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Review of the Interim Report of the Estonian Working Party on Nuclear Energy

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stuk
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STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Contents

1 Executive Summary

STUK reviewed the interim report prepared by the Estonian Working Party on Nuclear Energy. The review focused mainly on development of the governmental infrastructure required for a nuclear power programme. The main objective of the review was to provide comments that would help Estonia to prepare for the IAEA INIR mission scheduled for 2023. STUK caried out the review using the IAEA Milestones Approach and the related IAEA publications as a reference. The IAEA Milestones Approach comprises three phases for the development of a national infrastructure for nuclear power, and there are 19 infrastructure issues to be considered. The commenting of STUK focused mainly on identification of gaps in consideration of the infrastructure issues. It should be noted that the review comments on the interim report of WPONE do not necessarily reflect comprehensively the current status of the ongoing work of Estonia to prepare itself for the IAEA INIR mission.

STUK made 68 comments on the interim report emphasizing infrastructure issues whose development is mainly the responsibility of the state. The following nine comments were considered as key findings:

1. Safety is essential for the use of nuclear energy.
2. Safety Culture is needed within all the organizations involved in the nuclear power programme.
3. Scope and purpose of the report could be clarified.
4. Interim report does not cover adequately all the 19 infrastructure issues.
5. In addition to legal framework there is a need to develop Regulations in Phase 2.
6. Development of SSAC should be started at early in Phase 2.
7. Development of the national capacity required for the nuclear power programme requires investments and time.
8. Public acceptance is a pre-requisite for the use of nuclear energy.
9. Discussions on nuclear waste management should start early in order to establish a clear national waste management strategy and policy.

As a final comment and key finding #10 it can be added that there is a need for comprehensive roadmap for the development of the national infrastructure required for the energy programme. The roadmap should account for the linkages between infrastructure issues and planning should be done at a level of detail that allows for a realistic assessment of how much time and funding the national development programme would require.

2 Glossary

AP	Additional Protocol
BWR	Boiling Water Reactor
CSA	Comprehensive Safeguards Agreement
EC	European Commission
EIA	Environmental Impact Assessment
ESARDA	European Safeguards Research and Development Association
EU	European Union
FOAK	First of a kind (nuclear power plant)
IAEA	International Atomic Energy Agency
INIR	Integrated Nuclear Infrastructure Review
IRRS	Integrated Regulatory Review Service
MSR	Molten Salt Reactor
NPP	Nuclear Power Plant
LILW	Low and Intermediate Level Radioactive Waste
LCOE	Levelized cost of electricity
LWR	Light Water Reactor
NEPIO	Nuclear Energy Programme Initiating Organization
NPP	Nuclear Power Plant
NPT	Non-Proliferation Treaty
PWR	Pressurized Water Reactor
SEED	Site and External Event Design
SMR	Small Modular Reactor
SSAC	State System of Accountancy for and Control of Nuclear Materials
STUK	Radiation and Nuclear Safety Authority of Finland
WPONE	Working Party on Nuclear Energy

3 Introduction

STUK reviewed the interim report prepared by the Estonian Working Party on Nuclear Energy (WPONE). The review focused mainly on development of the governmental infrastructure and capabilities. STUK has recused itself from commenting issues that it has only limited expertise or that are mainly question of the Estonian national energy policy. The task was carried out on commercial basis in cooperation with STUK International Ltd that was established to provide international experts services utilizing the regulatory expertise of STUK. The members of the STUK review team are listed in Appendix 1.

The IAEA Milestones Approach and the related publications of the IAEA were used as references in the review. Figure 1 depicts the IAEA Milestones Approach that comprises three phases for the development of a national infrastructure for nuclear power. At each phase, 19 infrastructure issues need to be considered. Estonia is currently in the Phase 1, where the country is analyzing the implications of the initiation of a nuclear power programme. The review aimed at identifying the weak points of the interim report and provide WPONE with recommendations to help Estonia to prepare itself for the IAEA INIR mission.

