using specific software products.

*Security Risk*

Security risk means a phenomenon that has a social character and the potential to cause an adverse change to the subject of security or may represent an adverse impact on the interests of another subject.

**Standardized Management of Risks According to ISO 31000**

ISO 31000 is a general standard for the risk management. It can be used in any organization, regardless of its size. It can be applied to both public and private organizations and groups, businesses and associations. It is not specific to any sector or industry

Table 1. Environmental risks associated with the reduction of air quality.

Environmental component	Impacts and potential risks
The atmosphere and air protection management	<ul style="list-style-type: none"> <li>• High proportion of emissions of pollutants from mobile sources</li> <li>• Inadequate composition of the fuel base</li> <li>• Insufficiently effective separation technique</li> <li>• Increased production of emissions from economic activities caused by the increase of economic growth</li> <li>• Persistent high energy demand of the industry</li> <li>• Low share of energy from renewable sources</li> <li>• Non-compliance with national emission ceilings</li> <li>• High share of CO<sub>2</sub> emissions per inhabitant, which ranks e.g. Slovakia among the countries with the highest production – 7.7 tons per year</li> <li>• Insufficient consideration of environmental aspects when implementing energy-intensive investments, etc.</li> </ul>

Table 2. Environmental risks related to waste management.

Environmental aspects	Impacts and potential risks
Waste Management	<ul style="list-style-type: none"> <li>• High waste production in industry, low level in circular economy</li> <li>• Increase in municipal waste per inhabitant because of rising living standards, high level of landfilling</li> <li>• Low volume of separated municipal waste components</li> <li>• Low level of waste recovery, use as second-class raw material</li> <li>• Negative impact of selected types of hazardous waste on human health and the environment. This is mainly waste from health care, PCB waste, chlorinated pops, pesticides</li> <li>• Negative impact of old loads on people's health and individual components of the environment, etc.</li> </ul>

and can be applied to any risk. ISO 31000 can be used to achieve either one or all kinds of objectives at any level and in areas related to the organization. At the same time, it can be used at a strategic as well as an organizational level and can help with decision-making, when applied to any type of activity, and finally, it can be applied when managing processes, services, projects, assets, functions, products and programs [15-17].

All organizations should behave in such a way that the level of the risk management framework adequately corresponds to the criticality of the decisions to be implemented. The list of indicators listed in ISO 3100x represents a high level of risk management performance. To help organizations measure their performance according to standard criteria are some specific indicators are presented for each indicator.

Key results have to demonstrate that:

- The organization has an up-to-date, correct and comprehensive understanding of its risks.
- The risks of the organization are inside the own criteria of the management systems, environment quality, safety, etc.

The key aspects of integrated risk management are:

1. Continuous improvement: Emphasis is placed on continuous improvement of risk management through setting organizational performance goals, measuring, reviewing and subsequently changing process, system, resources, capabilities and skills.
2. This can be expressed by the existence of clearly visible performance targets against which the performance of the organization or individuals is compared and measured. The performance of the organization can be published and communicated. Under normal circumstances, performance is audited at least once a year, and after the review, a review of processes and the setting of revised performance targets for the next period are carried out.
3. The performance assessment is an integral part of the overall assessment of the organization's performance and the measurement system for departments and individuals.
4. Full responsibility for risks: Extended risk management includes comprehensive, fully defined responsibility for risk, its control and for its handling of risk requirements. Designated individuals fully accept responsibility, have the necessary experience and sufficient resources to control the measures taken, monitor risks, effectively improve management tools and communicate with internal and external stakeholders.
5. Application of risk management in all decisions taken: Decisions within an organization, regardless of how important and significant the decision is, clearly involve the consideration of risks and the use of risk management at some level. This can be evidenced by records of proceedings and decisions which demonstrate that open discussions regarding

risks have taken place. It should be most obvious that each part of risk management is represented within the key decision-making processes in the organization.

