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Стаття надійшла до ред.
07.09.2015 р.

УДК 330.332.16

JEL Classification: A23; D81; L92

RISK MANAGEMENT DESIGN OF INVESTMENT PROJECTS AT POWER GENERATION ENTERPRISES

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Electric power industry as a leading energy sector of Ukraine needs constant renewal and development. Therefore, realization of investment projects aimed at the modernization and reconstruction and at the construction of new power generation enterprises is appropriate. Since the process of project implementation is accompanied by a number of risks, in this case, a question arises as to the necessity

of designing risk management of investment projects. Resolving this issue has become the purpose of the study, for which theoretical and empirical methods of scientific knowledge have been used. Risk management is an effective tool by which risks are minimized and the planned project objectives are achieved. As a result of the research, the scientific and methodical approach to the design of risk management of investment projects at power generation enterprises has been improved. The basis of the study is the project for construction of power units No. 3, 4 at Khmelnytska nuclear power plant. The design was based on the identification of project characteristics that form the background of the risks. The expediency of taking into consideration the type of contract for the further redistribution of risks between project participants has been determined. The necessity of risk management integration using the system, process and situational approaches has been revealed. The details of the business process "risk management" which is aimed at the integrity of the investment project management, and the support of both basic and providing processes have been described. Thus, the integration of risk management through systematic, process and situational approaches provided an opportunity to shift the emphasis of risk management from the corrective function to the preventive one. The description and specification of the process of risk management formed the basis of the recommendations for management of investment projects at nuclear power plants.

Keywords: risk management, investment project, power generation enterprise, system approach, process approach, project management.

**ПРОЕКТУВАННЯ РИЗИК-МЕНЕДЖМЕНТУ
ІНВЕСТИЦІЙНИХ ПРОЕКТІВ ЕНЕРГЕТИЧНИХ ПІДПРИЄМСТВ**

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Електроенергетика як провідна галузь енергетики України потребує постійного оновлення та розвитку. Тому доцільним є реалізація інвестиційних проектів, спрямованих на модернізацію і реконструкцію та будівництво нових потужностей підприємств електрогенерації. Оскільки процес реалізації проектів супроводжується низкою ризиків, то в такому разі постає питання щодо необхідності у проектуванні ризик-менеджменту інвестиційних проектів. Вирішення цього питання стало метою проведеного дослідження, для здійснення якого було використано теоретичні та емпіричні методи наукового пізнання. Ризик-менеджмент є тим дієвим інструментом, за рахунок якого мінімізують ризики та досягають намічених цілей проекту. У результаті дослідження вдосконалено науково-методичний підхід до проектування ризик-менеджменту інвестиційного проекту енергетичного підприємства. За основу в дослідженні було взято проект зі спорудження енергоблоків № 3, 4 Хмельницької атомної електростанції. Проектування ґрунтувалось на визначенні особливостей інвестиційного проекту, котрі формують передумови виникнення ризиків. Визначено доцільність урахування типу контракту для подальшого перерозподілу ризиків між учасниками проекту. Розкрито необхідність в інтеграції ризик-менеджменту на основі системного, процесного і ситуаційного підходів. Здійснено деталізацію процесу "ризик-менеджмент", спрямованого на цілісність системи управління інвестиційним проектом, та підтримання інших процесів: як основних, так і забезпечувальних. Отже, інтеграція ризик-менеджменту шляхом застосування системного, процесного та ситуаційного підходів надала можливості змістити акценти управління ризик-менеджменту з коригувальної функції на превентивну. Опис та деталізація процесу ризик-менеджменту лягли в основу рекомендацій для управління інвестиційними проектами на атомних електростанціях.

Ключові слова: ризик-менеджмент, інвестиційний проект, підприємство електрогенерації, системний підхід, процесний підхід, управління проектом.

