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Regulatory Requirements for Siting of the New Slovenian NPP

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ABSTRACT

Nuclear energy, as a free-carbon source, is an important contribution to reduction of the levels of CO_2 emissions. The planning and preparation project to build a second nuclear reactor unit in Krško, so-called JEK2, has already started 15 years ago, at a site next to existing plant in Krško. The new project of JEK2 obtained the first license called energy permit in July 2021. In March 2022, the documentation for initiative for the national spatial plan was prepared.

Licensing of new reactor facilities is under the responsibility of Slovenian Nuclear Safety Administration (SNSA). SNSA actively responded to the investor's activities. A project team was formed at SNSA with the aim to prepare experts for such extensive task of licensing the new NPP. The regular exchange of information started between the investor GEN Energija and SNSA to facilitate the preparation of licensing documentation and immediately address any open issues about the evaluation of the site and the design of JEK2.

The SNSA activities are aimed at increasing its capabilities by employing new personnel and preparing the qualifications criteria as well. The Slovenian legislative framework was also upgraded with new revisions of acts on spatial planning, environmental protection, and construction. SNSA is preparing amended regulations with nuclear safety requirements based on the WENRA Safety Reference Levels and the IAEA requirements.

SNSA started with preparation of requirements for site evaluation according to the national regulations and the appropriate IAEA standards. An initial safety analysis report shall be prepared with the basis for the site authorization. At the stage of this siting safety analysis report, information about the nuclear power plant design will be limited to a general design envelope, while information about the site is likely to be comprehensive.

1 INTRODUCTION

Slovenia is the smallest nuclear country in the World. The current Krško NPP, owned jointly by Slovenian and Croatian utilities, is approaching its 40 years of operation, and is approaching long-term operation of additional 20 years [1]. However, extended operation of existing plant is not sufficient to supply the predicted future use of electric power in the countries (Slovenia and Croatia). Economic progress in Slovenia results in ever growing

demand for supply of electricity. This should be supplied by carbon free technologies, with high capacity factor not only nuclear power can provide.

The utility GEN Energija d.o.o. (GEN), a 50% part-owner of the existing Krško NPP, started planning a new NPP close to the existing NPP in Krško already some 15 years ago to build. This preparatory process was also accompanied by some preparatory activities of the regulatory body Slovenian Nuclear Safety Administration (SNSA) from 2008 onwards. By 2010, the situation was almost ready to begin the siting process of new NPP, but the project was abruptly stopped by the Fukushima accident in March 2011. All the resources of SNSA previously engaged in the new NPP project turned then towards the EU stress tests and, in parallel, the preparation of National Action Plan as well as licensing of the Krško NPP Safety Upgrade Program.

The GEN also started with the licensing processes by obtaining the Energy permit in 2021. After completion of the post-Fukushima National Action Plan, SNSA started again with the preparation for the new build. The start of licensing process for site approval is expected at the end of 2022. The paper will present the regulatory activities in preparation of requirements for site evaluation, necessary for further licensing of the new NPP project.

2 RESTART OF THE JEK2 ACTIVITIES IN 2021 AND 2022

By 2021, the original post-Fukushima actions for Krško NPP were mostly completed. The SNSA resources were relieved from many years of intense activities. The only remaining action of the Krško NPP Safety Upgrade Program is the construction of Spent Fuel Dry Storage facility. In 2021, SNSA prepared new amendments to the regulations on nuclear safety that also included new requirements for design of a new NPP. In January 2022, the action plan from the second Krško NPP Periodic Safety Review (PSR) was completed and the third PSR started with the safety review which included the evaluation of site relevant characteristics. The results of this review also apply to the proposed site of the new NPP. The Integrated Regulatory Review Service (IRRS) mission to SNSA in 2022 issued recommendations and suggestions on how to further improve regulatory processes for the new build [2].

Two important Slovenian strategic documents, namely *Resolution on the Slovenian long-term climate strategy 2050* and *Integrated National Energy and Climate Plan* were issued by both the Ministry of Infrastructure as well as the Ministry of the Environment and Spatial Planning. There were favourable conditions for GEN that enabled the restart of the JEK2 project [3]. The Energy permit for JEK2 was issued already in July 2021 [4] and defined the new NPP basic characteristics (Table 1). GEN has not yet chosen the vendor of the NPP as this should be selected by 2027, following the final decision on the new NPP construction. By then, the siting process should be already completed. In accordance with the regulations on the construction of buildings, a preliminary decommissioning project and a waste management plan must be prepared for JEK2 as a part of the process to issue the construction permit.