6. Continuous communication: Improved risk management includes continuous communication with internal and external stakeholders, including full and frequent reporting on risk management performance, as part of good governance. This can be expressed through communication with stakeholders, which is an integral and fundamental part of risk management. Communication is rightly seen as a two-way process within which informed decisions about the level of risks and the need to treat risks can be correctly made according to properly established and exhaustive criteria.
7. Full integration into the management structure of the organization: Risk management is the basis for the management processes of the organization so that risks are considered as an effect of uncertainty focused on goals. Management structure and processes result from risk management. Effective risk management is considered by managers to be the basis for achieving the organization's goals. This is expressed in the language of managers and important written documents in the organization using the term "uncertainty" in relation to risks. This feature is also expressed in the provisions of the organization's policy, especially in the part that refers to risk management. Normally this attribute would be verified by interviewing managers and using evidence of their activities and provisions.

## Results and Discussions

### Design of an Integrated Enterprise Risks Register with Applied on EVO Vojany

#### *Environmental Aspects, Impacts and Risks*

The practical assessment and specification of the exploration of new type thermal power enterprises' fulfillment of environmental protection responsibilities is relatively behind the development of environmental performance evaluation of all types of power generation enterprises, particularly under the current environmental regulations [18].

The main condition for evaluating the environmental profile is to decide in advance about the company's relationship with the environment. It is necessary to determine the environmental aspects related to the company's activities and services as well as its products. Procedures for businesses to determine their environmental aspects are found in the standards ISO 14001 and ISO 14031 and others [19, 20]

According to them, the organization must define the environmental aspects necessary to create, implement and maintain procedures to:

- Find out the environmental aspects of the activities, services and its products that it can manage, and to act on them by taking them into account either in planning or in the case of new events/activities, products and services;
- Determine such aspects that have/may have significant impacts or impacts on the environment (i.e., significant environmental aspects).

Next, the process of how the organization should identify environmental aspects and determine those that will be dealt with as a priority by the organization's environmental management system is presented. At the same time, the organization must identify its environmental aspects within the subject of environmental management and take into account the inputs and outputs associated with its current and past activities, services and products.

The environmental management system is a managerial instrument that tries to accomplish predetermined environmental objectives and targets. It is a tool for recognizing and fixing environmental problems that assists businesses in meeting legal responsibilities and defined environmental performance [21].

When identifying environmental aspects, they should be considered in particular:

- Soil contamination;
- Release of dangerous substances into soil and water;
- Emissions released into the air;
- Use of raw materials and natural resources.

The demonstration of environmental aspects are environmental impacts, such as specific changes in the components of the environment. Uncontrolled aspects and impacts are the potential risk.

#### *Information Security Aspects and Risks*

The information security management system according to ISO 27001 is designed to protect information and therefore to manage risks that can potentially threaten this information [22, 23]. The information security management system is a documented system proving that identified information assets are protected, information security risks are managed, measures with the required level of assurance are in place and they are controlled.

Information is an asset that is of great value to the organization and therefore needs to be protected in an appropriate way. Information security is focused on a wide range of threats and thus ensures the continuity of the organization's activities, minimizes business losses and maximizes the return on investment and business opportunities. Information can exist in different forms [24, 25]. They can be printed, written, captured on film or sent by electronic mail. Whatever form they take or whatever means they are shared, they should always be appropriately protected [26].

The organization prefers a process approach, focusing on information security aspects such as

the assessment of computing technology, communication technology, application and information systems, but also on physical security, personnel security, security principles, organizational procedures, internal processes and procedures [27]. The result is a comprehensive assessment of the level of information protection, regardless of the form and method of its processing.

#### *Aspects of Quality, or Risks of Poor Quality*

The international standard ISO 9001 supports the adoption of a process approach when developing, improving efficiency and implementing a quality management system to increase customer satisfaction by meeting their requirements [28]. If an organization is to function effectively, it must identify as well as manage several activities. A process can be understood as an activity that uses resources and is managed in such a way as to enable the transformation of inputs into outputs. Exit from a particular process often means entering the next process directly.

This international standard specifies the requirements for the quality management system where the organization:

- Needs to demonstrate its ability to consistently provide a product that meets customer and regulatory requirements;
- Wants to increase customer satisfaction using efficient use of the system as well as processes of continuous improvement of the system and ensuring similarity with customer requirements and applicable regulations.

#### *Safety Aspects and Risks*

The ISO 45001 standard is intended for all organizations that want to create an OSH management system to eliminate or minimize risks for workers in their organization and stakeholders who may be exposed to OSH hazards [29].