ПРОЕКТИРОВАНИЕ РИСК-МЕНЕДЖМЕНТА ИНВЕСТИЦИОННЫХ ПРОЕКТОВ ЭНЕРГЕТИЧЕСКИХ ПРЕДПРИЯТИЙ

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Электроэнергетика как ведущая отрасль энергетики Украины нуждается в постоянном обновлении и развитии. Поэтому целесообразным является реализация инвестиционных проектов, направленных на модернизацию и реконструкцию и строительство новых мощностей предприятий электрогенерации. Поскольку процесс реализации проектов сопровождается рядом рисков, то в таком случае возникает вопрос о необходимости проектирования риск-менеджмента инвестиционных проектов. Решение данного вопроса стало целью проведенного исследования, для осуществления которого были использованы теоретические и эмпирические методы научного познания. Риск-менеджмент выступает тем действенным инструментом, за счет которого минимизируются риски и достигаются намеченные цели проекта. В результате исследования усовершенствован научно-методический подход к проектированию риск-менеджмента инвестиционного проекта энергетического предприятия. За основу в исследовании был взят проект по сооружению энергоблоков № 3, 4 Хмельницкой атомной электростанции. Проектирование базировалось на определении особенностей инвестиционного проекта, которые формируют предпосылки возникновения рисков. Определена целесообразность учета типа контракта для дальнейшего перераспределения рисков между участниками проекта. Раскрыта необходимость интеграции риск-менеджмента на основе системного, процессного и ситуационного подходов. Осуществлена детализация бизнес-процесса "риск-менеджмент", который нацелен на целостность системы управления инвестиционным проектом, и поддержки других бизнес-процессов: как основных, так и обеспечивающих. Итак, интеграция риск-менеджмента путем применения системного, процессного и ситуационного подходов дала возможность сместить акценты управления риск-менеджмента с корректирующей функции на превентивную. Описание и детализация процесса риск-менеджмента легла в основу рекомендаций для управления инвестиционными проектами на атомных электростанциях.

Ключевые слова: риск-менеджмент, инвестиционный проект, предприятие электрогенерации, системный подход, процессный подход, управление проектом.

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Rising domestic demand for electricity makes power generation enterprises implement investment projects for reconstruction and modernization and for construction of new capacities. Implementation of investment projects at power generation enterprises is accompanied by a number of risks that can lead to negative consequences, for example the exceeded estimated costs. There is a question about the necessity of designing risk management, which is aimed at the achievement of planned project objectives with minimal losses. The risk management of a project is an important part of it. It is based on the principle statements of a management system of a company.

A great contribution to the development of theoretical principles and applied recommendations to solve the problems of risk management implementation of investment projects was made by such native and foreign scientists as: Gracheva M. V., Kaplan R., Katasonov V. Yu., Korolkova E. M., Martsynkovskiy D. A., Simon P., Sekerina A. B., Hilson D., Shlopakov A. V., Soin K., Collier P., Yima R., Castaneda J., Doolen T., Turko M. O., Tumer I., Malak R., Feng G., Chang-Richards Y., Wilkinson S., Ti Cun Li etc. [1 – 11]. The scientists Galsanov B. B.,

Manaienko I. M., Notovskyi P. V. [12 – 14] dedicated their works to the organization of risk management at power distribution enterprises. Zubakin V. A., Kalinchik V. P., Kokorina M. T., Pavlova O. C. [15 – 17] and others made a great contribution to proving the necessity of risk management at power generation enterprises.

However, these scientific achievements do not fully include the specifics of Ukrainian realities. On the one hand, these achievements are subject to the legislation requirements, and on the other hand, they are affected by the international factors.

That is why there is a need to develop conceptual statements about the design of risk management of investment projects at power generation enterprises.

The object of the article is a scientific-methodical and practical study of risk management of a project, which is based on system, process and situational approaches.

The following theoretical and empirical methods were used in the study: analysis and synthesis were used for studying the scientific works on the topic and identifying those issues that have not been fully investigated; a system

approach was used for the definition of management of investment projects and the expediency to integrate risk management into the system; a process approach was used for designing risk management of a project as a providing process; a situational approach was used to consider the risk management in terms of risk situations that other processes of the system project have.

