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RISK MANAGEMENT IN THE PROJECT OF IMPLANTATION OF THE REPOSITORY FOR LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE

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ABSTRACT

Project RBMN is part of the Brazilian solution for the storage of radioactive waste generated by the activities of nuclear energy in Brazil. The aim of RBMN is to implement the National Repository to dispose the low and intermediate-level radioactive waste. Risk is a characteristic of all projects, and it is originated from uncertainties, assumptions and the environment of execution of the project. Risk management is the way to monitor systematically these uncertainties and a guaranty that the goals of the project will be attained. A specific methodology for the risk management of the Project RBMN is under development, which integrates models and processes for identification and analysis of risks, reactions, monitoring, control and planning of risk management. This methodology is fundamental and will be of primordial importance for future generations who will be responsible for the operation at final stages, closure and institutional control during the post-closure of the repository. It will provide greater safety to executed processes and safeguarding risks and specific solutions for this enterprise, guaranteeing the safety of the repository in its life cycle, which has a foreseen duration of at least three hundred years. The aim of this paper is to present the preliminary analysis of the opportunities, threats, strong points and weak points identified up to now, that will provide support to implement risk management procedures. The methodology will be based on the PMBOK® - Project Management Board of Knowledge – and will take into consideration the best practices for project management.

1. INTRODUCTION

The present Brazilian nuclear scenario includes three nuclear power plants (NPP) – Angra 1 and Angra 2, in operation, and Angra 3, under construction – and the use of radionuclides in industry, medicine, agriculture, and environmental and research and development (R&D) activities. In the future, it is also proposed to construct four more NPPs and new installations of fuel cycle [1]. In all of these activities radioactive waste (RW) is generated in smaller or greater quantities. Then the current situation already justifies a construction of a national repository to store definitively all the RW produced in Brazilian territory. The Project RBMN (RBMN) has the objectives to establish, control and execute all the tasks for the implantation of the Brazilian Repository, from its conceptual design until its construction and commissioning. As established by regulatory authorities, it will be especially designed and licensed to store low and intermediate-level wastes (LILW).

The aim of this paper is to present the preliminary analysis of the opportunities, threats, strong points and weak points identified up to now, that will provide support to implement risk management procedures. The methodology will be based on the PMBOK® - Project Management

Board of Knowledge – and will take into consideration the best practices for project management [2].

2. RBMN PROJECT

Repository is a licensed facility that meets all requirements established by the regulators, where RWs are definitively stored (disposal), without intention of removing them. A near-surface repository is an installation for disposal of radioactive waste located at or within a few tens of meters from the earth's surface, generally used for storing of intermediate and low-level wastes [3].

The Brazilian Ministery of Science, Technology and Innovation (MSTI) is responsible for implementing, among other targets, a Brazilian Policy for the Management of Radioactive Waste, aiming at the safe management and storage of RW generated in Brazil [1]. CNEN, one of the institutions of MSTI, is responsible for the disposal of the RW generated in the country, in accordance with Brazilian law n. 10.308 [4], which establishes the responsibilities, and the licensing and funding processes for waste repositories.

Consequently in November 2008, the "Project RBMN" (RBMN) was launched with the objective to have a licensed and commissioned repository to store LILW. The inventory to be stored includes the wastes from the NPPs operation, nuclear fuel cycle installations and from the use of radionuclides in medicine, industry, environment and R&D activities. Material classified as NORM and TNORM is not foreseen to be stored in this repository.

To manage the RBMN it was established a Work Breakdown Structure (WBS) that consists in the following phases: initiating, project management, waste inventory, conceptual design, site selection, licensing, basic and detailed designs, procurement of equipment and instrument, construction, pre-operation, commissioning and closing. The crucial phases for the project success are: conceptual design, site selection, licensing and the construction.

In the conceptual design phase, the waste disposal option is selected. The most important aspects are established here, in relation to inventory, safety and protection of human beings and environment, and consequently the general acceptance criteria for the waste packages [5]. The management system should incorporate systems and processes to comply with all requirements and also to demonstrate this compliance.

The site selection process for the waste repository includes a series of sequential activities: the identification of regions of interest, of preliminary areas, of potential areas, and finally the establishment of the candidate sites. The selection should take into account 4 factors: ecological, geological, physiographic and socio-economical.