The standard is also set for organizations that want to gain a competitive advantage or to reduce the most possible costs arising from fines or non-compliance with legislative requirements. It is oriented towards the protection of health and safety at work [30].

The standard is also intended for organizations whose main goal is to create an integrated management system for ensuring quality, environment and safety and information security.

The ISO 31000:2018 standard sets out recommendations (not requirements) for risk management in various areas of an organization, regardless of its size and focus. Although it includes a description of the risk management system, it is not intended for certification purposes. The standard does not have a 10-chap. structure (according to Annex SL), like other newly revised standards (quality, environment, safety). It contains 6 chap. (chap. 4. Principles, chap. 5. System, chap. 6. Process). It is recommended as a basic

standard for applying the requirements of ISO standards for management systems built according to ISO 9001:2015, ISO 14001: 2015, ISO 45001:2018, etc., which results also from chap. 6 Planning. It is therefore suitable as a basic framework for the implementation of an integrated risk management system and the unification of different approaches in risk management. The newly revised standard contains several recommendations that can be fully integrated into the standardized management systems of the organization, e.g. (chap. 5.2 Leadership and commitment = chap. 5.1 Leadership and Commitment, chap. 5.6. Evaluation = chap. 9 Performance evaluation, chap. 6.3 Subject, context and criteria = chap. 4 Context, Organizations).

### Risk Management in Integrated Management System

The integration of management systems for quality, environment and safety built according to ISO is a necessary prerequisite for simplifying management and system processes, increasing profitability and gaining a competitive advantage on the market. Many organizations are interested in integrating these systems, but do not know how to handle this complex process. For some organizations, it is more complicated, as they understand the individual components of management separately and have them distributed under different sections or divisions in their organizational structures [31].

The integration of management systems is driven by the companies' strategies toward sustainability. The stakeholders' perception is that a firm's image as a sustainable company also enhances environmental and social performance [32].

In today's complicated socio-economic situation, the guarantee of the development sustainability and success of the organizations through various types of management systems is increasingly becoming a matter of course according to the internationally recognized standards to which they belong:

1. Environment management systems (EMS), according to ISO 14001;
2. Quality management systems (QMS), according to ISO 9001;
3. Occupational health and safety management systems (OHSMS), according to ISO 14001;
4. Information security management systems (ISMS), according to ISO 27001, etc.

Integrated systems are a very effective tool of sustainable development that considers not only quality, but also access to the environment and safety and health protection at work. In addition, the system approach guarantees orientation in legislative requirements and their fulfillment, reduces administrative complexity and saves financial resources [33, 34].

An integrated management system respecting the requirements of the ISO 9001, ISO 14001, ISO 45001 and ISO 27001 standards is advantageous to

introduce and integrate into a single functioning system of organization management, linked to the risk management system according to ISO 31000. IMS would thus become a functional management tool ensuring the prevention of all potential risks in activities and processes of the organization.

For effective integrated management system, it is important to know the risks resulting from its activities and processes. Today, in the identification, analysis, evaluation, assessment, i.e. management of business risks, more exact methods based on mathematical statistics, fuzzy sets, operational analysis approaches, etc. are used. They inherently assume a certain model of the occurrence of effects, i.e. they do not admit that these effects are extraordinary also, methods based on simulated or empirical scenarios. In principle, it is possible to pick two basic approaches [35, 36]:

1. Determination of the threat of the integrated management system from the disagreement  $N$  and the period of its occurrence  $\tau$  (in the fiscal year) by methods based on extreme value theory, fuzzy set theory, chaos theory, fractal theory, etc. According to the vulnerability of the protected interests (quality, environment, health and safety, at work) in the enterprise (process, technology, activity), determine the total damage due to non-conformity  $N$  (in monetary units) marked as  $S$ . The risk  $R$  is then given by the relation

$$R = \frac{S}{\tau} \quad (1)$$

2. Determination of the non-conformity scenario of the largest expected non-conformity size (it is possible to use the probable size of the expected non-conformity or the value of the normatively determined non-conformity or the least favorable non-conformity according to the requirements of the relevant ISO standards) and according to the data for the given company, or process to determine:
  - according to the protected interests and their vulnerability to impacts in the non-conformity scenario, determine the total damage to the enterprise (process) in monetary units  $S$ ,
  - according to professional data from databases or expert estimates, determine the frequency of occurrence of the largest expected non-conformity, standardized for 1 change of  $f$

$$R = S * f \quad (2)$$

For business management, we need to determine the integrated risk calculated for all possible non-conformities that contribute to the disruption of the integrated management system. To determine the integral risk of the system, which reflects all possible non-conformities that contribute to the disruption of the integrated management system, it is possible to use the sum of the risks calculated for each non-conformity.