The development of nuclear energy and industry will play an important role in the Energy Strategy of Ukraine up to 2030. By 2030 the strategy will have involved the construction and putting into operation new nuclear power units [18, p. 55–56]:

- construction of power units No. 3, 4 of Khmelnytska nuclear power plant (NPP) (Kh3Kh4);
- construction of units at new nuclear sites;
- construction of new units at the available nuclear sites (including the replacement units to be decommissioned).

The Kh3Kh4 project was taken as a basis for further research. For successful implementation it is reasonable to project risk management, which will focus on the integration of three key approaches in management: system, process and situational.

Analysis of the feasibility study (FS) of project Kh3Kh4 revealed its key features, that form the risk background of the investment project.

1. Implementation in the face of great bureaucracy.

The Cabinet of Ministers of Ukraine (CMU) approves the feasibility study as the cost of the project exceeds 100 million USD.

However, before you approve the feasibility study in the CMU, you must obtain permission of at least five government agencies: the Ministry of Finance of Ukraine (MF), the National Commission for State Regulation of Energy and Utilities (NCSREU), the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine (Regional Development), The Ministry of the Energy and Coal Industry of Ukraine (MECI), the Ministry of Justice of Ukraine (MJ). The process of approval of the feasibility study aims to achieve consensus between the company, which implements the project, and these bodies. It lasts from 3 to 6 months. As a result, there is a risk of delay of the start of the investment project, a renegotiation of its components, re-approval of the project.

2. Capital intensity of the project.

The estimated project cost is 36 456 608 million UAH, that is why budgetary appropriations and funds of the company "Energoatom" are not enough for this project. So funding for the project is possible involving credit from IFI secured by the state guarantees.

3. Insufficient financial stability of the power generation enterprise.

The project will be implemented by loans. So there is a question about the service of the loans. Therefore, finding sources of loan repayment requires a clear justification. One source is the inclusion of the investment component to the tariff for selling electricity by nuclear power plants (NPPs). In such case, there is difficulty in the process of harmonization of the project feasibility as to the tariff surcharge for NPP and getting permission from the National Commission for State Regulation of Energy and Utilities, which sets rates. The process of negotiations requires additional time that has a negative impact on the financial stability of the company.

4. The long term realization.

The investment projects of building new power units at nuclear power plants involve step-by-step works and implementation of measures that focus on long-term realization. The time length of investment expenditures and getting

benefits requires consideration of value changes of money in time, inflation, changes in the political and economic situation and uncertain result. However the peculiarity of the Kh3Kh4 project is also its implementation history, which goes back to the mid-80s of the last century and continues to this day.

5. The political and economic situation.

The political, economic and social situation in the country has become worse because of a series of negative events such as revolution, changing political parties, a sweep of hostilities in eastern Ukraine that has a great impact on investments of enterprises in power generation and realization of investment projects. So as a result, the date of putting power generation units Kh3Kh4 into operation was changed from 2016 – 2017 to the years 2020 – 2021.

6. The uniqueness of the project.

Each project is unique with its own characteristics, that are not identical to other similar projects. Construction of a nuclear power unit is a high-tech performance and highly intellectual complex work on the innovative basis, aimed at the safe operation and smooth functioning after construction. So the implementation of such a complex work requires the attraction of highly skilled professionals with experience in design, construction, putting into operation and operation of nuclear power units.

For the design of risk management of a project it is more reasonable to take into consideration the type of contract. According to the approved edict of CMU of 4 July 2012 [19], the Kh3Kh4 feasibility study indicated that the project had to be realized. Accordingly, the main funding scheme was adopted: 20 % of units were to be paid by the tariff component of "Energoatom" and 80 % by were to be covered by loans, that would be provided under the intergovernmental agreement between Ukraine and the Russian Federation (RF) [20, p. 26]. However, after signing the agreement, Russia has not fulfilled its obligations. In addition, another factor that influenced the suspension of the project was a political risk, which had not been taken into consideration in the feasibility study. Thus, the neglect of political risk showed how important further implementation of risk management to complete the project will be.