The Repository licensing is composed by two processes: the environmental licensing which is responsibility of the Brazilian Environmental Agency (IBAMA), and the nuclear one, which is given by the Nuclear Regulator – CNEN/ Diretoria de Radioproteção e Segurança Nuclear (DRS), responsible for the evaluation of the Safety Analysis Report of the installation.

After all these steps the Repository will be constructed. The construction phase is the period when all construction work is undertaken including site preparation, and construction of operational and administrative buildings, storage facilities, and the disposal facility itself [5]. During the construction the operational procedures are finished and organized for the commissioning. After the commissioning the Repository is ready to operate.

The repository should be operated for circa 60 years, and after its closure, it will start the institutional control period, totalling 300 years when the site will be released for unrestricted use. Consequently the studies should propose design and procedures to assure that during all this time the facility will meet the safety requirements. This approach is very important, since the staff will change many times until the end of the institutional control. Furthermore, RBMN has other original feature besides being the first repository of this kind to be constructed in Brazil, it is also the first in South America.

3. RISK MANAGEMENT

Risk is a common feature of all projects, and it is originated from uncertainties, assumptions and the environment of execution of a project. There are always uncertainties and unexpected events can occur. When they happen, they will affect a project in a beneficial or hazardous way. Risk management is the way to monitor systematically these uncertainties and a guaranty that the goals of the project will be attained.

A methodical evaluation of the risks in a project is an asset, because this approach and the continuous activity enhance the capability of risk identification, control and reduction, heightening the probabilities and impacts of favourable events and lowering the effects of negative events to the project. As projects get bigger and more complex, their risk management demand a more co-ordinated effort of their teams.

Nowadays, the relevance of risk management is worlwide accepted. A more efficient risk management could have avoided, for example, great financial losses to investors during an economy crisis, as well as some harmful accidents to comunities and environment. Institutions have been trying to apply these concepts when managing their projects, to solve their problems and making them successful projects.

Whenever a project is unique, being an activity never accomplished before, it has intrinsic risks. Lack of proper technical knowledge, incompatible technologies, technological advancements, changes of scope, turnover of the working team are just a few examples of the uncertainties that can jeopardize a project.

4. RISK MANAGEMENT OF RBMN PROJECT

As source of ionizing radiation, RWs are hazardous; therefore, they must be managed in a way that they will not harm human health or the environment, neither in the present nor in the future. Technical and operational processes for waste management are already firmly established *per se*, with its own set of standard rules and procedures, which avoid inherent risks, assuring safe operations. The concern with future generations is part of *l'esprit* of radioactive waste management, which grasps the concept of sustainable development from the 1987 World Commission on Environment and Development's report: "Sustainable development is the development that meets the needs of the present without compromising the needs of future generations to meet their own needs".

By the other hand, RBMN, as a project, has its share of uncertainties and risks, which must be managed. At the beginning of the project, management methodologies had not been developed neither for the Project itself nor for the risks. At that time, the activities were ruled by intuition and empiricism. From 2010 on, proper methodologies of project management and risk management specific for RBMN begun to be developed. It should be noted that there is no methodology established, in Brazil, to manage risks in repositories for LILW, since RBMN is the first project in this area. Therefore, to fulfill this need, the authors are aiming at providing a methodology to lower

uncertainties during RBMN execution, during the repository operation, its closure and institutional control.

5. INTERNATIONAL SCENARIO OF NUCLEAR ENERGY

Considering the risk management of RBMN, there are external factors that can affect the project, like international and/or national scenarios, which have great relevance to risk assesment and management strategies.

During the 1980's, there was a lower interest in nuclear energy, due to many factors: the accidents of Three Mile Island and Chernobyl, high cost for building NPPs at that time; low cost of gas for thermoeletric plants, etc. Sustainability, global warming, plus the increasing demand for eletrical power, made nuclear energy more attractive, since it is a cleaner and more sustainable source of energy, in accordance to global warming worries. This scenario brought a renaissance of nuclear energy, from 2001, when many countries also increased their nuclear programmes. [6]

Among the concerns with this renassaince, RW management is of relevance, and a very important component of the new policies. This can be seen in the 2010 "Council Directive on the management of spent fuel and radioactive waste" for the European Union, where further steps should not be taken without giving suitable answers to the matter of RW [7].