Integral risk of the system expresses the probable magnitude of unacceptable impacts (losses, damages and injuries) of all possible non-conformities that contribute to the disruption of the integrated management system.

Based on the formulas, it is possible to identify the risks of individual managerial subsystems (quality, environment, safety, etc.) and of the integrated management system as a whole. The relation then gives the integrated risk  $R_{IN}$  as follow:

$$R_{IN} = \sum_{i=1}^l R_i \tag{3}$$

where  $R_i$  for  $i = 1, 2, \dots, l$  are the risks of partial subsystems. When considering  $n$  possible non-compliances that contribute to the disruption of the integrated system, the total integrated risk  $R_{CIN}$  of non-compliance is determined as follow:

$$R_{CIN} = \sum_{r=1}^n R_{IN,r} \tag{4}$$

*Integrated Management System in the Conditions of Thermal Power Station*

As a result of our research, a concept of the model was proposed for the implementation of the integrated

management system in the conditions of thermal power plants. The system is built on the basis of new-revised international ISO standards and the application of integrated risk management according to ISO 31000 (see Fig. 1).

The solution was verified and modified in the operational conditions of the EVO thermal power plant and its outputs were generalized to the benefits of such integration.

Integration will be made possible by the unification of the newly revised standards into 10 key elements for these management systems, i.e., an integrated policy of the organization, better participation of “everyone” in its implementation, saving time, lower costs and, apparently, a better position of the organization in terms of its responsibility towards stakeholders, society and development sustainability.

The standards of individual management systems are intended for certification purposes. ISO 31000 - Risk management - Guidelines is a guide for risk management.

The basis for the risk management in the integrated management system is the creation of an integrated register.

