

ASSESSMENT OF THE IMPLEMENTATION RISKS FOR ALFRED DEMONSTRATOR

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ABSTRACT

The risks related to the implementation of ALFRED demonstrator in Romania are discussed. The assessment is based on the risk matrix approach. Two groups of experts were used in the investigation: participants in FP7 ARCADIA projects and members of the FALCON consortium. The results consist of the hierarchy of the risks obtained based on the appreciations of the two groups. They are comparatively presented and discussed in terms of the identified critical risks and possible measures for prevention and mitigation. Additionally, some elements derived from the experience of similar project such as SUSEN and ELI-NP are discussed.

Key words: ALFRED, risk assessment, prevention, mitigation strategy

Introduction

According the consortium agreement of FALCON [1] Romania is considered as the reference site for the LFR demonstrator, ALFRED. Due to a set of advantages such as the existing research infrastructure, more than 40 years experience in the nuclear field, the proximity of specialists, the good connection to networks, and the acceptance of the public the nuclear platform Mioveni, Arges County, is considered as the reference site for current stage of the Viability Phase of ALFRED [2].

The phases of ALFRED project as defined by [2] are: Viability Phase, Preparation Phase, Construction Phase, and Operation Phase. The paper is devoted to the assessment of the risks for the Viability, Preparation, and Construction Phase. Therefore, the risks resulted from the operational phase are not included in the present analysis.

Generally, the risks of nuclear investment are discussed from different perspective (return of investment, strategic national interests, sustainable development, etc.) In [3] the discussion of the risks is devoted to nuclear power plants concluding “the investors in new NPP are exposed to financial risks from inaccurate estimates and from changes in markets in the future” and it is based on some facts such as: the cost of the produced electricity is dominated by the cost of the capital for the NPP; duration of the implementation phase is greater than 7 years; payback times can be 30 years or more.

In [4] it is appreciated that “long-term electricity price risk creates bias against high capital cost technologies such as nuclear”. The case of demonstrators is quite more difficult since the nature of such projects (novelty of the technology, still open issues, reliability of innovative components and equipment, licensing duration susceptible to delays, etc.). Moreover, the demonstrators introduce important difficulties in financing process since the nature of the investment.

In [5] the main barriers for raising finance for First-Of-A-Kind demonstration projects were identified as:

- (1) high risk nature of the First-Of-A-Kind projects;
- (2) lack of supporting policy and regulatory frameworks that would allow to build a commercially viable business case;
- (3) lack of coordination and complementarities between financing instruments from EU, Member States, and technology promoters;
- (4) lack of financial and technical advice to technology developers and investors, respectively

Even in such favorable conditions nuclear demonstrators will not be built unless there is investment. According with [6] “governments support new build, but do not create the criteria for success”. Comparing the investment in nuclear, coal and gas plant [6] concludes: “nuclear projects are capital intensive and have long project schedules, gas plants are fuel intensive, and coal plant are balanced”.

The methodology

The list of risks was built based on brainstorming approach in the frame of ARCADIA project [7]. The risks were codified and grouped into 7 categories as follows:

- Technical risks (1.1 to 1.23),
- Financial risks (2.1 to 2.15),
- Political risks (3.1 to 3.10),
- Market risks (4.1 to 4. 4),
- Management risks (5.1 to 5.26),
- Relationship risks (6.1 to 6.12),
- Governance risks (7.1 to 7.9).

All the 99 risks were considered in the investigation. The definition of them is detailed presented in [8].

The assessment approach is based on matrix of the risks [8]. It consists of a matrix with 5x5 elements corresponding of the level 1 to 5 for the likelihood (perceived frequency of the risk) and the impact (perceived importance of the effect of the risk). Each respondent attributed a mark (1 to 5) for each risk according with own perception based on the experience and expertise in the field:

- likelihood (1 to 5 from, from Non-credible risk to Highly likely),
- impact (1 to 5, from Negligible to Very high impact).