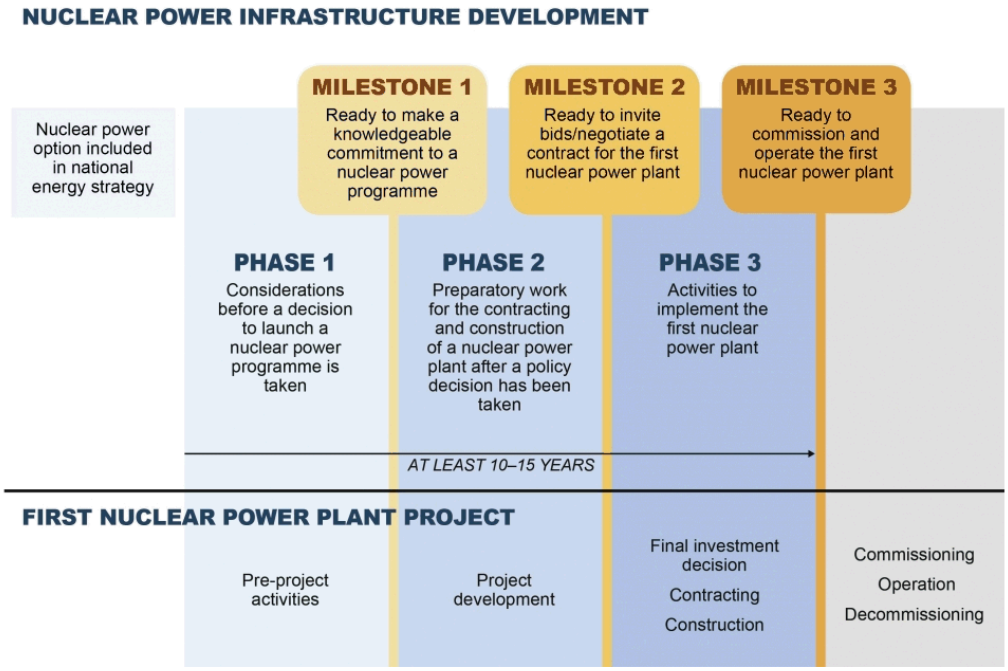

Figure 1. The Phases of the IAEA Milestones Approach (source: the IAEA).

The main objective of Estonia in Phase 1 is to reach Milestone 1, i.e. to become ready to make a knowledgeable decision to launch a nuclear power programme. Thus, while all the 19 infrastructure issues are considered already in Phase 1, the actual development work would begin in Phase 2. Therefore, the review comments related to Phase 2 should be considered provided with the intention to increase awareness of the development work ahead, and they do not imply that Estonia would not be able to reach Milestone 1 in time.

Figure 2. The 19 infrastructure issues of the IAEA Milestones Approach (source: the IAEA).

The review comments made by STUK are organized as follows. The first comments are general comments that are related to the overall structure and contents of the interim report. They are followed by more specific comments organized according to the 19 infrastructure issues of the IAEA Milestones Approach. The comments include findings and sometimes also recommendations. The most important findings are called key findings. The main conclusions and discussion of the review findings are presented in Chapter 5 of this report.

4 Review Comments

4.1 General Comments

This section provides generic comments related to the overall contents of the WPONE interim report.

Comments

C1. The report gives a clear overview of the current situation in Estonia before the decision to launch a nuclear power programme. The relevant infrastructure issues and the main needs of future development have been identified. The IAEA Milestones Approach and the IAEA mission services, such as INIR, SEED and IRRS, can be highly recommended for a nuclear power programme embarking country.

C2. Considering the existing infrastructure and capabilities of Estonia there are certain areas that can be recognized as strengths. Firstly, Estonia is aware of the international agreements related to the peaceful use of nuclear energy and has already joined and ratified many of them. Secondly, Estonia has developed national capabilities to deal with the legacy radioactive waste, and thirdly, factors such as stable economy, digital society, sound legal and educational systems of Estonia form a good basis for the further development of the national infrastructure.

C3. Chapter 1 provides a good overview of nuclear power technology and information on basic principles. The operation principle of a thermal reactor and power conversion process are described at a general level. The life cycle phases of a nuclear facility are not addressed (Design, Construction, Commissioning, Nuclear Commissioning, Operation, Decommissioning). This additional information would be relevant for the regulatory body when establishing a regulatory framework and planning the oversight of new build projects.

C4. Chapter 6.2 includes up to date information on SMR developments around the world and provides a good overview of reactor designs. The chapter could be supplemented by a brief presentation of the main safety functions for reactivity control, heat removal and confinement of radioactive materials. Some of the content seems to be adopted directly from the supplier and the information may be perceived as biased. It would be better to use credible independent sources of information.

Key Finding #1: Safety is essential for the use of nuclear energy

C5. Use of nuclear energy introduces radiation risk to public and to environment, and measures need to be taken to protect people and environment from radiation exposure. The report should provide basic information on the risk and how and to what measure it can be managed, as this kind of information is essential in decision making. The main references are the IAEA Safety Standard Series SF-1 and GSR Part 1.

Key Finding #2: Safety Culture is needed within all the organizations involved in the nuclear power programme

C6. The report should highlight management for safety and the importance of developing an organizational culture that promotes safety within all the organizations involved in the nuclear power programme. The report could support that by including safety consideration for all discussed topics, and by bringing forward even more strongly that safety is broader concept than just the technical safety of the facility.

Key Finding #3: Scope and purpose of the report could be clarified

C7. The introduction of the interim report could include a description of the task given to WPONE. The introduction could be based on the Chapter 5 of the interim report and the following points points could be emphasized:

- An explanation of the role of WPONE in identifying topical issues and launching topical studies to collect information, preparing development plans, and estimating the cost of required development work.

