A STUDY FOR AN INTEGRATED RESPONSE TO THE RISKS INDUCED BY THE NATIONAL CONTEXT IN THE PLANNING OF THE GEOLOGICAL REPOSITORY IN ROMANIA

Veronica ANDREI[1], Ilie PRISECARU[2]

The schedule of the current strategy for a national geological repository (NGR) dedicated to the long-lived radioactive waste generated by Cernavoda Nuclear Power Plant might be jeopardized due the risks induced by a premature national context.

The authors approached a staged systematic study based on an improved risk management process in support of a sustainable planning of the repository. The extended study provided an optimum solution for an integrated response to the national context risks in the planning of the NGR, too. The solution identified and established several processes which should contribute to NGR planning and support this integration.

Keywords: geological repository planning, national context, risk management

1. Introduction

In respect of the provisions of the European Union Council Directive 2011/70/Euratom, the Romanian State, as any EU Member State which has a nuclear power program, guaranties and has the last responsibility for a safe radioactive waste management and a safe spent fuel management, ending with implementation of programs for safe disposal of radioactive waste.

The national context risks, *further called risks*, have been seen by the authors as one potential reason for delays in the schedule of an early geological disposal program [1]. In order to identify and respond to these risks international experience should be approached but the experts involved in the NGR program planning should search how to do it because there are certain differences between the Romanian context and other countries. Lessons can be learnt from other countries having advanced such programs but their programs were initiated more than 25-30 years ago.

[1] Eng., Romanian Association for Nuclear Energy (AREN), Romania, e-mail: veronica_andrei@yahoo.com

[2] Prof., Power Plant Engineering Faculty, University POLITEHNICA of Bucharest, Romania, e-mail: prisec@gmail.com

Data and information from the international standards and reports do not detail the management of any project for geological disposal implemented in an individual country and they do not make judgments on the justness and fairness of the activities of a project derived from a specific national context. Also, taking into consideration the characteristics and needs of the specific national programs, the results of the international peer-reviews cannot be transposed to any individual country in a simple manner without a more detailed and adapted analysis.

The NGR program planning should integrate risk management planning.

2. Systematic study of the Romanian national context risks

In 2008-2009, a first strategy schedule [2], *further called the current Strategy*, was elaborated for commissioning a national geological repository in 2055. The NGR should accommodate spent fuel and long lived-low and intermediate level waste generated by Cernavoda NPP.

The authors concluded based on a PESTEL analysis they made on geological disposal in Romania [3], that an update of the current Strategy by evolving in a sustainable NGR program should rely on a national framework that would overpass certain boundary conditions for developing such a program.

In support of further research, the authors defined 3 major processes in the schedule of the current Strategy, as presented in Figure 1.

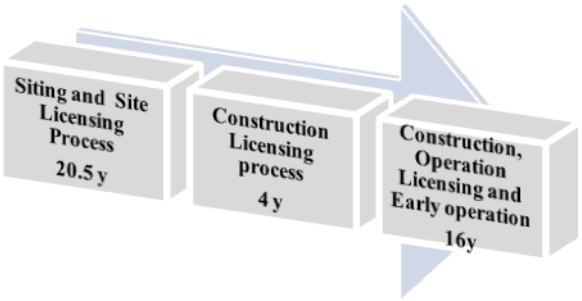

Fig. 1. Main processes for NGR commissioning [1]

The research provided a systematic study based on expert judgment and reliable methods and tools [1] which could help to define the boundary conditions of the national framework. The study identified that, the current national context would raise several certain risks when the Romanian geological disposal program would be developed and it allowed defining an optimum solution for integrating risk responses to planning and implementing a sustainable NGR program.

The risks were found to act only on the activities of the Siting and Site Licensing Process [3]. The major activities of this process considered in the study are presented in Table 1.

Table 1

List of major activities in NGR's Siting and Site Licensing Process [1]

Major activity (the current NGR Strategy)	Duration (20.5 years)
Define general framework ("State of art")	0.5y
Define and document siting process and select till 10 potential areas	1y
Field investigations, selection up to 3 areas, peer-review	6y
Sites characterization, selection of one area, peer-review	6y
Site Licensing Process (including approval of siting in Parliament)	2y
Complete site characterization	5y

The authors have chosen to approach the risk management of projects in support of NGR program planning since the Romanian stakeholders become more and more familiar with risk assessment terminology.