The risks were evaluated by 48 experts [8]. The data were collected by the representative of each organization in ARCADIA-WP3 by using face to face method. In few cases the questionnaire was answered by each respondent based on the supplied questionnaire and associated Excel sheet; in this case the instructions were discussed before, in details, with each respondent in order to reduce any misunderstandings. Data were collected between April and July 2015. For each set of data, a separate Excel sheet was produced. For each risk the two scores - $Lik(i,j)$ and $Imp(I,j)$ -were transformed into a mark based on the relation: $S(i,j)=2^{(Lik(i,j)-1)} * 2^{(Imp(i,j)-1)}$

Finally, the answers were converted in a total score by summing all the appreciations for each analyzed risk, and into an average score. Since for some risks, some respondents didn't offer any answer in the averaging operation these answers were eliminated. Therefore, the number of total respondents were replaced with the number of respondents offering non-zero answers.

Results and discussions

The results were grouped into categories: (C1) ARCADIA group, including all 48 respondents; (C2) FALCON group, including only the members of FALCON participating in the investigation. The analysis of the results has produced:

- the hierarchy of risks,
- the analysis of the explanations for high marks
- the identification of some prevention and mitigation measures.

For C1 the detailed results are presented in [8]. In Table 1 the more important risks according with the results of the investigation are presented (the critical risk group). A complete hierarchy for C1 is presented in [8]

Table 1 The critical risks for ALFRED implementation in Romania – Comparative results: (C1) ARCADIA and (C2) FALCON

		(C1) ARCADIA	Risk (averaged)	Corresp.		(C2) FALCON	Risk (averaged)
1	2.7	Difficulties to ensure the pre-financing planned amounts	51.13	1-1	2.7	Difficulties to ensure the pre-financing planned amounts	68.00
2	2.6	Delays and costs overruns	46.04	2-9	5.20	Unavailability (in time) of the equipment, components, materials	56.33
3	1.1	Maturity of the technology is not reached	43.78	3-20	1.4	Unavailable infrastructure for pre-licensing and licensing	56.00
4	2.12	Underestimation of expenses	41.34	4-5	2.8	Lack of some funding sources	53.67
5	2.13	International crisis introducing disturbances in supporting of projects	39.91	5-16	2.12	Underestimation of expenses	51.00
6	5.26	Uncertainties concerning the spent fuel and RWM decisions	37.53	6-14	3.5	Vulnerability to political action	44.33
7	2.8	Lack of some funding sources	36.62	7-4	5.25	Excessive bureaucracy in reimbursement of the eligible expenses for each step	40.33
8	1.2	Licensing approval issues - GIV insufficient expertise at regulatory body	35.97	8-15	2.3	Uncertainty in the costs for the equipment, components and materials	38.67
9	3.5	Vulnerability to political action	35.29	9-6	2.6	Delays and costs overruns	38.00
10	5.17	Loss of experienced managers and experts due to limited bonus	35.21		3.1	Decreasing of the political support due to inadequate	37.33

		system				evolution of the project	
11	5.25	Excessive bureaucracy in reimbursement of the eligible expenses for each step	34.72	11-7	3.4	Escalation of green visions	37.00
12	5.27	Inadequate “Human resources” management	34.59		3.3	Decreasing of European support	36.00
13	2.3	Uncertainty in the costs for the equipment, components and materials	34.04	13-8	2.2	Overestimation of funding sources	35.67
14	5.23	The complexity of the project	33.28	14-19	5.26	Uncertainties concerning the spent fuel and RWM decisions	35.56
15	3.1	Decreasing of the political support due to inadequate evolution of the project	33.00	15-10	1.2	Licensing approval issues - GIV insufficient expertise at regulatory body	35.56
16	5.21	Unavailability of personnel	32.90		2.13	International crisis introducing disturbances in support of projects	34.67
17	5.20	Unavailability (in time) of the equipment, components, materials	32.85	17-2	2.10	Inadequate application to funding sources	34.33
18	3.6	Considering ALFRED as a NPP	32.49		2.14	Underestimation of operation and maintenance cost	34.00
19					5.23	The complexity of the project	33.67
20					1.1	Maturity of the technology is not reached	33.33
21					5.24	Long-term project	32.33
22					6.2	Inadequate interaction with EU political institutions	32.33
23					3.2	Decreasing of the national support	32.00

The middle column (between ARCADIA and FALCON results) show the correspondence between the rankings resulted from the averaged perceptions of the two groups. For example, 2-9 means the second ranked risk for ARCADIA is find on the 9th place in the FALCON perception. The cell of the risks that are present in both lists are dashed.