- An overall roadmap and schedule of the work of WPONE. Visualization of the roadmap and schedule and the interconnections between the infrastructure could be useful.

C8. The report could include an executive summary about the fundamental issues related to the decision of starting a nuclear power programme.

Key Finding #4: Interim report does not cover adequately all the 19 infrastructure issues

C9. The IAEA Milestones Approach provides a basic structure for analyzing current status and gaps (Phase I and Milestone I) in national infrastructure for the use of nuclear energy. The contents of the Estonia's national report on compliance with the obligations of the Convention on Nuclear Safety could be used for this purpose.

It is recommended to launch additional topical studies in accordance with the IAEA Milestones Approach. The interim report included some examples of such an approach (eg. nuclear security). There could be a matrix to plan the topical studies, development actions and to follow them. The topical reports should provide input to the self-assessment task before the IAEA INIR mission.

4.2 National Position

A strong continued governmental leadership and support is vital at every stage and throughout the lifetime of the nuclear power programme.

Comments

C10. The report should aim at providing the decision makers of Estonia a clear overview on the decision to start a nuclear power programme. Particularly there is need for information about what commitments, development work and investments are required from the government, when to expect the first NPP to become operational, and what are the risks associated with the decision.

C11. The importance of energy security and reliability of power supply has increased because of the recent energy crisis. Use of nuclear power has potential to alleviate the problem in the future. The issue needs to be assessed on the overall energy system level.

4.3 Nuclear Safety

Nuclear safety requires commitments by all elements of the government, owner/operator, regulatory body, nuclear technology and equipment suppliers and other organizations to ensure safety in all aspects of the nuclear power programme.

Comments

C12. Priority for safety is underlying principle in the safe use of nuclear energy and should also be considered in the content of the national report. The report should address safety perspective in the use of nuclear energy in more comprehensive manner to provide a balanced view. Safety is a broad entity thus it is important to identify areas that are connected to it and need to be considered in the national program. The report could address safety regarding all the 19 infrastructure issues introduced in the IAEA milestone approach as most of the issues have some impact on safety. Even is for some issue safety aspects are not recognized, it is good to document that safety has been considered.

C13. The topic of responsibility for safety isn't addressed enough in the report. The chapter 9.2 only mentions the liability of the operator for nuclear damage. It would be a relevant issue to include considerations on, who bears the overall responsibility for safety in the use of nuclear energy. It should also not be forgotten, that other parties involved in the use of nuclear energy and projects thereof have responsibilities for safety.

C14. High-level fundamentals of nuclear safety could be included in the national report. At least fundamental safety objectives, fundamental safety functions (reactivity control, heat removal and confinement of radioactive materials) and defence-in-depth principle (structural barriers and functional levels) should be addressed on general level. See for example IAEA Safety Standard Series No. SF-1 (Safety Fundamentals) and IAEA Safety Standard Series No. SSR-2/1 (Rev.1) (Safety of Nuclear Power Plants: Design Specific Safety Requirements).

C15. The report could identify and briefly describe other key topics relevant for safety. Such examples are quality assurance, continuous safety assessment,

verification and improvement, learning from experiences and risk informed approach, just to mention a few. These among others are highly connected to the other milestones as well.

C16. The interim report stipulates many ongoing analyses, that WPONE has planned to be performed (Section 5.3). It is good, that the working group has identified many relevant areas to be considered such as emergency preparedness, security, siting, legislative framework, regulatory framework, international legislation and human resource development. These are important elements for the national nuclear safety infrastructure, mapping of which is a good practice. The relation and significance of these elements to the safety could be made more evident in the report, and that is why a more comprehensive view on nuclear safety should be included in the report

4.4 Management

The roles and responsibilities of management will change as the process of developing a national nuclear power programme progresses from study to implementation to operation. Management of a nuclear power programme is demanding, and highly competent managers are vital to success at all stages. Effective management entails strong leadership, management systems, project management, strategy and planning, organization and competence development.

Comments

C17. The need for excellent management skills is mentioned in the report but not discussed in detail. It should be noted that development of the national infrastructure for the nuclear power programme or management of a NPP construction project are megaprojects whose managers need to be highly skilled experts. Thus, training of the managerial skills need to be accounted for in planning of the national competence building programmes.

C18. The IAEA organizes international trainings on nuclear and radiological leadership. The aim of the course is to support governments in their work to foster leadership for safety and safety culture by helping early to mid-career professionals to develop their safety leadership potential. It does this through improving their understanding of what leadership means in practice in nuclear and radiological working environments with their inherent complexities and often competing considerations.

4.5 Funding and Financing

The funding and financing requirements for a nuclear power programme overall, and a nuclear power plant specifically, are very large. Funding refers to items that are the responsibility of the government (e.g. ensuring resources for regulation), while Financing refers to items that are the responsibility of the owner/operator (whether

government owned or a private utility), whose costs will be recovered by selling electricity (e.g. the costs of construction, fuel and equipment replacements).