This concern is also present in Brazil, and led to IBAMA's decision that the environmental licensing process for the construction of the repository should be started before the start up of Angra 3 [8]. This was an additional reason for the launch of RBMN, in 2008.

6. RISK MANAGEMENT METHODOLOGY

The scope of the methodology is to develop and integrate models and processes to risk management. This will enable to treat uncertainties of RBMN proactively, mitigating the negative effects. In other hand it will also give support to enhance the potential opportunities to improve the project performance, for all stakeholders in RBMN. In summary, the steps will be carried out in such a way that will enable reductions in costs, under and overestimations refering to the schedule, human and technical resources.

The methodology is based on the PMBOK® - Project Management Board of Knowledge –a guide published by the Project Management Institute (PMI) [2], and will employ the best practices for project management. This methodology is primordial, especially for the stages of operation, closure and institucional control of the repository, because these stages must be planned and forecasted during the execution of RBMN. This will enable the future generations, who will manage these stages, take advantage from performed procedures and having an available set of possible risks specific to this enterprise, and their solutions, in order to provide the assurance of maintainance the repository in the safety conditions established for its life cicle, i.e., for more than 300 years. Therefore, RBMN needs tools that enable the management and maintenance of records and registry of occurrences throughout at least three centuries.

The process of risk management spreads throughout the entire life cycle of a project, interacting with the other areas of management of the project. The processes of risk management and the products of each of them are given in Fig.1. The activities to be developed for risk management processes are described in Table 1.

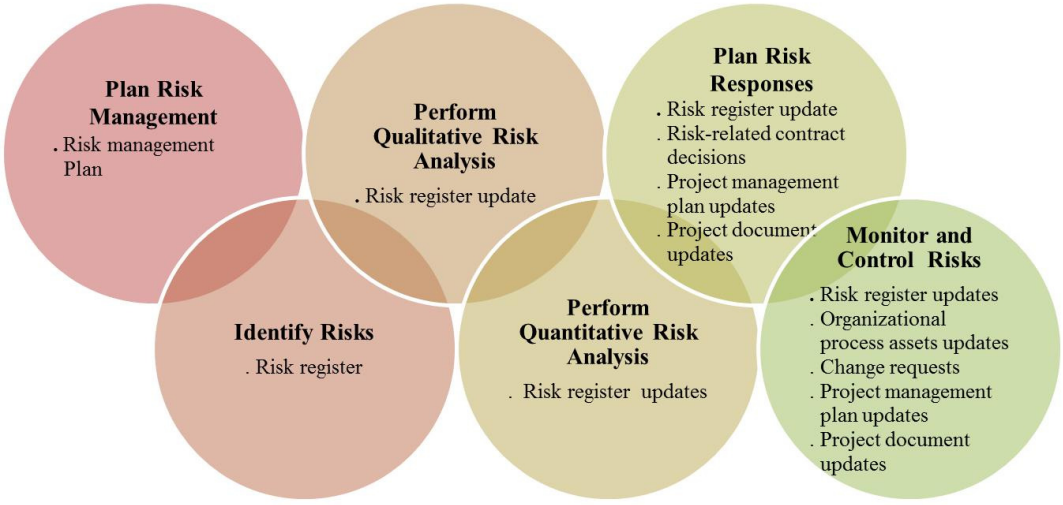

Figure 1. Overview of the risk management of a project.

Table 1. Process activities

Process	Activities
Plan of Risk Management	Definition of: approach, structure and execution of risk management; responsabilities; schedules; resources and an agreed basis of evaluation. Methods for sorting risks and their levels of tolerance are documented, to lead the staff in actions of further processes of management.
Risk Identification	All risk possibilities are raised, data are formalized and documented, i.e., elaboration of a basis for the management of a project until it ends. New risks can be identified along the life cycle of a project, due to changes of its environment. This relies on the whole staff, so each risk has a nominated responsible person for it and for the necessary actions. External interested parts should also provide relevant data.
Perform Qualitative Risk Analysis	Characterization of the most important features to risk priorization and to additional action analysis, through the evaluation and combination of their probabilities of occurrance and impacts.
Perform Quantitative Risk Analysis	Numerical analysis of the effect of identified, qualified, and priorized risks to the general goals of a project, quantifying gains and losses, in financial terms and as positive or negatives consequences.
Plan Risk Responses	Development of options and the determination of actions to enhance the opportunities and reduce threats to the goals of a project.
Monitoring and Control Risks	Control of the execution of the plans of reactions and evaluation of the efficiency of the methodology, selected tools and models, and corrective and preventive actions for the effective implantation of the methodology.