Starting from the findings of the PESTEL analysis on geological disposal, the authors approached a systematic study of the risks based on 3 major stages as follows:

- the PESTEL analysis made on geological disposal in Romania,
- a study of a national context risk management process and
- A study of the influences of the national context risks on the durations of the major activities in the current Strategy.

It was out of the scope of the study to analyze any internal risks or the organization responsible for planning and implementing the NGR program.

The basic definitions used in the study were as follows [4]:

- National Context Risk Management Process (NCRMP) = a structured risk-informed approach that assess national context issues and identifies, analyses, communicates, monitor and treats risks with the aim to increase the likelihood of having a sustainable program for developing a NGR;
- National Context Risks = are risks associated with inputs, actions or inactions from outside the NGR program developer organization, over which the management of the developer organization has no control, but which may have significant impact on the program. These impacts may manifest themselves in terms of technical, cost, schedule and/or acceptance of the program.

For studying the NCRMP in a confident manner, international and national standards and guidelines on risk management were overviewed and there were applied those that have been used in a broader manner for projects and processes by managers and stakeholders [4]. A list of the 21 risks (6-political, 3-economical, 4-social, 2-technical, 2-environmental, 4-legal) identified in the study has been registered in a comprehensive Risk Register also containing information on Risk Identification, Risk Analysis and Risk Planning [4].

For analyzing risk influences on the durations of the current Strategy schedule a quantitative risk analysis was approached by defining and applying an analysis process in steps [1] that allowed by expert judgment to estimate additional time for each major activity due to risk actions.

The mathematical method used a formula for calculation of probable duration of each major activity as PERT mathematical formula using 3 points time estimates (minimum time, maximum time and most likely time) [1] obtained following the establishment of 3 scenarios (optimistic, pessimistic and most likely). The optimistic scenario was considered to result in the current Strategy and thus, the minimum time durations would be the durations from the current Strategy. For the pessimistic and most likely scenarios there were described hypothesis and assumptions defining the framework in which the current Strategy would be implemented in each scenario. Additional time for each major activity was estimated in each scenario by approaching the analysis process of risk actions mentioned above. The formula for calculation was [1]:

$$T = \frac{O + 4M + P}{6} \tag{1}$$

Where:

- T is the new duration of a major activity,
- O is the minimum time for forming the major activity, as resulted from the optimistic scenario (NGR current Strategy),
- M is the most likely time for performing the major activity, as resulted from the most likely scenario and
- P is the maximum time for performing the major activity, as resulted from the pessimistic scenario.

The hypothesis and assumptions for the pessimistic and most likely scenarios were defined based on the experience from implementation of previous major nuclear projects in Romania. These still assumed limitations in implementing an effective risk management process induced by owners of risks. It is known that the project managers usually haven’t approached risk management in schedule and cost planning [5].

For deciding on using the quantitative analysis, the authors were in favour of expert opinions that suggested that modification of the project risk management processes to facilitate an uncertainty management perspective could enhance project risk management [6]. In this case the term "risk" becomes associated with more general sources of significant uncertainty contributing to improve the planning of the NGR program.

3. A solution for an integrated response to risks in the NGR planning

The improved risk management process approached by the authors resulted from the development of the following:

- A methodology relying on registrations of risks' identification made by understanding the sources of the issues and support subsequent review of estimates and analyses [1];
- A process that facilitate a risk schedule analysis based on a mechanism for analyzing risks action on individual activities of the NGR program [1];
- A solution that facilitates the managers to integrate the planning of the national context risk management earlier in the planning of the NGR program.

The registrations allow any future reiteration of the process and delineate what issues could remain in the responsibility of the managers of the NGR program and what issues should be solved by external parties which normally are responsible for solving those issues.

The risk schedule analysis made in the study resulted in the duration of the Siting and Site Licensing Process.

This duration was calculated as a sum of the new estimated durations of all major activities for each of the 3 scenarios considered for analysing risk influences. The results are given in Table 2.

