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TECHNICAL-ECONOMIC PROTECTION OF SMALL MODULAR REACTORS (SMR) CONSIDERED ENERGY-MINING OBJECTIVES

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Abstract: *Based on scientific research, it appears that for investments in complex energy-mining infrastructures (including the SMR Doicești-Dâmbovița), attention must be paid to the groups of variables belonging to weak points and threats. The main objective of the article is to combine the sub-strategies of the complex energy-mining infrastructures for protection, safety and security, respectively to obtain the appreciation of the level of positive situation on the scale of the coefficients of importance of the components of the researched complex. The approach in relation to the main objective also gives rise to the formulation of three secondary objectives, as follows: a) identification of probabilities and degree of risk assessment regarding protection, safety and security in complex energy-mining infrastructures and characterization of the consequences in the field; b) the application of the SWOT analysis and the TOPSIS Method for the researched objective, emphasizing the characteristics located between appropriate weights; c) highlighting the strategic values of the sub-strategies in relation to nuclear protection, safety and security, showing the decision-makers whether the investment in the energy-mining infrastructure is feasible, reliable and efficient. The paper reports technical protection considerations of the Small Modular Reactors (SMR) system, the list of nuclear hazards/events/incidents drawn up for SMR, technical aspects in the system of underground mining enterprises for the extraction of uranium ore. Also presented are the factors of opportunities, threats, strengths and weaknesses systematized in the SWOT analysis for SMR, the possible algorithm and mathematical models of mining security, the characterization of sub-strategies of protection, safety and nuclear security in relation to the importance coefficients collected for the decision to mount and put into operation the SMR.*

Keywords: *Small Modular Reactors, nuclear protection, safety and security, uranium mines, SWOT and TOPSIS Method*
JEL: *C81; D81; L72; O22*

1. Introduction

A comprehensive system of protection, safety and security refers to the development of a robust and comprehensive framework to manage and protect people together with critical resources and infrastructures in energy and mining and nuclear energy activity.

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Approaches to generating adequate protection, safety and security in the field cover: threat assessment, planning and preparedness, surveillance and monitoring, cyber security, critical infrastructure protection, collaboration and coordination, risk management, legislation and regulation.

The approach must be comprehensive and interdisciplinary, involving collaboration between entities, institutions, organizations and sectors, so as to face any threats or emergencies. In fact, with respect to Modular Nuclear Power Plants (MNPs)/SMRs, which are proposed as a case study for scientific research in the present work, and Uranium Underground Mines/Uranium Concentrate Preparation Plants, complexity expresses diversity and adaptability as well as challenges related to difficulties in understanding and infrastructural and operational management of these types of systems.

Nuclear protection is complex, requires collaboration and accountability; it is a dynamic field due to technological progress, geopolitical and environmental context.

2. Methods, research methodologies

2.1. Technical system protection considerations of Small Modular Reactors (SMR)

For SMR

Based on the observations and systematizations carried out for SMR Doicești, the overall picture with technical protection measures was reached as follows: a) SMR protection as a complex industrial objective, b) risk assessment, c) physical security systems, d) security personnel, e) alarm and detection systems, f) cyber security, g) emergency planning, h) continuous monitoring and surveillance, i) collaboration with authorities and other stakeholders, [1], j) periodic audits and reviews, k) staff awareness and training. [2]

For SMR Doicești the nuclear risk R_n is the probability of exposure to the hazard action, denoted h in the field:

$$R_n = f\,(h \times E \times V/C) \qquad (1)$$

with the meanings E = items entered under the scope of the risk; V = vulnerability; C = the response capacity of the community where SMR is located (Doicești and in the area).