6.1 Preliminary SWOT Analisys of RBMN Project

A preliminary analysis of the risks of RBMN was conducted by a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis. It is divided into two parts: the external environment to the organization (opportunities and threats) and internal environment (strengths and weaknesses). The external environment is totally outside the control of the organization, its represents opportunities or threats to the sucess of the project. The aim of identifying these factors is the elaboration of strategies to take advantage of the new opportunities and neutralize the threats from external inffluence to a project, use the strong points and act to eliminate the weak points from internal inffluence; this analysis was employed in the process of Risk Identification, as summarized in Fig.2.

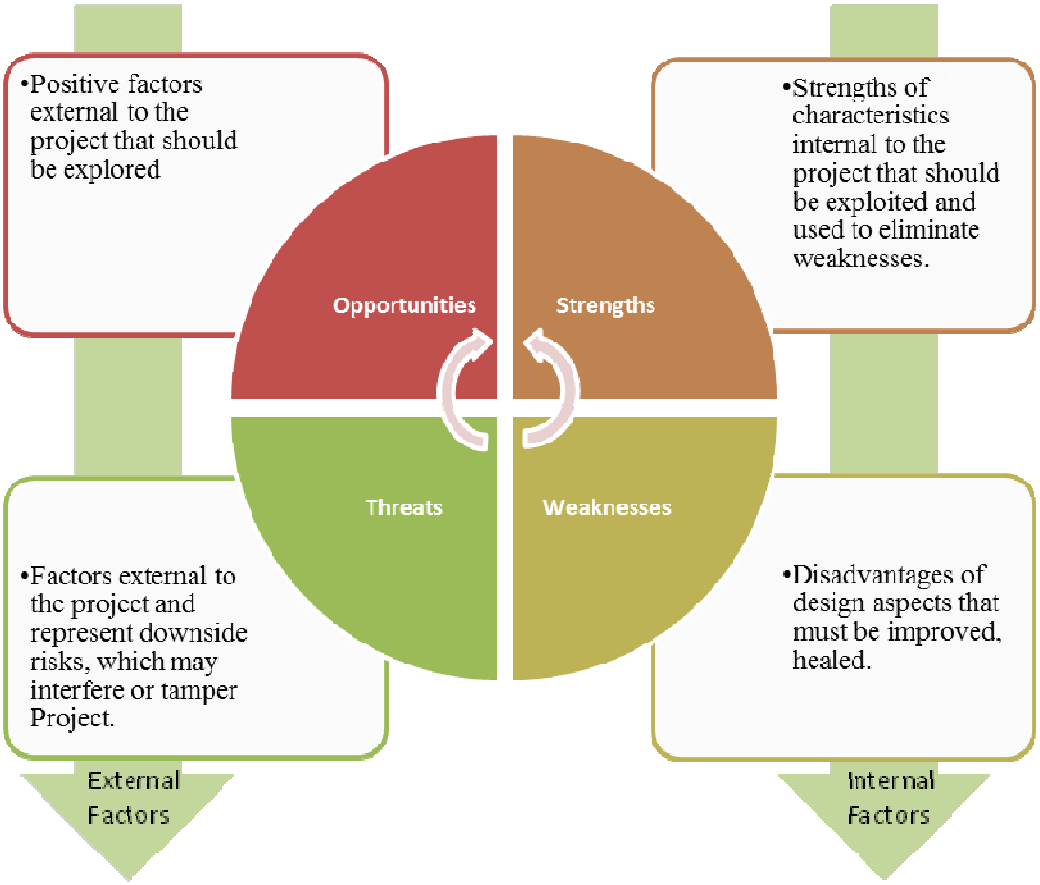

Figure 2. Scheme for Project SWOT RBMN

The technique is based in quick brainstorms to document preliminarly the risks from the external and internal environments of a project, with the following questions:

- Which are the weak points of the project?
- Which are the strong points of the project?
- Which are the opportunities that the external environment might provide to the project?
- Which are the threats that the external environment might have to the project?