Comments

C19. The experiences of the other embarking states are useful references for planning and assessment of cost of development actions. For Estonia the most feasible references are states with similar governance, legislation and basic education system.

4.6 Legal Framework

The legal framework for nuclear power should establish the responsibilities of all organizations necessary for a successful nuclear power programme. National legislation should comprehensively cover all aspects of nuclear law and implement all relevant international legal instruments.

Comments

Key Finding #5: In addition to legal framework there is a need to develop Regulations in Phase 2

C20. Section 10 states that a separate Nuclear Act would establish the basis for regulation of the use of nuclear energy. It is mentioned that there is a need for supplementary Regulations, but their role in regulation of the use of nuclear power is not described in detail. In Phase 2 there is a need to develop binding Regulations are needed to set the safety objectives and requirements. In addition to them there is a need for additional non-binding regulatory guides that explain how the safety objectives can be achieved.

C21. Section 10.1 states that the Nuclear Act would establish legal basis for nuclear energy and activities related to the management of nuclear material and fuel, the fundamental safety requirements and the rights, obligations and liability of persons in relation to nuclear installations. There is a need to ensure that legislation covers the establishment of an independent regulatory body, its mandate and provisions for resources. It is also important to bear in mind that the Legal and Regulatory Frameworks are closely linked and that legislation defines the responsibilities of governmental organizations.

C22. Section 5.3 of the report describes that there is an ongoing tendering to find a contractor to update the draft nuclear law for Estonia. The assignment includes planning the overall legislation, drafting an updated version of the existing draft nuclear law and assessing the need for additional legislation. In general STUK recommends active participation of the relevant governmental organization in the development process in order to ensure that various stakeholder points of view are accounted for. The process can also be used to increase the awareness and competence of the stakeholders on nuclear safety, security and safeguards. There are various options on how to arrange the legislation

development process, and a reasonable draft nuclear law may be of use to initiate the process.

4.7 Safeguards

With regard to Safeguards member states are expected to demonstrate a clear commitment to their international non-proliferation obligations and Safeguards agreements with the IAEA.

Comments

C23. International treaties and agreements are setting frames and prerequisite to all use of nuclear energy (peaceful use of nuclear energy and nuclear non-proliferation). State international rights and obligations could be described in the beginning: NPT (+CSA+AP) and Euratom Treaty (+Safeguards Regulation 302/2005, Export control of dual-use items in the EU 2021/821)

Key Finding #6: Development of SSAC should be started at an early stage in Phase 2

C24. There is a need to describe the State System of Accountancy for and Control of Nuclear Materials (SSAC) and who is responsible for establishing, maintaining and development of it. Roles, responsibilities and tasks of the Safeguards Regulatory Authority and licensees (users of nuclear energy) need to be clearly described: the operator is responsible for safety, security and implementation of safeguards in its facility, while regulatory authority shall have the rights to receive all the necessary information and to inspect and verify the operation at all phases of fuel cycle. Additionally, the IAEA and EC have their specific roles and responsibilities and shall be equipped with the required powers to carry out their tasks. Development of SSAC should be started early on after the decision to initiate a nuclear power programme.

C25. Early considerations of safeguards requirements are essential for effective safeguards implementation in all phases of the use of nuclear energy: Early provision of information form the basis for the implementation of Safeguards by Design that enables necessary safeguards measures and enables nationally safety and security consideration of these measures (ensuring efficient 3S approach).

C26. Licensing and approval of use of nuclear energy is a key element for safeguards implementation/supervision. This includes provision of information and establishing requirements for the Nuclear Material Accountancy and Control (NMAC) systems.

C27. Note: In the interim report Section 9.2, the Additional Protocol to the CSA (Safeguards Agreement) is under the safety conventions and there is a reference to the EU safeguards regulation 302/2005. It is recommended to correct this and have a dedicated chapter for safeguards.

C28. In Chapter 10, safeguards is mentioned as an area of national competence to be developed. In building of competence, sharing of experiences and use of international training possibilities (eg. IAEA and EC safeguards training courses, and participation to ESARDA activities) are the recommended ways to gain expertise necessary for safeguards implementation, both nationally and internationally.

4.8 Regulatory Framework

A Regulatory Framework is crucial for the long-term success of the programme and it includes the development of a competent, independent, and well resourced nuclear Regulatory Body.

Comments

C29. WPONE has emphasized the importance of establishing an independent nuclear safety regulatory body well before the decision on starting a national nuclear energy program is made (Section 9 and 9.1). This is good starting point for the development. The interim report has noted the many preparations and the large workload required to establish a regulatory body and has identified many relevant areas in which development is required, e.g personnel needs, competencies, human resources development, statute, budget, legislative amendments and preparations, establishment of a regulatory framework for requirements, the issuance of permits, oversight and enforcement.