From Table 1 it can be seen that the most critical risk is the same for the both groups: “difficulties to ensure the pre-financing planned amounts”. At the same time, it can be observed that in the ARCADIA list there are 18 critical risks compared with 23 in FALCON list. Due to the point of view of the intersection of the two lists there are 4 risks in the first list that don’t appear in the second one. Three of them are directly related with the human resources: “Loss of experienced managers and experts due to

limited bonus system”, “Inadequate human resources management”, “Unavailability of personnel”. ARCADIA group seems to be more concerned on the competence issues. The last is “Considering ALFRED as a NPP” that is considered by FALCON group as a not critical issue.

Conversely there are 9 risks in the second list that are not present in the first one. The most important difference consists of the risks “Unavailable infrastructure for pre-licensing and licensing” ranked by FALCON group on the 3rd position and not seen as critical by the ARCADIA group. Also it can be seen that the second group is more concerned on the possible loss of the support from different policy-makers (European, national) and changing in the acceptance landscape such as “Escalation of green visions” and financial aspects such as “Overestimation of funding sources” and “Underestimation of operation and maintenance cost”.

In Figure 1 a graphical representation of the ranking produced by ARCADIA group is presented. Similar in Figure 2 the results for the critical risk category, for FALCON group, are presented. As a general trend the appreciations of FALCON respondents are more pessimistic than those of ARCADIA group at least for the first 10 critical risks.