Nowadays the project conditions have changed and one of the potential partners in completing the construction of power units Kh3Kh4 can be the Czech company "Skoda" [21]. According to the agreement which had been signed between Ukraine and Russia in accordance with the contract on a "turnkey bases", Russia assumed a great part of the risks. It is reasonable to distribute responsibilities between the Ukrainian and Czech parties and other involved stakeholders because conditions and sources of funding for the project have changed. In this case, a solution to funding issues, minimizing risks and delegation of responsibility is project financing (PF). All project participants, risk assessment, project operations are indicated in the PF schemes; responsibilities for operations and risks and the ways to minimize them are identified there.

It was planned within the project Kh3Kh4 to attract such members as public authorities; a regulatory body; an operating organization; a general contractor; an architectural and engineering firm (the general designer); subcontractors; a supplier of equipment and systems; a supplier of fuel; consultants. However, if the future project is implemented within the PF, according to the loan agreements and contracts the participants of the project will be the lender, insurance companies and guarantors. The main PF member is the creditor, who accepts risks completely or partially related to the implementation of the project. Payment obligations of the loan recipient are paid solely or mainly due to cash proceeds, that are received from the sale of the project.

Including the high level of risk, each project participant seeks to secure himself against default within the contracts. Risk management is a system that involves step-by-step procedures aimed at achieving optimal results (in terms of profitability and reliability), evaluation of risk situations and minimization of the project risks, providing financial stability for all the project participants. It must be integrated into all phases of the project and into the project management system in general.

Risk management must be integrated into the system because the project management system consists of interrelated elements such as people, structure, tasks, technologies and processes. The integration of risk management of a project should be implemented by means of a process approach, because business processes (basis and providing) of the project management are carriers of risk situations. In this case, risk management is a preventive function, which ensures the integrity of project management and supports all business processes of the system.

According to paragraph 3.4.1 of the International Standard ISO 9000: 2005, a process is a set of interrelated and interacting activities, which transforms inputs into outputs [22]. In this case, the business process of risk management (RM) can be presented schematically as shown in Fig. 1.

The risk manager is responsible for the process, he creates an organizational infrastructure for risk management at the company and develops main provisions and guidelines related to these activities. The ideological task of the risk manager and his team is the development of the basic principles of risk management in the organization [4, p. 66]. It is necessary to prescribe script actions for each subprocess that a risk manager should follow. During implementation of the business process he is responsible for correction of the scripts according to the changes in the external and internal context process.