C30. Emphasis should be given to national safety requirements and regulations as the establishment of a regulatory framework requires a broad amount of expertise in different disciplines, the most important ones being nuclear safety and radiation safety, but also many other technical (e.g mechanical, structural, manufacturing, civil, material, electrical and instrumentation and control, chemistry and nuclear/radiation physics) and human-organizational expertise are required for the nuclear oversight. The development of safety requirements and regulations is also resource consuming and takes time, even if experienced experts are involved. It would be recommended to map out the expertise and competence needs required to be able to establish nuclear regulatory framework. National regulations and regulatory guides of the other countries could be used as reference when assessing the expertise needs in different areas. National regulatory documents are often more detailed when compared to international standards and guides, which could be advantageous for the purpose of such an analysis. It should also be noted that nuclear safety is a broader entity than radiation safety, which calls for own regulatory framework – existing regulatory framework of radiation safety could be utilized in the development, but the scope of nuclear safety and associated activities during the life cycle of a nuclear facility necessitate additional effort in the establishment of a regulatory framework.

C31. It is advantageous to combine the governmental function of the oversight of the use of nuclear energy with the oversight of the use of radiation for medical, industrial and research purposes. However, in development of the regulatory body, its organization, processes and management system it should be noted that the oversight of the use of nuclear energy is in many ways different from the oversight of the use of radiation.

C32. Chapter 9 of the interim report discusses the stage obligations, and the main focus is on safety. Section 9.1 about the establishment of a regulatory body, should include also security and safeguards. It is an important consideration, whether Safety, Security and Safeguards, all belong to one regulatory body, or alternatively there are separate governmental bodies for regulating security and safeguards.

C33. In order to avoid a conflict of interest the regulatory body for nuclear safety should be independent from the governmental organization that handles the license applications related to the use of nuclear energy.

C34. Section 5.3 of the report describes that there is an ongoing tendering to find a contractor to develop a human resources development strategy for Estonia. The assignment is expected to provide an overview of the regulatory framework for the introduction of nuclear energy and proposals for the establishment of a nuclear regulator. STUK could assess the thematic report once its results are available.

4.9 Radiation Protection

Estonia has a national infrastructure for radiation safety related to the use of radiation for medical, industrial and research purposes. While the radiation protection aspects of a nuclear power programme require additional consideration, they will likely best be addressed by building on the existing infrastructure.

Comments

C35. Report mentions radiation protection as an area where there is a need for further national capacity building. However, the issue is not discussed in detail. The basics of the radiation protection are similar for the use of radiation for medical and industrial purposes, but specific additional expertise is needed to support the use of nuclear energy. The issue should be considered among others in planning of the human resource development.

4.10 Electrical Grid

An early step in considering the introduction of nuclear power is an assessment of the electrical grid's current and planned size and reliability.

Comments

C36. Chapter 3 of the report includes an informative description of the Estonian electrical grid. According to Section 3.5 the maximum unit size for a NPP that can be connected to the Estonian electricity system is 350 MW. This maximum appears to be surprisingly low and limits the choice of the NPP plant supplier. Thus, it could be worthwhile to study further possibilities to increase the upper limit and what would be the related cost.

4.11 Human Resource Development

The availability of skilled staff is vital for the success of a nuclear power programme. Skilled employees are needed by the regulatory body, the owner/operator, technical support organizations and other relevant organizations. In addition to their fundamental scientific and technical education, staff typically require special training in safety, security, and radiation protection. Safety culture is an essential part of the training.

Comments

Key Finding #7 Development of the national capacity required for the nuclear power programme requires investments and time

C37. According to the international experiences collected by the IAEA the development of the required national infrastructure for the safe use of nuclear energy takes at least some 10-15 years. Majority of the governmental capacity required for the nuclear power programme needs to be developed in Phase 2 of the Milestones Approach, which is often from the governmental point of view the most intense and challenging development phase required for the nuclear power programme.

C38. Section 5.3 of the report explains that there is an ongoing procurement to find a contractor to develop a human resources development strategy for Estonia. The winner of the tendering process is asked to map Estonia's opportunities for developing human resources in the field of nuclear energy and provide an overview of the regulatory framework necessary for the introduction of nuclear energy, together with proposals for the creation of a nuclear regulator. The results of the work are expected to be available in early 2023. The assignment appears to touch several major infrastructure issues.

C39. Chapter 10 of the interim report provides further information on the existing national competences in Estonia. The description list some of the required competencies, but there are many additional areas of expertise that would be worth of mentioning explicitly such as project management, quality management, inspections, construction engineering, mechanical engineering, geology, electrical engineering, automation and control room, water chemistry, radiochemistry, probabilistic risk assessment, material engineering, process engineering, systems engineering, reactor physics and dynamics, thermal hydraulics, nuclear fuel, analysis of severe accidents, human factors, operator duties, safety culture, licensing, communications, nuclear waste management,

security and safeguards. For most of the above-mentioned areas of expertise a master's degree education provides a suitable starting point to reach an adequate professional level of expertise.