The main entrance to SWOT analysis is the Work Breakdown Structure (WBS), where the work packages from the scope of a project are pormenorized. Fig. 3 shows, in a macro level, the work packs of RBMN, and identified external and internal factors that affect the project.

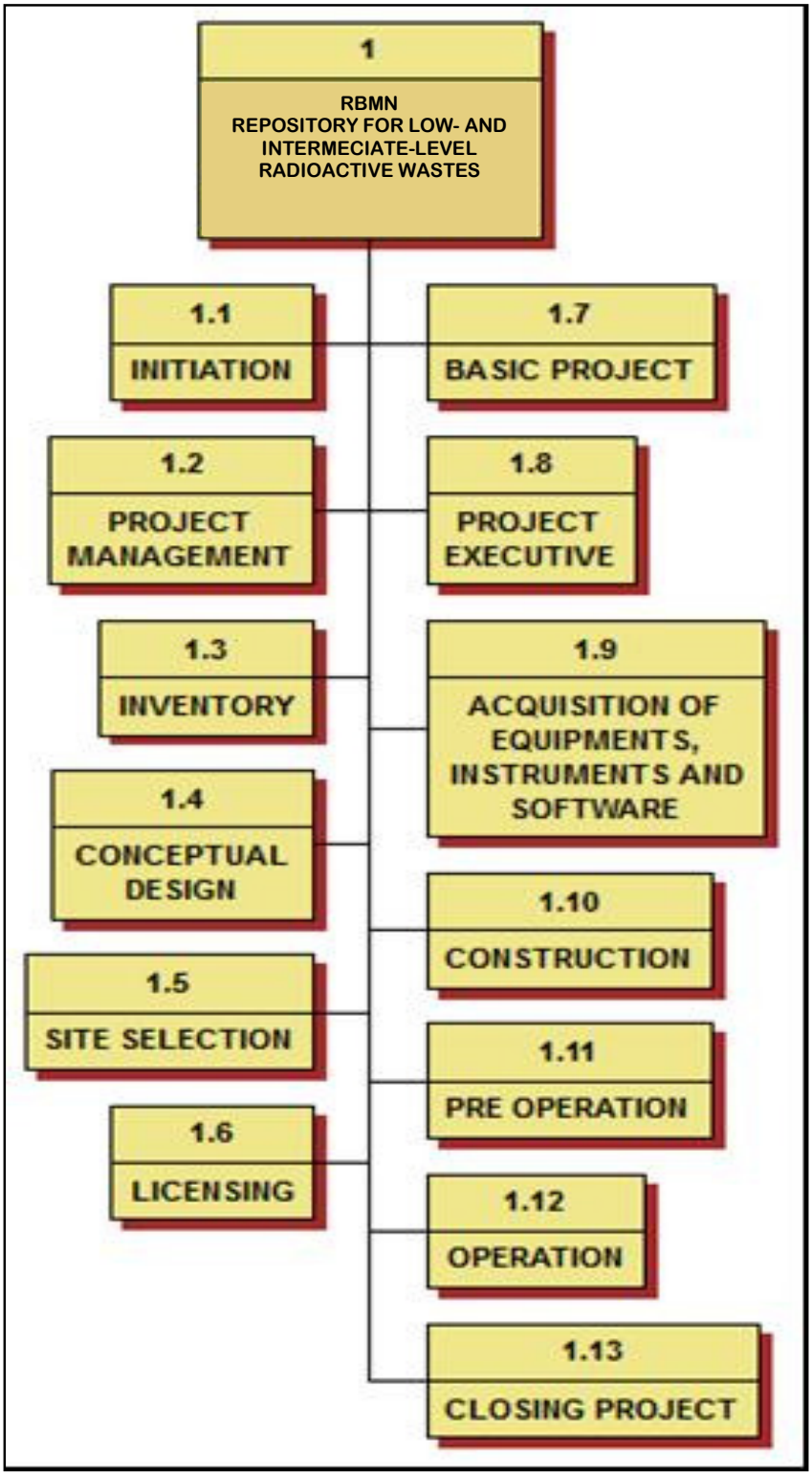

Figure 3. WBS of the Project RBMN

From the WBS, the answers to the four questions aforementioned were inserted in a spreadsheet, sorted by issue, for which weights and relevance were atributed. Relevance has levels from 1 to 3 (low, medium, high, respectively). The product (weight x relevance) classifies the risk level to the project. The issues in which the risks were grouped are presented in Fig. 4.