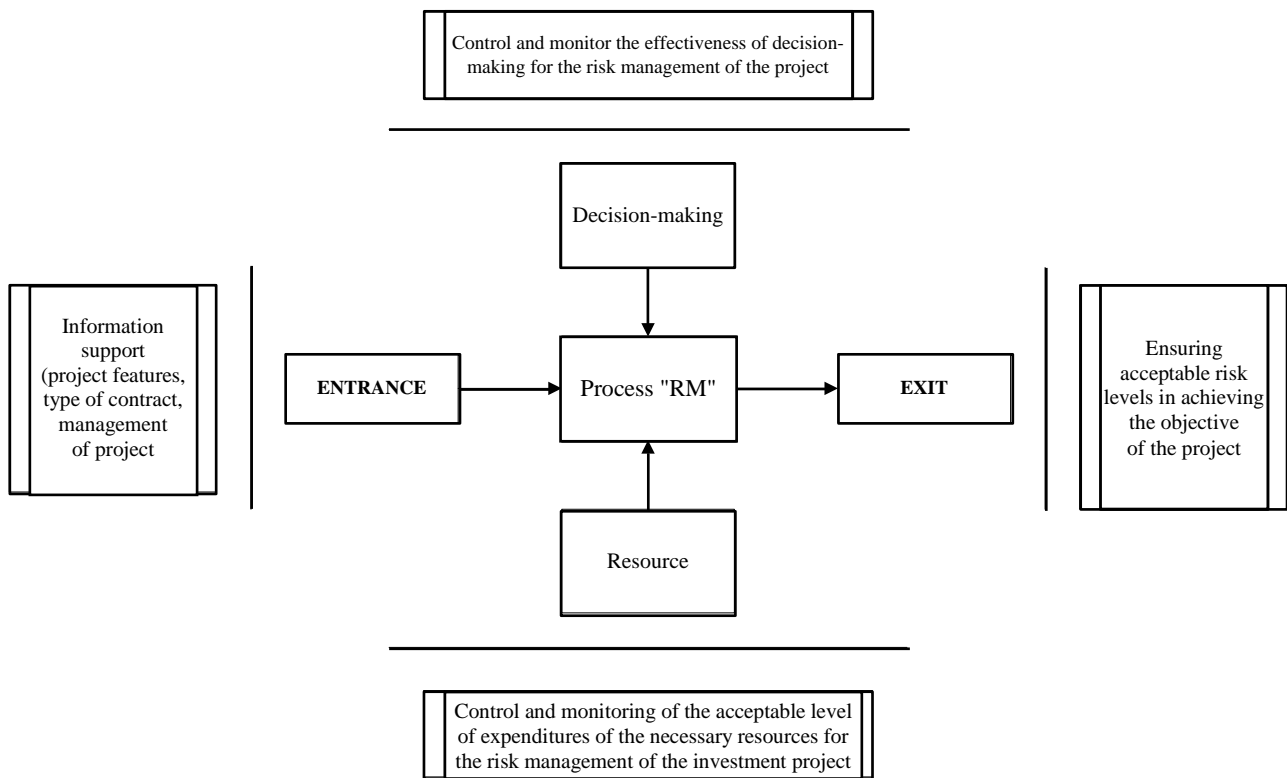


Fig. 1. A business process scheme of risk management in an investment project (developed by the authors)

If the business process gets the code PrP.1, its components will get the subprocess codes PrP.1.1, PrP.1.2 ... PrP.1.n. Subprocesses of RM are: risk identification, analysis, evaluation of the identified risks, development of a risk management plan, monitoring and risk control, preparing reports on risks etc. According to the international standard ISO 31000: 2009 "Risk Management – Principles and Guidance" [23], the business process of RM interacts with such components as communication and consultation, the database of the project risks, setting the context. A detailed scheme of the business process is shown in Fig. 2.

The business process RM, which is a providing process should be focused on supporting the basic processes of the project. These include: BP.1 Design; BP.2 Purchase of

goods; BP.3 Construction work; BP.4 Putting into operation; BP.5 Operation. Each basic process has a subprocess, which is implemented step by step. Integrity and sequence of subprocesses of basic processes depend on the integrated process RM. Fig. 3 shows the function of subprocesses providing the process RM in accordance with the basic processes of project management. Moreover it is expedient to note that subprocesses PrP.1.1 – 1.4 (identification, analysis, risk assessment and development activities of management work in parallel with the BP.1 (design) and PrP.1.5 (risk monitoring) works during the implementation of the process BP.2 – 5 (Procurement of goods, Construction, Commissioning, Operation). The approach involves prevention of project risks and leads it to a successful completion.