C40. The preliminary estimate of the need for additional specialists with higher education provided in Section 9.1 appears to be low. However, the actual number depends on the number of nuclear facilities to be oversighted and the amount of work procured from Technical Support Organizations and Inspection Organizations.

C41. There are many options for the development of national capacity for a nuclear power programme. While the long-term objective should be establishing specific bachelor and masters level programmes at the local universities, it may in the beginning be more feasible to send students to graduate at foreign universities. Additionally, there are good examples of using a research reactor project to train national experts for the nuclear power programme.

C42. The state obligations of international conventions, treaties and EU legislation have been considered in the interim report (Section 9.2). It is good, that the Working Group has an ongoing analysis of mapping international obligations and those based on voluntary conventions and treaties to provide an overview of relevant international legislation that Estonia has already joined or could (or must) join, and what requirements are arising from the EU legislation. The establishment of a nuclear energy program has been recognized to increase the burden of fulfilling the obligations of conventions/treaties in which Estonia is already part of, which needs to be considered in development of national human resources, competencies and know-how. It would be beneficial for the Working Group to address these state obligations in the context of the IAEA Milestones.

C43. The interim report stipulates on international cooperation activities, past cooperation and ongoing work and potential future plans (Section 5.4). It is good, that the report provides an overview of international cooperation activities. It would be beneficial for the Working Group to map out and select the most important partners, allocate the effort to certain IAEA milestones, set the goals, scope and clear directions for the work involved to have more coordinated and consistent approach in utilizing international cooperation for the IAEA Milestones Approach. IAEA has been mentioned to be the main cooperation partner, offering training, consultations, expert missions and guidance. However, the Working Group could also consider detailed cooperation with other international partners as well, the scope of the work should be defined as large enough to provide enough value for Estonian development in the field of nuclear energy. National differences exist and it should be taken into consideration when making decisions on selection of cooperation partners and the scope of their work. The work should have consistent directions, that are based on guidelines and opinions of the most important cooperation partners, because the scattered cooperation may have drawbacks in the long term if variances exist in national practices.

C44. According to Section 4.1.2 the development of national competence and legal framework would cost at least 10 million euros. The report contains no further justifications for the estimate. Considering the broad scope of the national competence to be developed and the amount of work and challenges in development of a sound legal framework, the preliminary cost estimate appears to be underestimated. The cost estimate could be compared with the realized costs of the nuclear power programme embarking states.

C45. The interim report provides background on the development of national competencies and stipulates on current situation, work performed, ongoing developments and plans (Chapter 10). The safe use of nuclear energy requires ensuring sufficient competencies, expertise and know-how, that should be highly emphasized when developing national program. The regulatory body should have adequate human resources and competencies to fulfil its task in establishing safety requirements and regulations and overseeing, that the licensee meets required levels of safety in all activities important to safety. As mentioned in the interim report, at the moment Estonia has limited expertise in nuclear safety and development in this area should be a top priority of the national development plan in Phases 2 and 3.

C46. National competence and legal framework are cornerstones of a successful nuclear power programme and sufficient governmental funding is required for development of them. The use of SMR technology would have some implications on the need for national competences, but it would not likely substantially affect the amount of work needed for development of the legal framework.

4.12 Stakeholder Involvement

Effective stakeholder involvement addresses concerns early and explains the nuclear power programme's rationale, plans and progress. Stakeholders include the general public, legislators, government agencies and decision makers, and, as the nuclear power programme progresses, the owner/operator, the regulatory body, potential suppliers, workers, communities near possible sites, neighbouring countries and non-governmental organizations.

Comments

C47. Sections 5.3 and 5.5.2 describe the communication strategy of WPONE and communication partner's activities, respectively. According to the information included in the report the current communication strategy includes relevant elements and the main challenges are recognized. It should be noted that while currently the NEPIO has a certain communication strategy, the communication needs will evolve along the development of the nuclear power programme. Furthermore, there will later be a need to develop separate communications roles and strategies for the different stakeholders of the nuclear power programme, and the various governmental organizations forming the regulatory

framework of Estonia may emphasize different aspects in their communication strategies.

Key Finding #8 Public acceptance is a pre-requisite for the use of nuclear energy

C48. Public acceptance is a pre-requisite for the use of nuclear energy. Stakeholder involvement and communication with the local communities is an essential part of the site selection process for any nuclear facility including waste facilities. According to Finnish experiences it is acquired thru transparency, clear roles and responsibilities and strong safety commitment of all the stakeholders and clear waste management strategy and policy.