For uranium type fuel

The transport of uranium, along the entire circuit: the underground mine, the "R" Feldioara Plant, the Pitesti beam manufacturing plant, SMR, [3], in the present case and/or the Cernavodă Nuclear Power Plant, the storage of radioactive waste, [4], carries risks for urban or rural areas, self-protection requirements. [5]

Mainly, statistically, it is found that accidents/incidents with dangerous nuclear substances can rarely occur in Romania (in the proportion of approx. 50% are on roads, 30% on railways and 20% on river and maritime routes). [6]

List of potential events

An "*Evaluation Sheet of the SMR Doicești-Dâmbovița system"* is proposed, which includes: the presentation of the SMR, [7], the sources of danger, the radioactive substance, the dangers themselves, the estimated, evaluated and controlled risks, the perimeter of the area with the highest risk, objectives and prevention methods/procedures (SMR start, [8], operation, shutdown, breakdowns, maintenance / maintenance). (Table 1)

Table 1. List of Nuclear Hazards/Events/Incidents drawn up for SMR Doicești-Dâmbovița which requires permanent, real-time and/or periodic monitoring

Danger/ Event/ Nuclear incident in SMR Doicești	Permanent	Periodic
1. Neutralization of hazardous radioactive substances in the area	x	
2. Measures against flooding in the area		x
3. Measures against earthquakes in the area		x
4. Measures against dangerous meteorological phenomena in the area		x
5. Defective, improper, erroneous design of SMR		x
6. Incorrect installation of the SMR installation		x
7. Pressure above the limit allowed for SMR operation	x	
8. Improper temperature for SMR operation	x	
9. Defects due to wear and tear of SMR elements	x	
10. Vibrations/fatigue within the SMR	x	
11. Separations of component elements within the SMR		x
12. Grips of component elements within the SMR	x	

13. Disturbance of elements in continuous motion		x
14. Chemical reactions not foreseen in SMR		x
15. Lack of radioactive fuel for operation (supply)		x
16. Non-functioning of protection, safety and security control equipment		x
17. Lack of coolant in the SMR reactor	x	
18. Various malfunctions during nuclear operation	x	
19. Disturbances in starting or stopping SMR		x
20. Disturbances during SMR maintenance/maintenance		x
21. Dangers when transporting uranium fuel to / from SMR		x
22. The presence of explosive substances in the area		x
23. Highly flammable materials in the area		x
24. Electrostatic discharge in SMR		x
25. Electric sparks at SMR elements		x
26. Uncontrolled electromagnetic waves in the area		x
27. Non-functional alarms for SMR and in the area		x
28. Explosions due to uncontrolled leaks of uranium fuel		x
29. Explosions due to human errors in SMR		x
30. Explosions due to non-functioning of nuclear control parameters		x
31. Unforeseen local explosions in the area		x
32. Explosions due to loss of inertization in SMR		x
33. Mechanical sparks at SMR elements		x
34. Uncontrolled increase in nuclear radiation in the area	x	
35. Expansion of toxic clouds in the area		x
36. Measures against outdoor fires		x
37. Overheating of some surfaces at the SMR elements		x
38. Partial fire prevention and protection measures		x
39. Insufficient limitation or direction of the spread of the radioactive substance		x
40. Inappropriate emergency exits for SMR personnel		x
41. Minimum distances between SMR installations / sub-installations		x
42. Lightning rods and high voltage lines in the area		x
43. Pipelines with dangerous substances in the area		x
44. Explosions from outside the area		x
45. Access of unauthorized persons to the SMR area		x
46. Access roads for intervention vehicles at SMR		x
47. Intervention equipment in the area		x
48. Cooperation plans with forces from outside the SMR		x
49. Defective assessment of SMR hazard elimination		x
50. Alerting all staff in the event of an accident at SMR		x
51. Lack of means of extinguishing fires in the area		x
52. Checking the means of extinguishing fires in the area		x
53. Sufficient spaces for interventions in the area		x
54. Staff training for SMR interventions in the area		x
55. Inoperable detection systems in SMR	x	
56. Blocked valves at the complex equipment of SMR	x	
57. Release of radioactivity in the area	x	
58. Molten radioactive core of the SMR reactor	x	
59. External human guard in the SMR perimeter	x	
60. Internal human guard in the SMR perimeter	x	