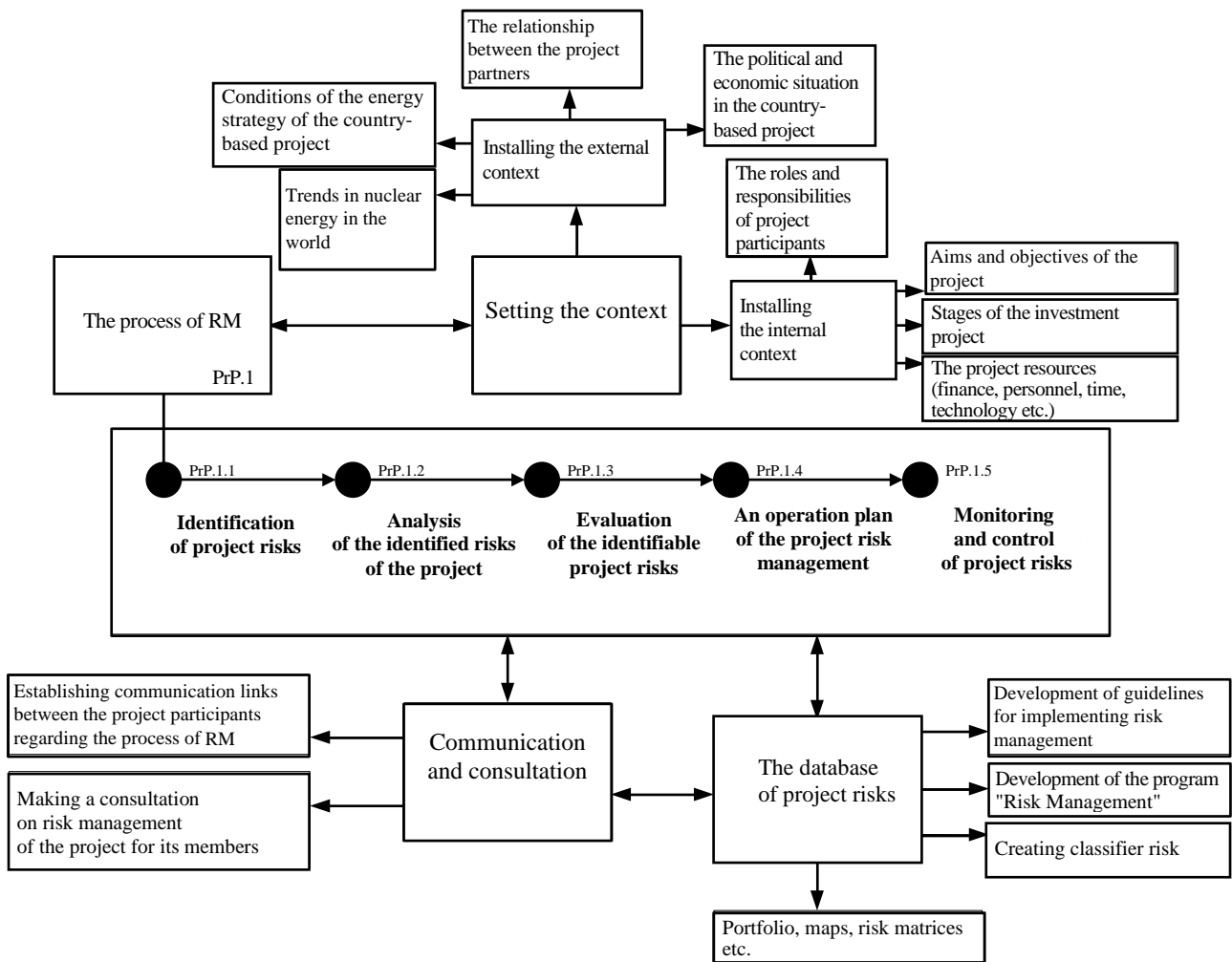


Fig. 2. The detailed business process of risk-management in the project Kh3Kh4 (developed by the authors)