4.13 Site and Supporting Facilities

Siting of NPPs and other nuclear facilities is a multiphase process of selecting a suitable location for the facility, including appropriate assessment and definition of the related design bases. The siting process for a nuclear installation generally consists of a site survey, site selection and site evaluation. Siting addresses all types and interactions between the installation and the surrounding environment.

Comments

C49. The Estonian approach to establish a subsidiary working party on spatial planning and involving all the relevant stakeholders appears feasible.

C50. The results of the preliminary analysis of potential sites for a nuclear power plant and for disposal of spent nuclear fuel are essential information for the Estonian decision-makers. A third-party assessment may be needed to ensure the validity of the results.

4.14 Environmental Protection

Protecting the environment when developing a new nuclear power programme is one of the important issues that nuclear newcomer countries face. Environmental considerations are often key drivers of the public perception and acceptance of a nuclear power project. In addition to the radioactive effluents during the operation of a NPP there is a need to consider conventional environmental impacts, such as land use, water use, water quality, etc.

Comments

C51. According to the Environmental Impact Assessment Directive, an Environmental Impact Assessment (EIA) is required for a NPP project, before the project can be started. This requirement needs to be considered in development of the regulatory framework for licensing of NPPs.

C52. Construction and use of a NPP has various environmental impacts and hazards similar to those of other major industrial facilities. In general the significance of the environmental impacts depend to the size of the facility and the chosen technology. Use of nuclear power has the following specific environmental impacts that are to be taken into account in the EIA:

- Radioactive effluents into the atmosphere and the water bodies.
- Thermal load on water bodies.

One recommended source of information about the environmental impacts of a NPP project is the publicly available documentation on the EIA of the Fennovoima project in Finland (https://tem.fi/en/environmental-impact-assessments).

4.15 Emergency Planning

Emergency planning for the protection of plant personnel, emergency workers and the public beyond the site boundary is a necessary element of overall plant safety. Emergency planning ensures the capability to take actions that will effectively mitigate the consequences of an emergency.

Comments

C53. Emergency Planning is not covered in detail in the interim report of WPONE. The report mentions that Estonia has an Emergency Act and subsidiary legislation on radiological emergency plans. In case Estonia makes a decision to initiate a nuclear power programme, there is a need to review and amend the existing legislation and develop the required additional governmental functions in the Phase 2.

4.16 Nuclear Security

Nuclear security concerns the prevention of, detection of, and response to, intentional unauthorized acts related to nuclear material, other radioactive material, and associated facilities and activities. The national nuclear security regime comprises its legal and regulatory frameworks and administrative measures governing nuclear security, the organizations responsible for nuclear security, and the nuclear security measures themselves.

Comments

C54. Establishing a sound Nuclear Security Regime requires careful planning and good cross-governmental cooperation. A team of Estonian experts visited Finland in August 2022 to study the Finnish Nuclear Security Regime. The findings of the visit could be useful for the development of the Estonian Nuclear Security Regime. Estonia is recommended to establish a dedicated working

party to study the issue. It should be noted that because of the national security the final report of the working party can be published only partially.

4.17 Nuclear Fuel Cycle

A country should choose its fuel cycle strategy relatively early, as the choice will influence its selection of a specific nuclear technology. The fuel cycle includes activities prior to using the fuel in a nuclear power plant (front end) and after the fuel is removed from the reactor (back end).

Comments

C55. The report includes plenty of useful background information about the front and back end of the fuel cycle. Nuclear fuel cycle is a complex topic and attention shall be paid to ensure that the Estonian decision makers have adequate understanding about the long-term implications of their decisions.

4.18 Radioactive Waste Management

Radioactive Waste Management and disposal of all radioactive waste is an essential aspect of nuclear power and should be considered early.

Comments

Key Finding #9 Discussions on nuclear waste management should start early in order to establish a clear national waste management strategy and policy

C56. The interim report provides a good overview of the principles and challenges of radioactive waste management as well as the currently available technological solutions. There are many feasible waste management options to be evaluated and the selection of the optimal solutions will depend among others on the planned fuel cycle, reactor technology and local conditions. From the government point of view there is a need to evaluate beforehand various options by building scenarios and use them to determine the optimal waste management strategies and policies for various options. Optimal waste management strategy and policy are the key success factors for the national nuclear power programme and therefore, building of the scenarios should be initiated early in Phase 1. One recommended reference about the subject is the management of spent nuclear fuel and radioactive waste in Finland.

C57. The national programme for radioactive waste management should include the issues related to the management of spent nuclear fuel and radioactive waste in a comprehensive manner. The programme should include general objectives, principles, estimated amounts and planned measures of spent fuel and radioactive waste management as well as an estimate of the costs and schedule of waste management. A key objective of the national programme is

to develop radioactive waste management as the nuclear power programme evolves.