Table 2

Estimated durations of the Siting and Licensing Process

Optimistic Scenario (The current Strategy)	Pessimistic Scenario	Most Likely Scenario	Estimated time using formula PERT
20.5 y	38y	32y	32.32y

The results of analyzing the pessimistic and most likely scenarios indicated that the risks could delay the schedule of the Siting and Site Licensing Process considered in the current NGR Strategy with a significant duration of time.

The estimation of a maximum time of 38 years for this process in the pessimistic scenario was considered realistic since this value was met in the

countries which confronted with suspensions/ reconsiderations of the siting process of a geological disposal facility [1].

The improved risk management process as well as the risk schedule analysis allowed identifying an optimum solution for an integrated response to the risks. This solution was thought by the authors in accordance with PMBoK Guide processes and recommendations [7], through the way of identifying and establishing the processes which would contribute to the planning of the NGR program and support this integration. The processes identified for reviewing the current Strategy are presented in Fig 2.

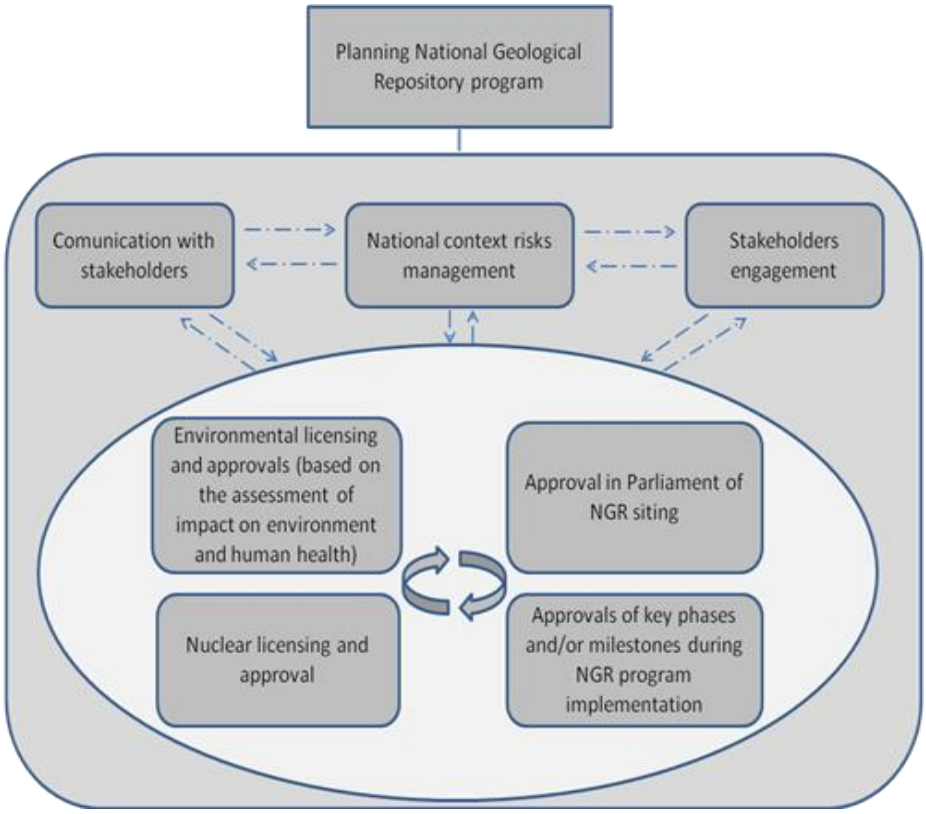

Fig. 2. Processes ensuring an integrated response to the risks in the current Strategy [8]

The processes proposed in Fig. 2 should be an integrative part of the NGR program and its work breakdown structure, respectively. They would relate with the NCRMP and the risk response planning would influence or determine the planning of these processes.

Much more, the study documented that following a diagram of questionnaire like in Fig. 3 there would be an opportunity and conditions for a stepwise implementation of responses to some of the risks after the program

implementation would be started. Meantime, detailed planning of these activities could be gradually made and integrated with the activities planned to meet the technical objectives of the NGR program.