In essence, for SMR Doicești, *it is recommended to develop a prevention documentation and simulate a major accident scenario*. [9; 10; 11]

Based on the research, it appears that, in fact, for SMR Doicești the consequences are negligible, the severity is unitary (class 1), and very often the probability is **8.50-9.00, very close to 1, so "certainty"** and, thus, the studied nuclear power plant type system has protection, safety and security ensured. (Table 2)

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Table 2. The probabilities and degree of risk assessment at the SMR Doicești – Dâmbovița Modular Nuclear Power Plant

			Probability/ Classes					
Consequences	Gravity/ classes	Characteri-zation	Extreme-ly rare	Rarely	Rare	Low frequency	Frequent	Very frequently
			1	2	3	4	5	6
Lives/env damage	6	Very bad	0,01					
Up to 10 casualties/ env damage	5	Serious		0,10				
Up to 5 casualties/ env damage	4	Big			0,20			
Up to 2 casualties/ env damage	3	Average				0,30		
Enviromental damage	2	Low					0,35	
Omit	1	Omit						8,50-9,00

Clarifications of interpretation
Production range: 0.00 –10.00;
0.00 = ideal; 10.00 = maximum (probability 1.00/certain occurrence of nuclear incident/accident)

Such a scientific investigation was based on the systematization of the average levels of consequences observed in the field, from analyzes and discussions, from the technical documentation of the SMR in question.

2.2. Technical protection in the system of underground mining enterprises for the extraction of uranium ore

Based on field tests in geological areas with deposits of interest and documentation of underground mining of uranium ores, it can be deduced that security in an enterprise of this kind is important to protect the life and property of employees, to maintain efficient and safe work. (fig. 1)

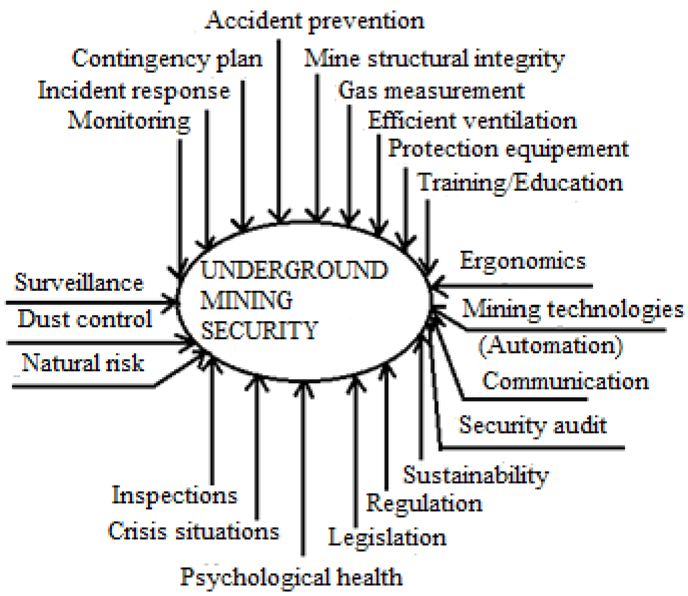

Fig.1 Security elements in uranium mining enterprises

Similarly to what happens in the SMR type objectives, protection, safety and security issues are also recorded in the case of mining enterprises and, on this basis, the following are proposed: mining risk assessment (the case of the Crucea, Tulgheș and Grințieș mines), [12; 13], mine and area emergency and

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evacuation plans, personal protective equipment, supervision and training, [14], access control, underground mine environment monitoring, chemical and explosive management, mine equipment maintenance, detection and alarm systems underground, tailings and waste management, tailings from uranium mining, health and safety oversight, government and community engagement, mining audits and periodic reviews.

3. Results and discussion

3.1. Algorithm and mathematical models of mining security

Algorithms can be used in the uranium mining industry to identify and manage protection and security threats and risks. [15; 16; 17]

There is no universally applicable specific algorithm for protection and security in energy and mining, but techniques and strategies can be implemented to improve the areas in question through customized, specific algorithms such as: monitoring and detection of mining incidents, data analysis, alarm and alert systems, perimeter and mining unit access control, incident management, auditing and continuous improvement.