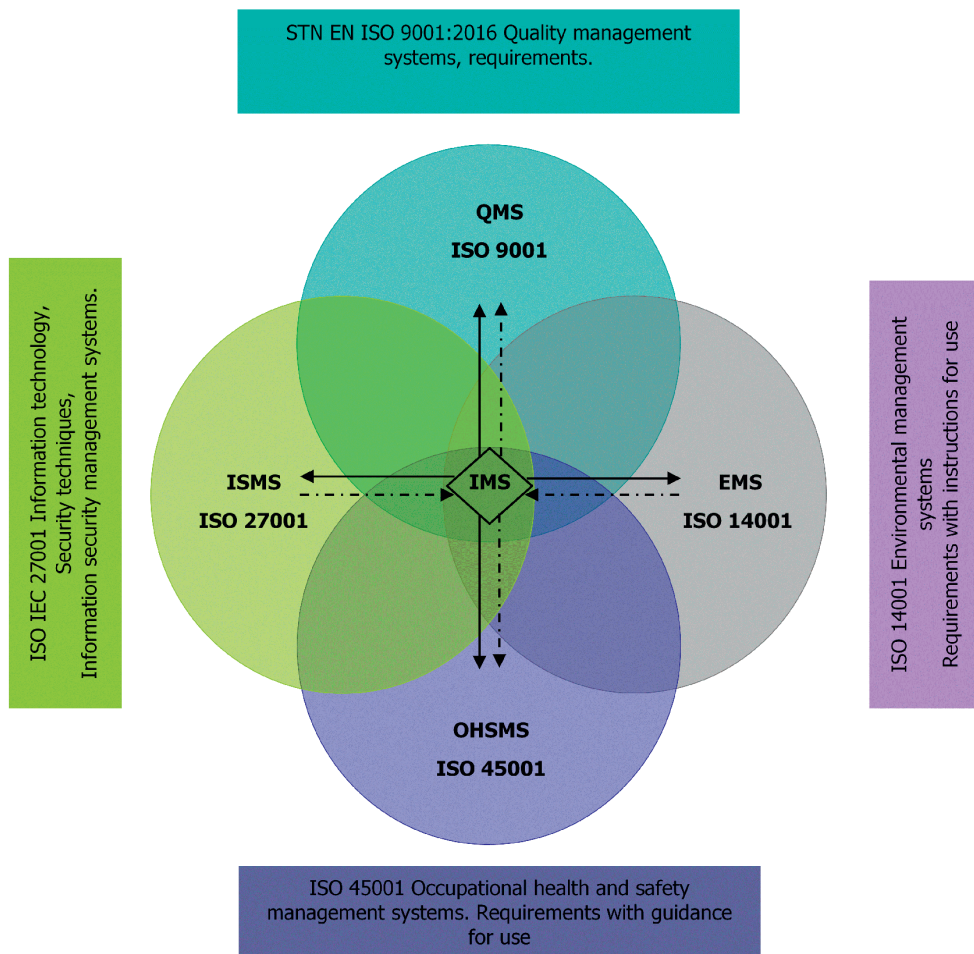


Fig. 1. Model of integrated management system in thermal power station.

Register E- IB-K Aspects, Impacts and Risks  
of EVO Vojany

EVO Vojany deals with the production and distribution of electricity, production and distribution of heat, production and distribution of filtered and demineralized water for the internal needs of the plant's mechanical technology and fire-fighting water. EVO Vojany is the largest thermal power station in Slovakia

and is currently looking for development incentives for its stagnant operation also in the context of black coal burning [37].

The company built two independent sources of electricity production, one coal dump, one central cooling water pumping and purification station, one pumping and filtering station, two electricity block substations, one slag-ash mixture depot, one stabilizer depot and industrial and municipal waste dump. EVO

Table 3. Identification sheet E-IB-K aspects, impacts and risks of operation EVO.

Number	Header	Note
1.	Aspect code (risks)	<ul style="list-style-type: none"> <li>• XXXX – department number, or number of the section where the aspect was identified;</li> <li>• ZZ/B – aspect number/aspect type</li> </ul> Aspect type: E – Environmental I – Information security S – Safety Q – Quality aspect
2.	Place of aspect's origin	The specific place where the aspect arises is added
3.	Activity	The name of the activity in which the given aspect arises is added
4.	Aspect name	The name of the environmental, information security or quality aspect is added
5.	The impact and possible risk	The following code is added depending on what the given aspect affects: En – Environment (air, water, flora, fauna, soil), W – Work environment I – Information security S – Safety Q – Quality
6.	The time factor	A code is added depending on whether the aspect relates to past, present or future activity. Pa – past activity Cu – current activity Fu – future activity
7.	Operating factor	The following code is added depending on whether the given aspect is considered for normal or specific operational activities or is related to the activity carried out by the supplier organization on the territory of the plant, or is related to potential emergency conditions. No – normal activity Sp – specific activity Or – ordinary activity Su – suppliers. Em – emergency conditions
8.	The importance of the aspect, or risks	The significance category (numerical value) is added, which we obtain by evaluating the aspect. The addition of the highest achieved significance category is carried out as follows: <ul style="list-style-type: none"> <li>• <i>The most important aspect</i> - a remedy is immediately implemented to eliminate the resulting consequences and a corrective measure is proposed and implemented to eliminate the cause in the shortest possible time = 5;</li> <li>• <i>Emergency significant aspect</i> – there must be an emergency measures plan = 4;</li> <li>• <i>Significant aspect</i> – considering its inclusion in long-term or short-term goals to achieve continuous improvement and ensuring that the aspect is operationally managed and monitored = 3;</li> <li>• <i>Moderately important aspect</i> – there must be a procedure for operative management and monitoring of the aspect = 2;</li> <li>• <i>Less important aspect</i> – there must be a monitoring procedure, at the same time it is considered whether it is necessary to develop a procedure for operational management of this aspect = 1;</li> <li>• <i>Insignificant aspect</i> = 0.</li> </ul>



Table 3. Continued.