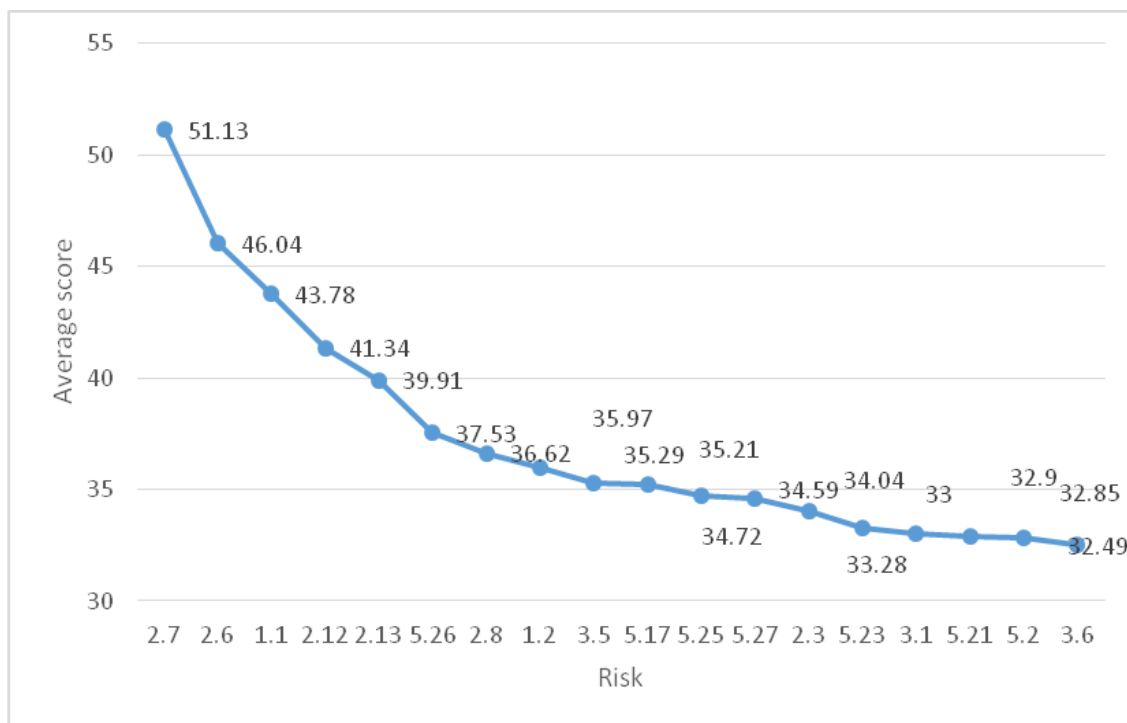


Fig. 1 ARCADIA group – Relative ranking for the category of critical risks

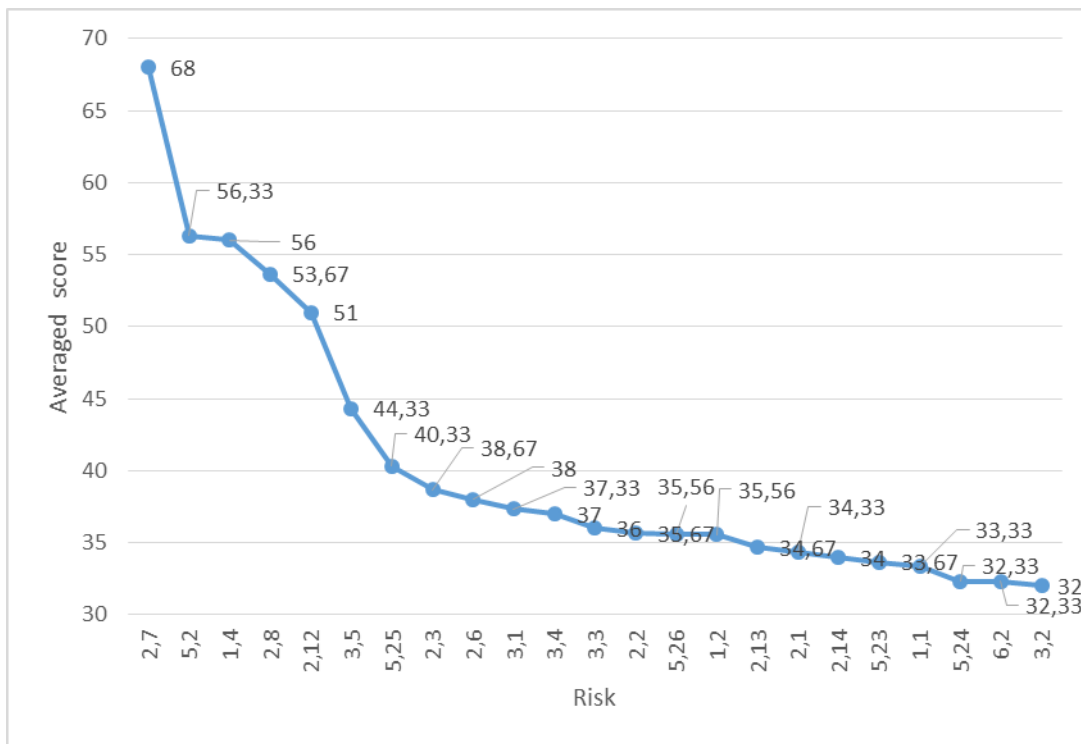


Fig. 2 FALCON – Relative ranking for the category of critical risks

The previous investigations revealing the concerns of the 48 involved experts were completed by desk research and discussion aimed to elicit the difficulties appeared in the implementation of similar projects, mainly in SUSEN [9] and ELI-NP [10]. Both are devoted to research infrastructures and are in relation with the nuclear field. Moreover, ELI project introduces some peculiarities of the Romanian context for projects supported by structural funds taking into consideration the most probable financing scheme for ALFRED demonstrator. The feedback is described in [8].

Important difficulties are mentioned for the procurement process (due to the fact that many devices of the proposed research infrastructure are unique) and delays in the implementation (generated by negotiation process, procurement difficulties, and by an optimistic planning of the steps and activities).

At the same time some good practices were captured such as: the appropriate phasing negotiated from the beginning including the approval of the requested funds, international hiring for scientists as a good solution for human resources needs.