Mainly, in engineering science and mining economics one finds mathematical models and techniques that can be used in the field of mining safety and security.

They can help assess and manage risks, optimize the planning and allocation of specific resources, and improve existing mine security systems.

Among them, the following fall under the scope of systematization: modeling of mining risks, [17], optimization of evacuation planning from the area and from the underground mine, modeling of work flows (mining), anomaly detection algorithms, epidemiological modeling.

In recent years, research and development in the field of mining safety has led to the development of refined and advanced models such as: modeling of mining fires/incidents, artificial intelligence and machine learning, supported decision systems, simulation and optimization of evacuation from the area and from the underground mine.

Some examples of mathematical equations in the field of mining safety refer to: 1) the heat diffusion equation, 2) Darcy's equation, 3) the underground fire propagation/reservoir autoignition equation, 4) the material strength and deformation equations, 5) mining risk assessment equations, 6) mining pollutant dispersion equations, 7) fire resistance equations of materials, 8) mining land stability equations, 9) equations for evaluating the effectiveness of detection and alarm systems in the area and underground.

Mathematical equations show the importance of applying mathematical concepts and methods to assess and model issues related to security and risk management in the nuclear power mining industry.

3.2. Blockchain technology for protection, safety and security in SMR and uranium mines

Blockchain technology in the case of the present study enables the secure and transparent recording and storage of transactions and information in a distributed digital ledger.

In fact, it is a continuous and cryptographic record of transactions or mining events, known as "blocks" that contain information about recent events, being linked to previous blocks through a cryptographic mechanism.

Thus, a block chain (chain) is created, a chain-type structure that allows the verification and authentication of each record, respectively ensures the integrity of the data.

The main characteristics of blockchain technology in the uranium mining sector refer to: decentralization; cryptography; transparency; immutability.

Other advantages of blockchain technology in underground mines of useful mineral substances, especially in uranium mines, refer to: 1) recording and verification of mining security incidents; 2) tracking of mining equipment certifications and inspections; 3) creating transparent systems for security-related decisions; 4) auditability in the mining supply chain; 5) data management regarding the health and safety of employees in uranium mines; 6) decentralized decision-making, etc.

3.3. The results related to protection, safety and security in SMR Doicești-Dâmbovița

For the present work, the contents were identified, examined and conclusions reached regarding the protection, safety and security of the SMR by resorting to *the SWOT Analysis (Strengths, Weaknesses, Opportunities and Threats).* [9; 18; 19]

First of all, the *opportunities* are really identified, then *the threats*, the strong and the weak elements for the constructive approach and commissioning in the National Energy System, from the perspective of protection, safety and security, of SMR Doicești-Dâmbovița.

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For accuracy and conclusiveness, the analysis (in the depth of the matrix) of the SO (*Strengths, Opportunities*) strategic alignment has been extended.

In works from the specialized literature [20; 21; 22; 23; 24] the SWOT analysis is associated with the TOPSIS method, - (*Technique for Order Preference by Similarity to Ideal Solution*), this being the higher stage in the process of searching, identifying and assuming the best scenario among the possible strategic scenarios for protection, safety and security at SMR Doicești-Dâmbovița.

The TOPSIS method is a support for making protection, safety and security decisions, in our case nuclear and uranium mining, based on multicriteria, being deduced *the least close to the positive ideal solution* (x) and *the most distant from the negative ideal solution* (y). [25]

On this basis, the SWOT matrix was developed, inventorying and systematizing in its own way for SMR Doicești the *Opportunities*, *Threats*, *Strengths* and *Weaknesses* regarding the protection, safety and security of this complex energy-mining industrial objective. (tab. 3)

Table 3. Factors Systematized Opportunities, Threats, Strengths and Weaknesses in the SWOT analysis for the SMR Doicești-Dâmbovița nuclear power plant