9.	Monitoring procedure (MP) and identification number	The identification number of the monitoring procedure is added, or if there is no identification number, the name of the monitoring procedure is added for each significant aspect.
10.	Operational management procedure and identification number of guideline (G)	The identification number of the operational management procedure is added, or if there is no ID number, the name of the operational management procedure is added for each significant aspect. For an aspect with a determined significance category 1, it is considered whether it is necessary to develop an operational management procedure, for an aspect with a determined significance category 0, not an operational management procedure is needed.

has established and certified QMS and EMS according to valid standards. During the next certification or surveillance audit, aspects of ISMS and OHSMS management can also be included into the integrated management system in accordance with ISO standards. To create a register of corporate risks related to the merging of environmental, information security and quality aspects, an identification sheet “List of E-IB-K aspects” (Table 3), useful for the operation as a whole.

The list of the aspects is developed, revised and supplemented in Register according to this methodology. In the register of E-IB-K aspects, all environmental, information security aspects and production quality aspects of the EVO Vojany plant are listed. Register is complex and extensive, approximately 80 pages with approximately 20 aspects on each page. For the illustration is in the Table 4 listed only the torso of the Register for the operation of engine room EVO.

For the needs of environmental management, environmental aspects, impacts and risks of all activities and processes at EVO Vojany were identified. Problems related to the rehabilitation of tailings pond of the dross-ash mixture sludge were also analyzed in detail [38].

The creation of the Register is the initial step into the risk assessment process in the integrated management system of the EVO Vojany operation. Subsequent procedural steps in risk management according to ISO 31000 are documented in Fig. 2, with the fact that they are included in the Register.

Our research focused on operational aspects, impacts and risks not only in the engine room, but also in other operations, especially in the boiler room, during coaling with a share of biomass and waste, at the tailings pond of mixture sludge dump, the landfill of the stabilizer, etc. Our research can be considered as a part of the construction and implementation of standardized management systems according to ISO standards. In terms of the LCA life cycle analysis according to ISO 14040, E-IB-K risks were identified only in the power plant operation phase in order to extend the life of the processes in the intentions of the best available techniques and technologies. Based on the subject and purpose of integrated risk management, the construction and end-of-life phases of power plant combustion processes were not investigated in more detail, as is the case with the LCA and LCI methodologies.

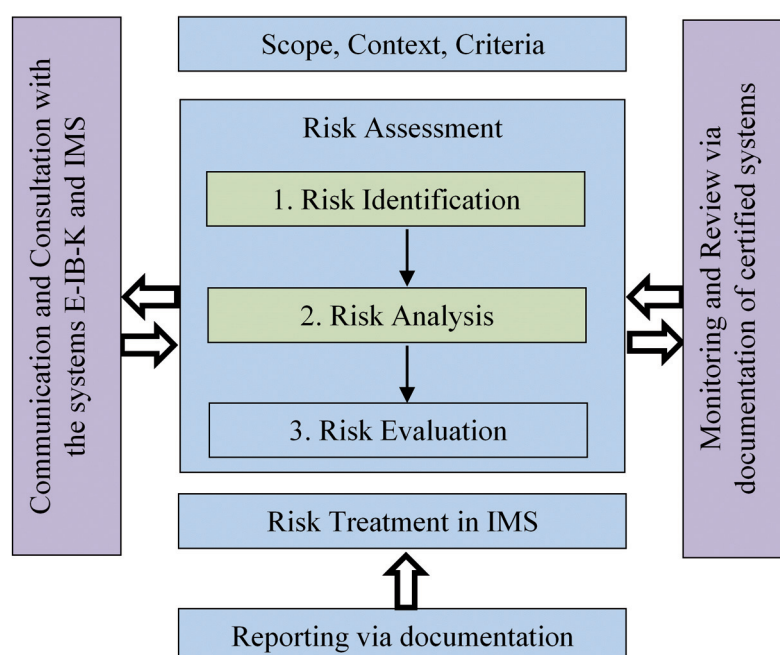


Fig. 2. Process of risk management according to ISO 31000 in the integrated management system.

Table 4. Costs of reusable surgical cover per one surgical procedure.