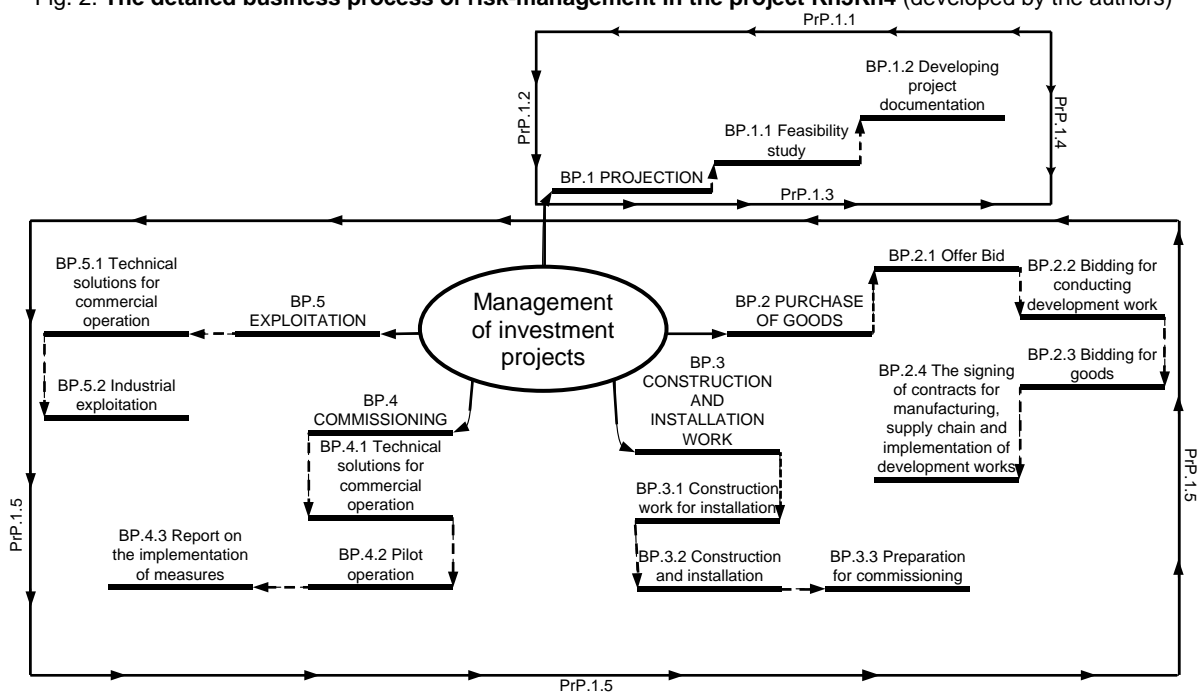


Fig. 3. A scheme of providing the process of risk management operation during the implementation of the basic processes of the project Kh3Kh4 (developed by the authors)

Kh3Kh4 feasibility study includes the concept of governance, which involves such business processes as: development and keeping to schedules, quality assurance, cost management [24, p. 9]. Risk management in this concept takes place in block decisions on the implementation of corrective measures, i.e. risks are taken into consideration after becoming apparent. In the authors' view, this approach is not effective because it does not perform a preventive function. These business processes at power generation enterprises refer to support processes (providing processes). So a block diagram of providing project management processes Kh3Kh4 including the statements of risk management is shown in Fig. 4.

Risk management of the project, which is integrated into the management system, must correspond to the following characteristics [1, p. 64–65]:

- 1) application of a systematic approach to risk management, which involves integrity, complexity, system's ability to integrate new elements;
- 2) integration with the risk management of each participant who is involved in the project, i.e. correspondence to

the strategies of economic security, companies, banks, insurance companies, etc., and operational features;

3) correspondence of goals and objectives of the project, defining the highly specific nature of decisions within the project management system;

4) focus on risk situations that affect the deterioration of the financial stability of the company;

5) support to other basic and providing business processes for successful implementation of the project.

Risk management is an effective tool for monitoring deviations in individual business processes, that take direct part in the implementation of an investment project. Constant monitoring and control of risk-making factors, abnormal and emergency situations can prevent the emergency and increase the effectiveness of the investment project. The systems approach gives an opportunity to identify the investment project management system, its elements and processes (risk management is integrated into them). The process approach in management of the investment project makes it possible to implement new business processes and support its basic and providing processes.