1. Opportunities	**2. Threats**
- dynamism in the field (x1) - understanding the interconnections and interdependencies between components (x2) - resilience in the field (x3) - positive outlook (x4) - the recognized and assumed peaceful purpose of nuclear energy (x5) - economic security of the domain (x6) - modularity of small nuclear reactors (SMR) (x7) - global clean energy program (x8) - nuclear energy, free of CO2 emissions, contributes to the energy mix (x9) - the large amount of nuclear energy in total electricity generated worldwide (x10) - low carbon dioxide emissions from the nuclear-based electricity generation system worldwide (x11) - Romania has a competitive advantage in that there is already a complete nuclear cycle on its territory (x12) - Romania already domestically produces sinterable uranium powder (x13) - Romania already internally processes the nuclear reactors' supply beams (x14) - the existence on the autochthonous, local, national level of experience in the energy-nuclear field (x15) - The EU, respectively Romania, must reduce its risks of dependence on external energy sources (x16) - the existence of natural uranium deposits in Romania (x17) - the existence of National Research - Nuclear Energy Development alignments (x18) - experience and applications (CANDU) in Cernavodă (x19) - nuclear energy contributes to achieving energy security (x20) - energo-energia complies with the terms of military atomic non-proliferation (x21) - there is government commitment/support in the field (x22) - certificates, approvals and prior authorizations are always issued for SMR in order to strengthen the concept of nuclear protection, safety and security (x23) - overall, the performance of nuclear power plants in terms of safety and reliability is at a high level (x24) - worldwide demand for nuclear energy is increasing (x25) - the idea of the nuclear "multiple module unit" is assumed (x26)	- ever changing and adapting general nuclear protection (y1) - security to ensure the operation of the SMR (y2) - non-linearity (y3) - interdependence (y4) - interconnectivity (51) - cyber security of SMR (y6) - protection against attacks (including terrorist) (y7) - the level of radiation/radioactivity of the nuclear fuel used in SMR (y8) - the transport of radioactive or nuclear materials/ the security of special transports (y9) - wet and dry storage of spent nuclear fuel (y10) - radioactivity of mine waters (y11) - location of radioactive waste (y12) - underground water protection elements in the nuclear area (y13) - mastering the coefficients for exceeding the maximum normal content, for alerting and for nuclear/radioactive intervention (y14) - perception of nuclear risk and consequences (y15) - disparate/separate management of nuclear protection, safety and security projects (y16) - external security risks (regional conflicts) (y17) - radioactive waste must be managed safely and properly stored (y18)