1. Aspect code	2. Place of origin of the aspect	3. Activity	4. Risk		5. Impact	6. Time factor	7. Operating factor	8. Importance of the aspect	9. Receptors	10. Procedure for operational management and identification number
			Aspect name	Risk						
62021 01/B	Engine room	Operation of the device	Vibrations		W	Cu	Sp	1	EVO/ZSM-011 OHS	-
62022 02/E	Operation	Oil filtering	The formation of material contaminated with harmful substances		En	Cu	Sp	3	MPP for filtration	EVO/SM-013.15 OM – oil management
62022 03/E	Operation	Equipment repair	Generation of waste from insulating materials		En	Cu	Su	2	EVO/SM-13.15 OM	EVO/SM-13.15 OM
62021 /1-12/ 04/B	Engine room	Operation of the device	Heat (radiant)		W	Cu	Sp	0	EVO/ ZMS-011 OHS	-
62022 05/E	Operation	Operation of the device	Oil leakage into water		En	Fu	Em	4	MPP for engine room EVO I	Plan of measures in case of leakage of substances harmful to waters in EVO
62021 06/B	Engine room	Operation of the device	Noise		W	Cu	Sp	3	EVO/ ZMS-011 OHS	EVO/ ZMS-011 OHS
62021 07/B	Oil economy	Maintenance of OM equipment	Generation of material contaminated with harmful substances		W	Cu	No	3	EVO/SM-13.15 OM	EVO/SM-13.15 OM
62023 08/E	Operation	Replacement of worn mono-cells	Generation of dry galvanic cell waste		En	Cu	No	3	EVO/SM-13.15 OM	EVO/SM-13.15 OM
62021 09/B	Operation	Equipment repair	Generation of waste from insulating materials		W	Cu	Su	2	EVO/SM-13.15 OM	EVO/SM-13.15 OM
62022 10/E	Engine room	Operation	Generation of oily waters		En	Cu	Sp	3	MPP for normal operation	MPP for normal operation
62023 11/K	Operation	Operation	Construction		Q	Mi	No	1	MPP for normal operation	-
62023 12/K	Operation	Operation	Performance		Q	Pa	No	2	MPP for normal operation	-
62023 13/K	Operation	Operation	Accuracy		Q	Cu	No	2	MPP for normal operation	-
62023 14/K	Operation	Operation	Fortress		Q	Cu	No	2	MPP for normal operation	MPP for normal operation

Table 4. Costs of reusable surgical cover per one surgical procedure.

62023 15/K	Operation	Operation	Weight	Q	Pa	No	1	MPP for normal operation	-
62024 16/I	Office	Safety operation	Confidentiality	I	Cu Fu	Or	2	MPP for safety operation	MPP for safety operation
62024 17/I	Office	Safety operation	Integrity	I	Cu Fu	Or	1	MPP for safety operation	-
62024 18/I	Office	Safety operation	Availability	I	Cu Fu	Or	1	MPP for safety operation	-
62024 19/I	Office	Safety operation	Responsibility	I	Cu Fu	Or	2	MPP for safety operation	MPP for safety operation
62024 20/I	Office	Safety operation	Reliability	I	Cu Fu	Or	2	MPP for safety operation	MPP for safety operation

Adding the Register for the continual improvement

The model for the integrated management of operational risks of the EVO thermal power plant is a continuing process of environmentalization in the intentions of the best available techniques and technologies (BATT) according to the BREF and REF documents, during the burning of black coal in the energy industry.

Gradual implementation of managerial systems for quality, environment and health and safety in EVO according to international standards, subsequent implementation of corrective environmental, and safety measures designed after continuous improvement audits brought undeniable benefits to the operator of the power plant and also revealed other weaknesses as a potential for continuous improvement and its management. Concretely, they were actions such as desulfurization and denitrification, co-incineration of wood chips with coal and waste, remediation of the dross-ash mixture tailings pond, on which we collaborated as members of research team). The growing number of independently implemented management systems according to ISO standards and the related mandatory auditing of both systems and processes according to ISO 19011: Auditing of management systems, disproportionately increases the demands. Dozens of mandatory audits (internal and external) according to programs, certification, supervision, recertification audits of continuous improvement are demanding technically, organizationally, personally, financially and in terms of time. Another problem is the fact that some aspects, impacts and risks may overlap in the systems, and on the other hand, some aspects, impacts and risks may be omitted.

The proposed model for integrated risk management, the developed E-IB-K register and the policies derived from it for individual systems can be an effective tool in the field of auditing. The synergistic effect will be achieved by managing and maintaining the integrated risk management system through auditing and verification of the system functionality by combined or joint audit according to ISO 19011.