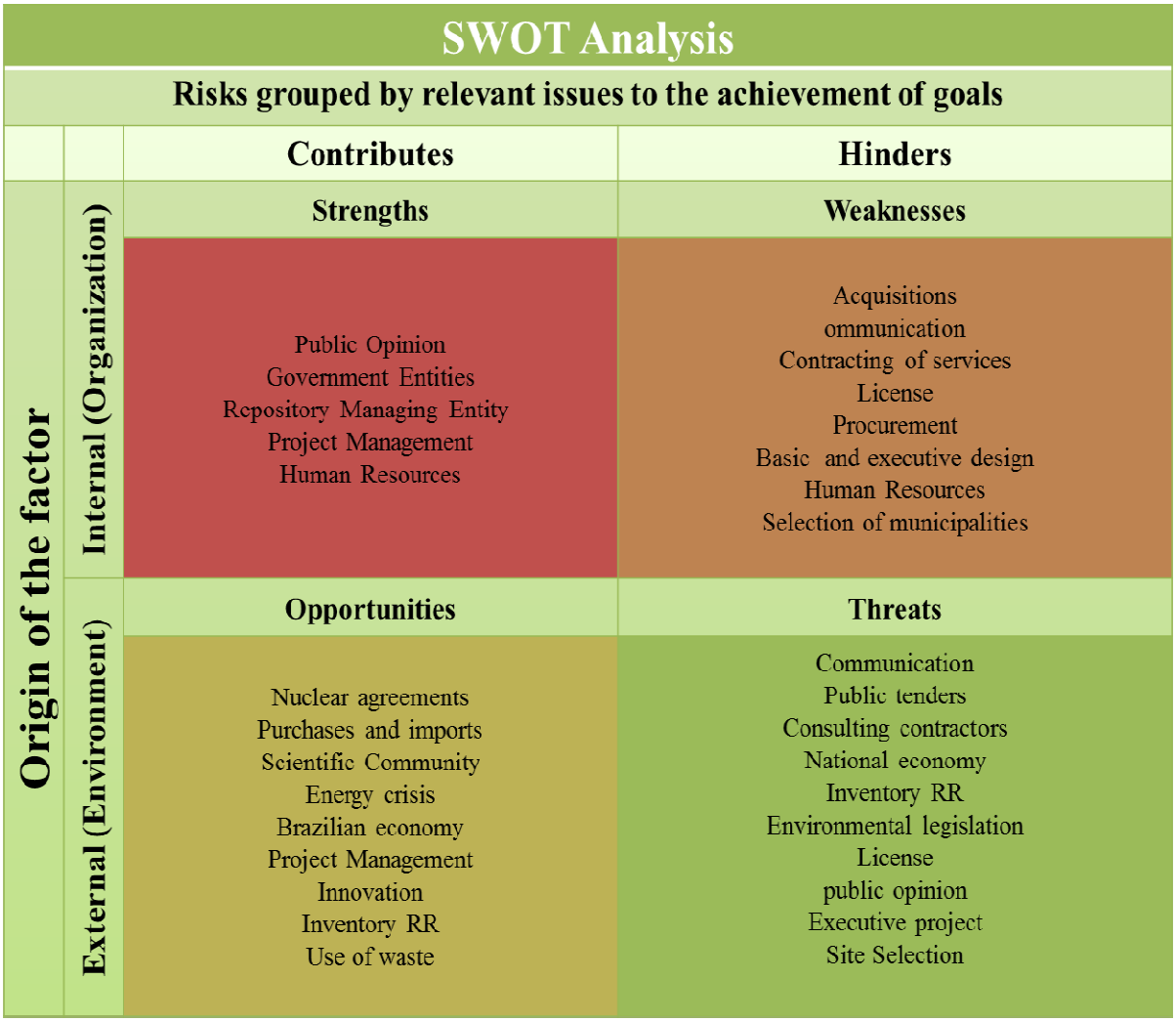

Figure 4. SWOT – Relevant subjects of the RBM

In Fig. 5 and Fig. 6 the risks identified in the initial stages of RBMN are summarized by the internal and external factors, respectively. They will be monitored, considering their ratings through risk response plans.