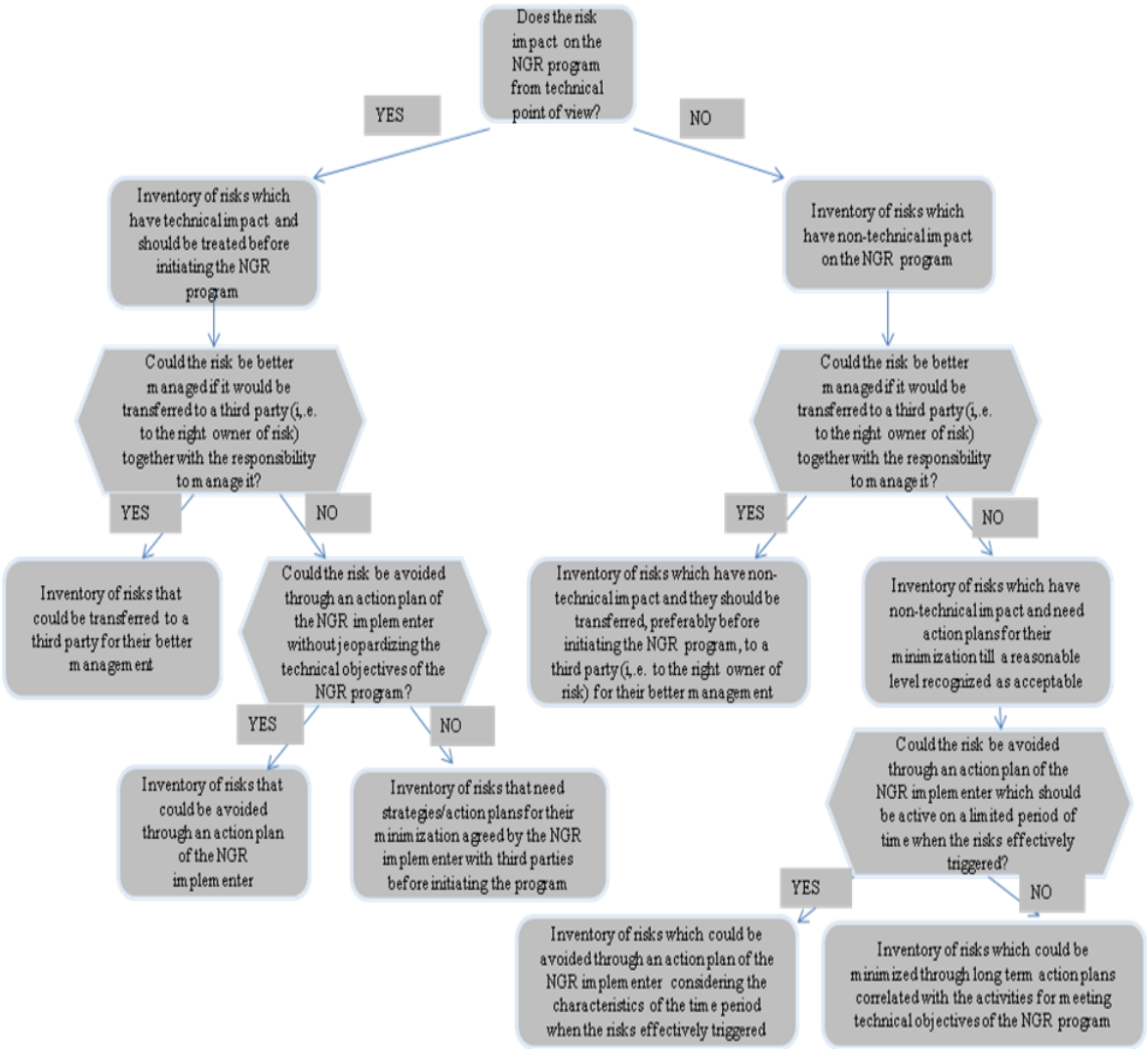

Fig. 3 Diagram for step wise planning of risk responses in the NGR program

For several risks having a complex impact, detailed action plans are needed during the implementation of the program. Detailed work breakdown structures of the processes presented in Fig. 2 should be elaborated in a stepwise manner and they should rely on the international experience.

3. Stepped actions for an integrated risk response in NGR planning

The results of the entire systematic study on risk management were seen they might help supporting clarifications on how the international expertise could be combined with national expertise since international experience is absolutely needed when planning the NGR program.