Possible benefits from the integration of standardized management systems and their linkage to the standardized risk management system according to ISO 31000 are included in Table 5.

### Conclusions

The integrated management system built in the organization according to ISO standards represents an excellent management tool for the realization of leaked intentions and defined goals of both manufacturing and non-manufacturing organizations in the field of management of environmental protection, work safety, quality of provided products and management of information security of assets. It effectively helps to maximize the market value and sustainable green growth of the organization. In organizations,

Table 5. Benefits of the integrated management system based on newly revised ISO standards.

Benefits from the risk management in the integrated system	Specifics of benefits for the organizations
For the strategic development targets	<ul style="list-style-type: none"> <li>• An effective, uniform and systemic tool for business process management recognized worldwide;</li> <li>• Protection of health and environment from the environmental impacts of the organization's activities;</li> <li>• Fulfilment of objectives in the field of safety, environment and quality;</li> <li>• Implementation of announced strategic development objectives of sustainability;</li> <li>• Better relations with customers, state organizations and customers;</li> <li>• Improving the image of the organization;</li> <li>• Increasing customer satisfaction.</li> </ul>
For the sustainable operational behaviour	<ul style="list-style-type: none"> <li>• Clearly defining the responsibilities and powers of employees;</li> <li>• Implementing the system in the management of organizational, management and operational documents;</li> <li>• Legitimization of evidence related to the observance of legal and organizational obligations, focused on the damage incurred by the customer.</li> </ul>
In the area of process management	<ul style="list-style-type: none"> <li>• Reducing costs related to correcting errors, or disagreements in production activities and in connection with the provision of services;</li> <li>• Improving the environmental profile;</li> <li>• Introduction of environmentally suitable bat technologies;</li> <li>• Reduction of waste production;</li> <li>• Reducing environmental risks;</li> <li>• Meeting legislative requirements;</li> <li>• Improving cost control and saving input materials and energy;</li> <li>• Determination of responsibility and authority in individual processes and activities;</li> <li>• Optimization of the work process.</li> </ul>
Working-Employee	<ul style="list-style-type: none"> <li>• Protection of health and the environment against possible environmental impacts of their activities,</li> <li>• Assistance in fulfilling the legal obligations of the organization in the field of health and safety at work of employees;</li> <li>• Involvement of employees in OSH;</li> <li>• Safe workplaces motivate qualified employees;</li> <li>• Permanent improvement of the level of safety and health protection at work;</li> <li>• Creating favourable working conditions and working relationships.</li> </ul>
In the area of the economic development	<ul style="list-style-type: none"> <li>• The possibility of achieving significant economic benefits compared to the competition;</li> <li>• Adequate position on the competitive market;</li> <li>• Integrated growth of the organization at all levels and levels;</li> <li>• Meeting the criteria for obtaining permits and licenses;</li> <li>• Obtaining a competitive advantage in tender procedures;</li> <li>• Improving the business profile;</li> <li>• Increasing the possibilities of applying in the globalized market;</li> <li>• Increasing the goodwill of organizations.</li> </ul>

in connection with building an integrated management system, such a procedure is clearly preferred, in which an integrated system is built, aimed at expansion the previously built functional and certified management system, e.g., quality, environment and other aspects.

IMS is from the point of view of investigated by us or another organization in the any area is currently and, in the future, considered a key management tool for the sustainability of production, consumption, green growth and the green economy.

Integrated strategic operational risk management is gaining importance today and in the near future (in connection with the global energy crisis and the implementation of "green" energies) and is becoming necessary. Analyzes and assessments of the life cycle of the product system (LCA, LCI) of thermal power

plants (including EVO) bring clear conclusions leading to their gradual decommissioning - as "environmentally unsuitable". From a technical point of view, as a necessary additional resource to "green" nuclear power plants and from the point of view of energy security with green energies at the time of the current global crisis, system and process innovations in thermal power plants are justified.

It is significant that despite the change in perception of nuclear power plants from originally "non-ecological" to today's "green" and the simultaneous massive development of renewable energy sources, overcoming the energy crisis from a global perspective will be a "long distance run". This is also the reason, why the extension of the operation phase in the life cycle of a thermal power plant by implementing globally

recognized and used ISO standards in the integrated management of the organization is justified today.

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### Conflict of Interest

The authors declare no conflict of interest.

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