C58. Management and final disposal of spent nuclear fuel or high-level radioactive waste is one of the biggest concerns of general public. Thus, there is need for reliable information about the issue. It should be noted that the information provided by a private company that has plans to build a nuclear facility are often considered biased, while governmental expert organizations are usually considered more trustworthy. Thus, governmental expert organisations can help the Estonian public and decision-makers to form an informed opinion on the issue by providing transparently unbiased information.

C59. When evaluating the cost of final disposal of spent nuclear fuel, it can be noted that the overall cost of the final disposal of spent nuclear fuel of the existing five Finnish nuclear power plants is of the order of seven billion euros.

C60. One part of the interim report describes a centralized storage for LILW, while the other explains that storage for LILW would be established in connection with the NPP. Estonia should have a clear radioactive waste management strategy.

C61. Cost of radioactive waste management needs to be taken into account when assessing the LCOE generated by nuclear power.

C62. Reprocessing and recycling of spent nuclear fuel does not cancel the need for a solution for the final disposal of high level waste.

C63. Section 7.2: in addition to uranium, fission products and plutonium, spent nuclear fuel contains also other actinides.

C64. Conventionally spent nuclear fuel generates so much decay heat that it needs to be cooled for nearly a decade in a wet storage before dry storage becomes an option.

4.19 Industrial Involvement

Many commodities, components and services are required to construct and support the operation of nuclear facilities. Such supporting activities can be a source of jobs and economic growth for the country.

Comments

C65. The report does not discuss the involvement of the industrial sector of Estonia in construction and maintenance of the nuclear facilities. The issue should be elaborated more in Phase 2 of the nuclear power programme.

C66. It should be noted that in general the relative part of national industrial involvement is substantially smaller in case of SMRs compared with large

NPPs, because of the differences in the manufacturing and construction technologies.

4.20 Procurement

Procurements are an essential part of a nuclear power programme. Usually, the first nuclear power plant is procured via a turnkey contract. It is important that the owner/operator specify the quality requirements and verify that the supplier meets those requirements. For governmental procurements there are clear rules in Estonia.

Comments

C67. Public procurements require good understanding of the products and services being procured and additionally specific expertise on national legislation on public procurements. In general STUK recommends long-term planning of public procurements and use of framework contracts eg. for procurement of technical support services.

C68. For successful procurement process intelligent customer capabilities are essential. In recent years, there have been cases where nuclear installations have been supplied with counterfeit and fraudulent items, and these quality deviations have caused delays in new build projects. International organizations such as the IAEA and OECD Nuclear Energy Agency have been publishing experience and guidance to tackle this challenge. Intelligent customer capability can be described as the capability of the organisation to have a clear understanding and knowledge of the product or service being supplied.

5 Conclusions and Discussion

Based on the findings of the review of the WPONE interim report, the Estonian national considerations prior to the decision to launch a nuclear power programme appear to be carried out in a systematic and timely manner. The Estonian approach to launch separate thematic studies on the 19 infrastructure issues of the IAEA Milestones Approach is feasible, provided that the linkages between the infrastructure issues are taken into account. The results of the thematic studies are very useful for the Estonian self-assessment carried out before the IAEA INIR mission.

STUK made 68 comments on the interim report. Most comments are related to some identified gap in considerations. Some comments include a recommendation on how to improve the situation or a recommended source of additional information about the issue. The following nine comments were considered as key findings:

10. Safety is essential for the use of nuclear energy.
11. Safety Culture is needed within all the organizations involved in the nuclear power programme.
12. Scope and purpose of the report could be clarified.
13. Interim report does not cover adequately all the 19 infrastructure issues.
14. In addition to legal framework there is a need to develop Regulations in Phase 2.
15. Development of SSAC should be started at early in Phase 2.
16. Development of the national capacity required for the nuclear power programme requires investments and time.
17. Public acceptance is a pre-requisite for the use of nuclear energy.
18. Discussions on nuclear waste management should start early in order to establish a clear national waste management strategy and policy.

As a final comment and key finding #10 it can be added that there is a need for comprehensive roadmap for the development of the national infrastructure required for the nuclear power programme. The roadmap should account for the linkages between infrastructure issues and planning should be done at a level of detail that allows for a realistic assessment of how much time and funding is required for the development programme.

6 References

Nuclear Infrastructure Bibliography | IAEA

IAEA Safety Standards Series No. SF-1. Fundamental Safety Principles.

IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), General Safety Requirements.

IAEA Safety Standards Series No. GSR Part 2, Leadership and Management for Safety.

IAEA Nuclear Energy Series No. NG-G-3.1 (Rev. 1), Milestones in the Development of a National Infrastructure for Nuclear Power.

Management of spent nuclear fuel and radioactive waste in Finland, Second national programme under Article 12 of Directive 2011/70/EURATOM of the Council of the European Union.

Appendix I: STUK Review team

The following STUK experts participated in the review of the WPONE interim report:

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