In this respect the study of the risk influences on the durations of the current Strategy indicated that an integration of the risk responses into the planning of the NGR program could be made in several stepped actions. These actions should be implemented in an integrated but also iterative manner since they are interrelated, and they would consist mainly of:

- Update of the strategic planning (the current Strategy) on the basis of the key phases and their duration in the planning of advanced geological repository programs; by using advanced and proven international expertise
- Define the basic work breakdown structure of the NGR planning by:
    - "Personalizing" the strategic planning towards a NGR program adequate to the national nuclear program taking into consideration advanced national programs for countries with waste resulted from similar nuclear technologies (i.e. geological disposal programs accommodating radioactive wastes generate by CANDU reactors); by using international expertise
    - "Adapting and assimilating" the strategic planning to developing and/or detailing work breakdown structure of activities taking into account requirements of national legislation and regulations, good practices or lessons learned from planning/implementation of other major national nuclear projects or other major national projects similar graded; by using national expertise
- Assess the national context's impact by implementing a NCRMP and analysis of influences of these risks on the duration of the activities from the strategic planning; usually, by using national and international expertise
- Establish an optimum solution for an integrated response to the risks in relation with the strategic planning; usually, by using national and international expertise and experience
- Finalize the NGR program planning by:

- Review of the NGR basic work breakdown structure by reviewing and/or detailing activities following the implementation of the optimum solution for an integrated response to the NC risks.
- Perform an integrated schedule and cost risk analysis and a review of the duration of the activities from the NGR program, corroborated with improvement of existing cost estimations, if needed.
- Define remaining uncertainties to NGR program planning and a plan for their monitoring; here, usually by using expertise of planners and experts of NGR implementer.

5. Conclusions

The managers of the NGR program as well as the authorities with responsibilities in the program development should consider preparing favourable national boundary conditions by acting for planning response actions to risks of the national context as early as possible in the NGR program planning further than to react on risks. This paper provided an optimum solution for integration following a staged systematic study. The solution may apply to major project similar with NGR, i.e. a first of kind project type or a national project with potential environmental impact and long term implementation.

R E F E R E N C E S

[1]. *V. Andrei, I. Prisecaru*, The Study of the National Context in Support of Planning Geological Disposal in Romania, Proc. International Congress on Advances in Nuclear Power Plants, ICAPP 2015, Nice, France, May 03-06, Paper 15232, 2015, 2701-2709.

[2]. *M. Radu, A. Panait, G. Barariu, G. Negut*, The impact of the Nuclear program development in Romania of the national radwastes management strategy, Revista Energia Nucleara, Bucuresti, **vol. 23**, nr.3-4, 2011, 25-29.

[3]. *V. Andrei, I. Prisecaru*, The Use of Pestel Analysis in Development of the Romanian Geological Repository, Scientific Bulletin of University Politehnica of Bucharest, Series C, **vol. 76**, 2014, 247-254.

[4]. *V. Andrei, I. Prisecaru*, Risk Management Process for National Geological Repository Program, Proc. WEC Central & Eastern Europe Regional Energy Forum – 12th Edition, FOREN 2014, 22-26 June, Paper s3-45-en, 2014, 1-8.

[5]. AACE International, Integrated Cost and Schedule Risk Analysis Using Monte Carlo Simulation of a CPM Model, Recommended Practice No.57R-09, Morgantown, WV, USA. 8-9, 2011, 11-13.PMI

[6]. *S. Ward, C. Chapman*, Transforming project risk management into project uncertainty management, International Journal of Project Management, Amsterdam, Netherlands, **vol. 21**, 2003, 97-105.

[7]. PMI, A Guide to the Project Management Body of Knowledge, PMBOK Guide-Fourth Edition, ANSI/PMI 99-001-2008, Newtown Square, USA, 2008, 146-157.

[8]. *V. Andrei, I. Prisecaru, T. Chirica, F. Glodeanu,* Use of experience from previous national nuclear projects in support of planning a sustainable geological disposal R&D program, Nuclear 2015, The 8th Annual International Conference on Sustainable Development through Nuclear Research and Education, Pitesti, Romania, May 27-29, 2015.