3. Strong elements	4. Weak elements
- informative protection for competitiveness (z1) - informative competition protection (z2) - high overall nuclear safety (z3) - high overall nuclear security (z4) - multiple existing legal regulations at national and international level (z5) - advanced modeling and simulation (z6) - technical security of the domain (z7) - relevant nuclear reaction control (z8) - relevant systems for detecting radioactive/nuclear situations (z9) - strong international and governmental nuclear energy regulatory agencies (z10) - increased role of intelligence and protection services (z11) - probability of lower risk of incidents/accidents at newer nuclear power plants (z12) - low human errors of nuclear power plant safety and operation tests (z13) - proportional-integral-derivative control, minimizing deviations in the energy-nuclear field (z14) - optimization of the smart SMR energy system - special standards and legislation are required (z15) - the construction and operation of nuclear power plants / SRM are of high resolution (z16) - there is generally a low risk of nuclear accidents (z17) - security in the SMR infrastructure ensures the accessibility, confidentiality or integrity of information or communications (z18) - nuclear power, protection, safety and security in the field depend on intelligent planning, proper design and construction of facilities (z19) - investment in advanced technology is introduced through nuclear power plants (z20) - there is a national radioactivity monitoring system (z21)	- is a complex system of resources and technology (w1) - correlations between security, safety and nuclear protection are often redundant (w2) - often confusing strategies, tactics and programs (w3) - reduction of nuclear waste (w4) - high initial costs for investments in SMR (w5) - emergency plans too diversified, with different levels of relevance (w6) - real-time analysis and threat assessment (w7) - continued high expenses for security, protection and safety services (w8) - probability of higher risk of incidents/accidents at nuclear power plants older than 30 years (w9) - requires development of software certification for activities in electro-nuclear power plants, safety, quality and configuration management, respectively for critical situations; (w10) - no further use of radioactive waste is expected (w11) - informing and involving the public in the area where SMRs are being built (w12) - mining operations in abattoirs and other underground works from uranium mines (w13) - real, all-encompassing consultation of the local community on the location of the SMR (w14) - the final configuration / homologation of the effective and safe SMR tool on a world / global level (w15) - low awareness of nuclear energy activities (w16) - quasi-infinite continuous control of nuclear activities and insufficient culture of nuclear protection, safety and security (w17) - the more relevant integration of safety in the energy-nuclear work processes (w18) - high operating costs of uranium mining deposits (w19) - replenishment requirements from imports of uranium concentrates (uranium oxide, uranium dioxide) (w20) - infrastructures with functional difficulties ("R", Halânga, IRNE) (w21) - high costs of invested capital (w22) - limited investment resources (w23) - relatively large capital investments take place (w24) - financial security in the field must be maintained (w25) - public trust and, in particular, tolerance in relation to the solution of accepting radioactive waste management properly (w26) - deterministic analysis of protection, safety and security, probabilistic assessment of nuclear hazards must be developed (w27) - the need to expand the "R" Plant with the "TG" preparation plant (w28) - physically and morally worn out mining technologies (w29) - restructuring requirements in the uranium mining sector (elimination of subsidies from the national public budget) (w30) - limited domestic uranium mining reserves (w31)

In summary, 26 Opportunities, 18 Threats, 22 Strong Points (elements) and 31 Weak Points (elements) were identified for SMR Doicești through research.

In the continuation of the scientific investigation, a scale of characterization of SMR between *catastrophic* and *definitely absolutely satisfactory* (ideal limits, which are never reached) was made from 1.00 to 10.00, giving coefficients of weight (importance) between 2.00 and 9.00 (with real registration probabilities) for SMR Doicești.

It was observed that for the researched objective the characterizations are located between weights 7.00 and 9.00 (satisfactory, more than satisfactory, very satisfactory).

On this basis, a table was compiled with the weightings/importance notes, the main conclusion emerging is that out of a total of 94 elements, 33 received the characterization of "medium level of acceptance" (between 6.00 and 6.50), i.e. 30.1%.

It should be noted that among the "opportunities" there is no inadequacy (all weights are over 7.50, the majority over 8.00, i.e. "more than satisfactory").

On the other hand, 7 inadequacies are found in "threats" (30.90%), in "strengths" 6 inadequacies (20.30%), and the most numerous (20) in "weaknesses" (60.39%).

The main conclusion is that, in fact, the construction and commissioning of the SMR plant in Doicești decisively meets "opportunities" (average 8.50), further the "strengths" (average 7.45) are acceptable, and the "threats" (mean 6.86) and "weaknesses" (mean 6.39) have inadequacies that can be mastered.

Next, we proceeded to formulate the sub-strategies considered for the assembly and commissioning of the SMR plant.

Placing in a new matrix the Opportunities and Threats on the column, with the positioning of the Strengths and Weaknesses on the line, the sub-strategies SO, WO, ST and WT are obtained by articulation. (tab. 4)

Table 4. Combination, articulation and mutual influence of SWOT analysis factors for protection, safety and security at SMR Doicești-Dâmbovița nuclear power plant

	Strong points / S/ (21 Z_i)	*Weaknesses* / W/ (31 W_i)
Opportunities/ O / (26 X_i)	SO [21 z_i*26 x_i]→ $\mathbf{S_{SO}}$	WO [31 w_i* 26 x_i]→ $\mathbf{S_{WO}}$
Threats / T/ (18 Y_i)	ST [21 z_i*18 y_i]→ $\mathbf{S_{ST}}$	WT [31 w_i *18 y_i]→ $\mathbf{S_{WT}}$

{S_{SO} * S_{WO} * S_{ST} * S_{WT}}→ $\mathbf{S}_{\textbf{SMR Doicești-Dâmbovița}}$

This shows that Opportunities can become Strengths and vice versa (SO).