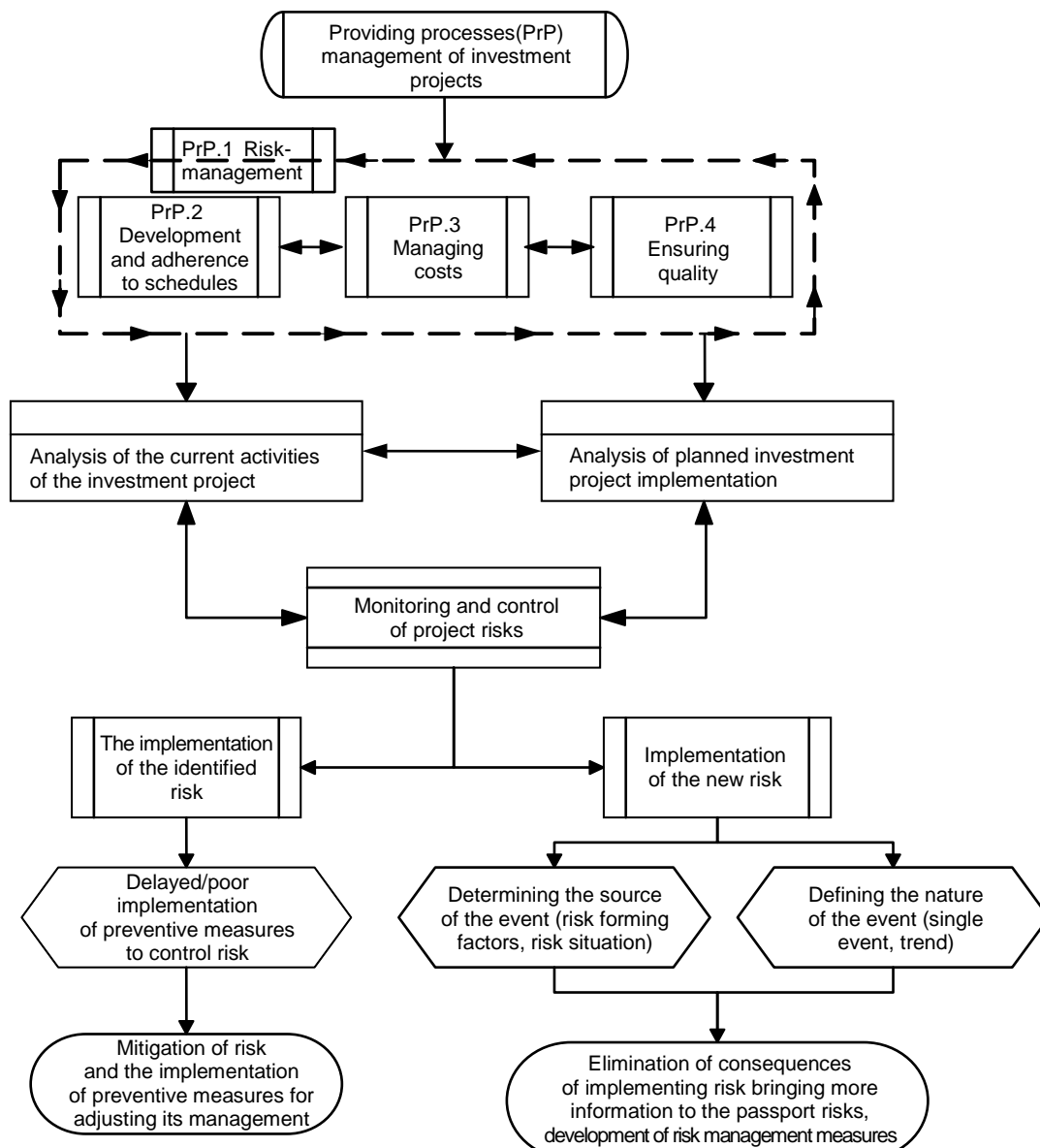


Fig. 4. A scheme of providing management processes in the investment project Kh3Kh4, including the statements of risk management (compiled by the authors, using [24, p. 9] as a basis)

Designing risk management of investment projects, which is implemented by power generation enterprises, requires a combination of system, process and situational approaches for visualization of management of their basic stages. The decomposition project management system can prevent risk situations by using the tools of risk management.

The originality of the study is in the improvement of the investment project management concepts of the development of scientific and methodological basis for designing risk management, using the system, process and situational approaches on the integration basis in risk management and turning the focus of the risk management from the corrective function to a preventive one. It is based on the determination of the background of the risks that are specific for a certain investment project at a power generation enterprise.

The practical value of the study is in the detailed description of the process of risk management for the investment project at the plant.

Further scientific research will be focused on the evaluation of procedure effectiveness in risk management in the context of the feasibility of using its equipment.

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Стаття надійшла до ред.
08.09.2015 р.