Some elements form the practice of other projects implemented in Romania is presented below:

- generally, in Romania, the projects funded by European funds suffers of delays produced by excessive bureaucracy - many approvals and time consuming from different local and national authorities, postponed decisions and frequent changes of the rules,
- in Romanian context the implementers of projects based on public funds faces difficulties of bids (such as the criterion of the lowest price as the dominant element of the decision; it influences the quality of works, products, services; the frequent litigations delay the implementation),

- insufficient personnel for the implementation causing delays or decline of the quality of the results,
- underestimation of the planned costs determining the increase of the non-eligible costs and consequently the efforts of the implementers,
- sometimes the sub-contractors produce delays and also low quality activities, including the supply of equipment,
- frequent changes in the legislation affecting the project, including the financial planning,

Based on the previous elements (risk identification and ranking, good practices and lesson learnt) the list of critical risks and threats was developed. At the same time mitigation and prevention strategies were developed for ALFRED demonstrator implementation in Romania.

The **main risks and threats** resulted from the questionnaire based investigation and from the analysis of other project are connected with:

- (R1) difficulties with funding, especially the pre-financing resources,
- (R2) overruns of the planned costs with significant impact on the local efforts to cover the investment costs in order to achieve the final objectives,
- (R3) delays of the project, of some steps or delays in availability of the equipment, components, materials,
- (R4) difficulties in the procurement process created by the uniqueness of some equipment (lead pumps, steam generators) and national legal context, stimulated by uncertainties in the costs of the equipment, components and materials,
- (R5) maturity of the technology is not reached (present technological limits such as coating of materials for large surfaces, pump fabrication, qualification of the equipment),
- (R6) large investment needs for ALFRED and vulnerability to political action,
- (R7) decreasing of national and international commitment in case of postponing of tasks and objectives,
- (R8) international crisis introducing disturbances in support of the project,
- (R9) siting and licensing issues (novelty, request for experimental installations and tests, insufficient expertise at regulatory body, etc.)
- (R10) uncertainties concerning the spent fuel and RWM decisions
- (R11) insufficient coordinated planning of national and local resources,
- (R12) excessive bureaucracy for the projects (approval, monitoring, reimbursement),
- (R13) inadequate “human resources” management (unavailability of personnel, quality of the hiring process, loss of experienced personnel),
- (R14) considering ALFRED as a NPP

The **prevention strategy** is presented in Table 2 and the **mitigation strategy** in Table 3.

Table 2 The prevention strategy

	Measure	Risks	Phase
1	Transfer of good practices and also analysis of the difficulties in the procurement process (SUSEN, ELI-NP, and from other available international experience)	R2, R3, R4, R11, R12, R13	Viability Preparatory Construction
2	Reducing as much as possible the misinformation about costs at the level of the planning and act for a realistic approach in all estimations	R2,	Viability Preparatory
3	Phasing for ALFRED and also a stepwise approach for the other supporting facilities, in direct relation with the specific conditions of the national calls for structural funds	R1, R4, R6, R9, R11,	Viability Preparatory
4	Organizing real debates involving all stakeholders (including general public and local communities) to allow the civil society to voice the criticism and to support of forecasts; knowledge generated in this way will be integrated in planning and decision making	R14, R6, R7	Viability Preparatory
5	Keep a strong connection between implementer, local and national decision-makers in order to produce a better coordination	R14, R6, R7	Viability Preparatory
6	Produce realistic planning of the tasks and deadlines in accordance with the predicted resources and a strictly respect of the proposed timeline	R11, R3, R4, R9, R13	Viability Preparatory Construction
7	Intensify the RD efforts to clarify the existing open issues and to identify appropriate solutions; keep the interest of international community (including Horizon 2020 framework) on the progress on the field	R5, R9	Viability Preparatory
8	Early identification of the peculiarities of the national regulations for licensing and siting, systematic communication with the regulators in the process, initiation of the pre-licensing process, early involvement of the public in the debate and decision making process	R9, R3	Viability Preparatory
9	Consistent approach to performance and progress monitoring based on key milestones	R3, R11, R13	Viability Preparatory
10	Competence building, including the cooperation with universities, started as early as possible; adaptation on national Curricula for nuclear engineering	R13	Viability
11	Develop a consistent communication programme and promote ALFRED as a demonstrator and research infrastructure	R14	Viability