In depth, the combination, articulation and interdependence of sub-strategies can lead to a Strategy for S_{SMR} Doicești-Dâmbovița

Table 5. Characterization of nuclear protection, safety and security sub-strategies, in relation to the importance coefficients collected for the decision to install and put into operation the SMR at Doicești-Dâmbovița

Specifications	Sub-Strategy $\mathbf{S_{SO}}$	Sub-Strategy $\mathbf{S_{WO}}$	Sub-Strategy $\mathbf{S_{ST}}$	Sub-Strategy $\mathbf{S_{WT}}$
Order of sub-strategies against importance coefficients	1	2	3	4
Distance from the positive ideal state	2.00	2.56	2.85	3.36
The percentage of distance from the positive ideal state [%]	20.00	25.60	28.50	33.60
Distance from the negative ideal state	7.00	6.44	6.15	5.64
Percentage of distance from the negative ideal state [%]	70.00	64.40	61.50	56.40
The strategic value of the nuclear protection, safety and security sub-strategies, compared to the installation and commissioning of the SMR at Doicești-Dâmbovița	8.00	7.44	7.15	6.64

Based on the data held, the order of the sub-strategies in relation to the importance coefficients was established for SMR Doicești, noting that the first place is the S_{SO} sub-strategy (Strengths, Opportunities), and the last place is the S_{WT} sub-strategy (Weak points, Threats). (tab. 5)

It is observed that SMR Doicești, through the $\mathbf{S_{SO}}$ (Strengths, Opportunities) sub-strategy, as a protection, safety and security system has a percentage of 70% distance from the negative ideal state, with the weight of importance on this alignment of "7".

In other words, the strengths and opportunities of this objective, from the perspective of protection, safety and security, are not close to the general bad, negative situation in the field, an aspect that confirms the feasibility of the decision to resort to the nuclear investment from Doicești.

In essence, the combination, articulation, connection and interdependence of the 4 sub-strategies was carried out and, in the end, the level of "7.30" on the scale of 1.00 - 10.00 was obtained for nuclear protection, safety and security at SMR Doicești, which which means that the limit of ½ is exceeded for the complex objective researched.

$$\{S_{SO} * S_{WO} * S_{ST} * S_{WT}\} \rightarrow \mathbf{S_{SMR\ Doicești\text{-}Dâmbovița}} = (8.00 + 7.44 + 7.15 + 6.64)/\ 4 = \mathbf{7.30\ /\ (73\%)}$$

Therefore, according to our scientific investigation, SMR Doicești is suitable for construction and commissioning.

On this basis, the proposals with recommendations included in this work, protection, safety and security at SMR Doicești must be accepted, [24], improved and it is appreciated that, in fact, the plant can be built and put into operation.

4. Conclusions

- Overall, nuclear power (nuclear energy capacity to produce electricity) is characterized by a scale showing zero relevance ("0"), weak and/or indirect relationship ("1"), direct relationship ("2") and the strong relationship ("3") with the National Energy System (SNE).
- It is recommended to develop a prevention documentation and simulation of a major incident/accident scenario.
- The article presents the probabilities and degree of risk assessment at the SMR Doicești - Dâmbovița Modular Nuclear Power Plant and concludes that, in fact, the consequences characterized as negligible are very frequent and have an importance coefficient between 8.50 and 9.00.
- From our own research, it appears that for the SMR Doicești-Dâmbovița investment, attention must be paid to the groups of variables belonging to weak points and threats.
- The sub-strategies show the conclusion that their strategic value towards nuclear protection, safety and security varies between "8" (strengths and opportunities) and "6.64" (weaknesses and threats).

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