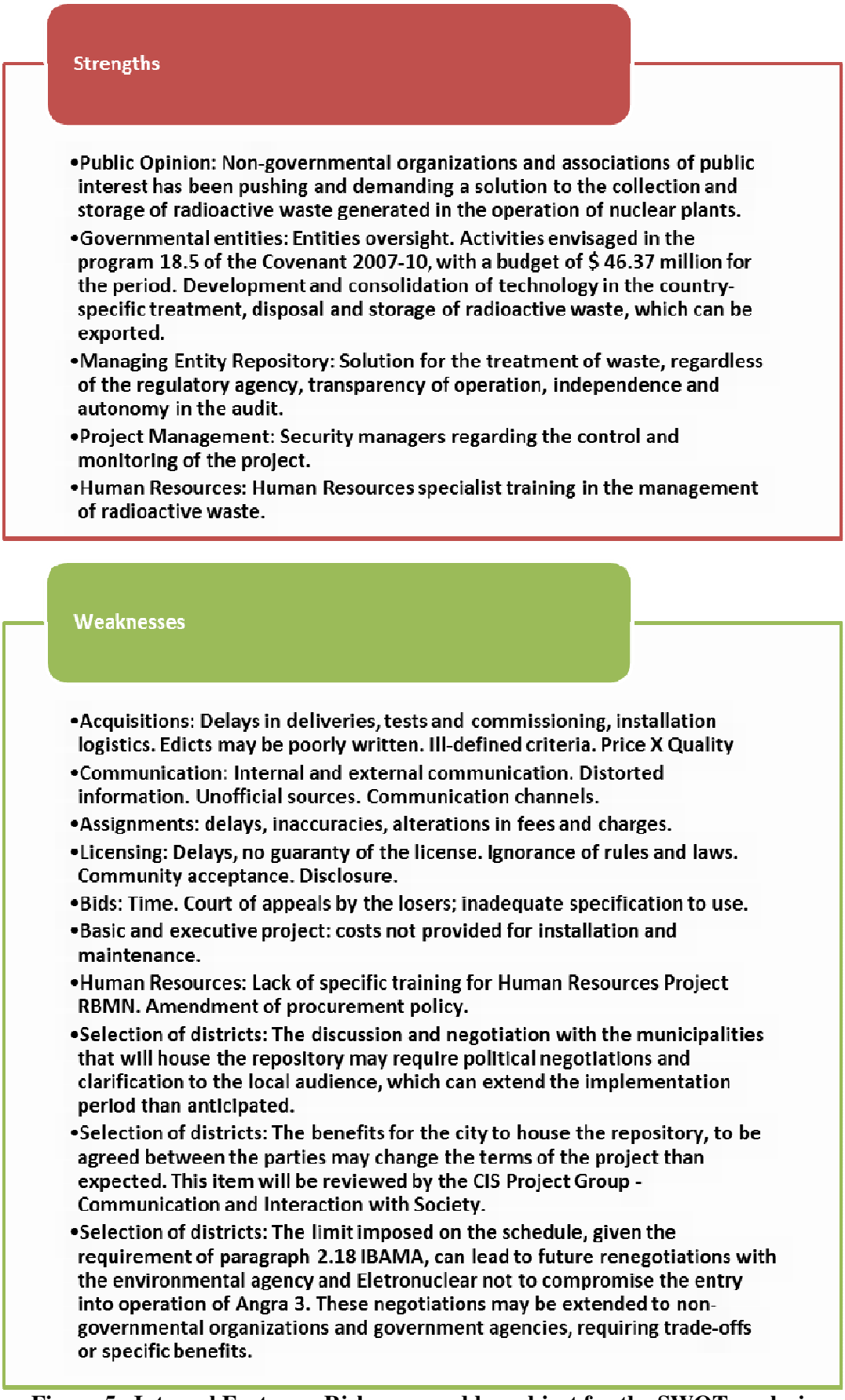

Figure 5. Internal Factors - Risks grouped by subject for the SWOT analysis

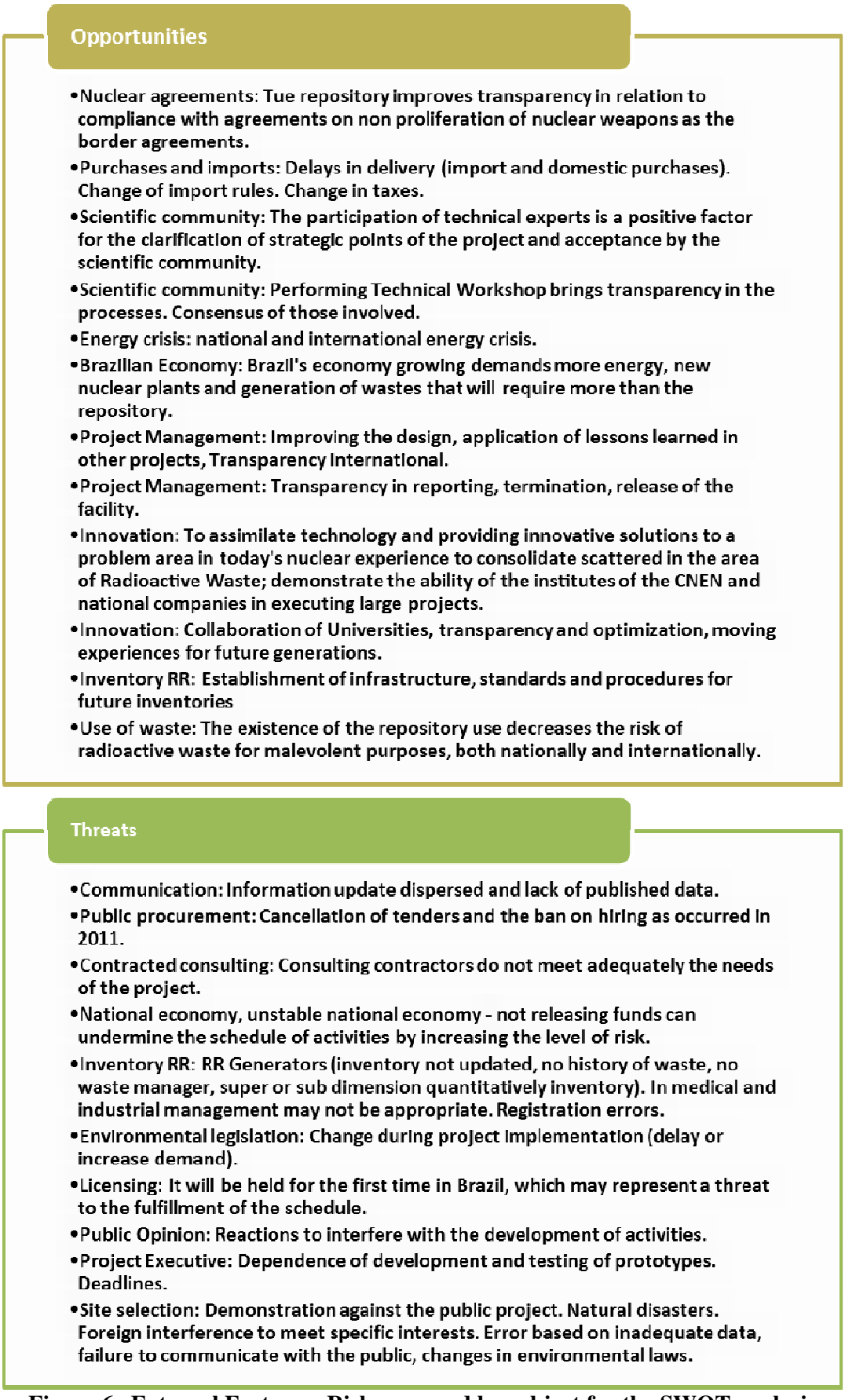

Figure 6. External Factors - Risks grouped by subject for the SWOT analysis

7. CONCLUSION (DISCUSSION)

RBMN has the objective to implement the first repository to store LILW generated in Brazil by the use of nuclear energy and radioisotopes. As it includes tasks and professionals from different areas of knowledge, it is important to have a project management in order to execute all tasks on time, with the budget and the quality proposed, assuring that all requirements will be complied with.

Risk management is one of the most essential parts of the project management. Creating a culture of risk management encourages stakeholders to share what they know about risks, acting proactively, contributing to the execution of processes.

It is unclear what will be the evolution of the world during the life cycle of the repository, which management tools and processes permeating the management of the repository will be used over the years, so the greatest legacy for future generations will be to guarantee security and shared knowledge about risks.

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