12	Plan sufficient time resources to analyze the risks and opportunities	All	Viability Preparatory Construction
13	Backup solution for the solution financing based mainly on structural funds	R1, R6	Viability
14	Prepare draft of the main documents before the official start of a call	R12	Preparatory

Table 3 The mitigation strategy

	Measure	Risks	Phase
1	Nominate the risk manager (responsible for risk mitigation plan)	All	Preparatory
2	Identify and plan the resources to implement the plan for the management of the risks	All	Preparatory
3	Management team will immediately analyze any deviation from the planning and estimated costs and will identify the appropriate corrective measures	R3, R4, R9, R11, R12, R13	Preparatory Construction
4	If necessary, a re-planning of the tasks will be rapidly performed and implementation measures will be ensured	R3, R4, R9, R11, R12, R13	Preparatory Construction
5	Creating an effective and flexible team to monitor the evolution of the impacts of the risks	All	Preparatory Construction
6	Appointment of a cost control consultant if a significant impact of the escalation of the costs will occur. Performing a continuously updating of the market study. Identification of the solutions that allow reducing the cost while keeping the project within the intended level of quality.	R2	Preparatory Construction
7	Solving disputes taking into account good practices in similar projects and situations	All	Preparatory Construction
8	Prepare training programme for the new personnel	R13	Preparatory Construction

Conclusions

(C1) The most important risks are grouped into the category of “high risks”. For ARCADIA respondents the first five positions are associated with: “Difficulties to ensure the pre-financing planned amounts”, “Delays and costs overruns”, “Maturity of the technology is not reached”, “Underestimation of expenses”, and “International crisis introducing disturbances in supporting of projects”. It can be seen a strong connection with financial aspects. For FALCON group the same positions are of the following risks: “Difficulties to ensure the pre-financing planned amounts”, “Unavailability (in time) of the equipment,

components, materials”, “Unavailable infrastructure for pre-licensing and licensing”, “Lack of some funding sources”, and “Underestimation of expenses”. Beside the similar financing concerns the risks associated with delays in preparatory phase appeared.

(C2) Good practices and difficulties resulted from the implementation of some similar projects was identified by desk research and by direct discussions with the management team of SUSEN and ELI-NP projects. These elements were integrated with the list of most important and represent the basis to identify appropriate preventive and mitigation measures.

(C6) Based on the investigations the prevention strategy and mitigation strategy were developed. They are in direct relation with the peculiarities of the implementation in Romanian national context and taking into consideration the reference site.

References

- [1] Alessandro Alemberti, G. Villabruna, P. Agostini, I. Turcu, M. Constantin, “FALCON Consortium – for ALFRED demonstrator implementation”, International Conference, FOREN, Bucharest, June 23-27, 2014
- [2] M.Constantin et al, “The Steps towards ALFRED Implementation”, International Symposium for Nuclear Energy, SIEN2015, Bucharest,
- [3] Energy Fair, “The Financial Risks of Investing in New Nuclear Power Plants”, www.energyfair.org.uk, March 2012
- [4] J.H. Keppler, and M. Cometto, “NEA Workshop on “Project and Logistics Management in Nuclear New Build”, Paris, 11 March 2014”, NEA Workshop on “Project and Logistics Management in Nuclear New Build”, Paris, 11 March 2014
- [5] J. Burnham, O. Debande, O. Jones, C. Mihai, J. Moore, I. Temperton, “Report on Innovative Financial Instruments for the Implementation of the SET Plan, First-Of-A-Kind projects”, JRC, 2013
- [6] M.Kaplan, “Nuclear Project Structuring and Financing”, WNU Summer Institute, Oxford, August 2012
- [7] ARCADIA project, www.projectarcadia.eu
- [8] M.Constantin et al, “Risks Assessment and Mitigation Strategies”, ARCADIA project, Deliverable D3.3, April 2016
- [9] SUSEN project, www.susen2020.cz
- [10] ELI-NP project, www.eli-np.ro