Table 1: Main characteristics of JEK2 defined in the energy permit [4]

Facility Type:	Pressurized Light Water Reactor (PWR)
Total electrical power	1 x 1,100 MW with a tolerance of ±10%.
Voltage of the network	400 kV
Basic fuel	fuel cells with uranium dioxide (UO_2), uranium enrichment 4-5%
Alternative fuel	reprocessed spent fuel elements (MOX), mixed core
Design lifetime	60 years

The situation in the EU has changed in 2022 in favour of new independent energy supply sources. The main reason was the war in Ukraine and possible loss of energy supply (gas, oil, coal) from the Russian federation. The EU shifted its energy policy into a new direction that favours energy production by independent means, including the carbon neutral nuclear energy. The electricity market prices are currently at record highs, thus providing another motive to invest in a new nuclear power plant.

3 SNSA AND ITS ACTIVITIES TO PREPARE FOR JEK2

At the end of 2021, SNSA formed a new project team for preparations for a possible new build that consisted of 5 experts from the Nuclear safety division. The project team immediately started to improve its competences related to the process of licensing the new NPP. In 2022, the project team was upgraded into a new section of the Nuclear safety division. When the decision on the new built will be taken (by 2027), this section shall be expanded into a new larger division at SNSA which would be dedicated to the JEK2 project.

SNSA realized that it needs to build-up the SNSA resources and competences. In December 2021, a plan for new hiring, based on the SNSA human resources analysis, was presented to the Minister of the Environment and Spatial Planning, but there was no immediate practical gain. The total number of employees at SNSA remained limited by quota set by the Ministry's human resources department. With the change of the Government in the 2022, the support to the SNSA human resources needs was provided by the Ministry of the Environment and Spatial Planning.

Another drawback is that, so far, SNSA was also not successful in providing adequate replacement for its staff leaving for retirement or to other jobs. SNSA requires experts in the fields of mechanical engineering, electrotechnics and physics, etc. To young engineers, the jobs at SNSA are not attractive because of low wages for beginners which are not comparable with what the human resources market can offer. In current conditions engineers for technical jobs are in high demand. SNSA is looking for a different approach in attracting new staff to fill-out vacant positions in the organisation, as well as in expanding according to the needs for the new NPP project. Young staff for SNSA shall be acquired through a system of dedicated scholarships for students of different faculties from the fields of technical and natural sciences.

The SNSA team for JEK2 tries to build-up competence based on the experience acquired in the last 10 years from the post Fukushima activities and other processes. In this way, SNSA shall improve the staff competences related to site assessment; to the design and construction of new nuclear facilities; and to the environmental impact assessment of new NPP (Table 2).

SNSA plans to organize education and training for newly hired staff. The most important is the system of new staff being mentored by experienced SNSA staff members which transfers the acquired knowledge and on the job experience to beginners. For the basic knowledge on nuclear technology and nuclear safety, the most suitable are the courses at the Milan Čopič Nuclear Training Centre (ICJT) of the "Jožef Stefan" Institute. For special topics, such as design on GEN III reactors with passive safety systems, the international training courses may be used. SNSA established good relations with international organizations, such as IAEA, OECD, and some regulatory bodies, mainly US NRC, where several SNSA staff members attended training courses and workshops in the past to gain knowledge on design and operations of NPPs and other nuclear facilities.

Table 2: SNSA experience gained during last 10 years in Krško NPP licensing processes that result in staff competence upgrade.

<table>
<tr><th colspan="3">Experience category</th></tr>
<tr><th>Site assessment</th><th>Design and construction</th><th>Environmental impact assessment</th></tr>
<tr><td rowspan="2">Third PSR of the Krško NPP, safety factors Hazard analysis and Emergency response</td><td>Krško NPP Spent fuel dry storage</td><td rowspan="2">Report on environmental impact for the Krško NPP lifetime extension</td></tr>
<tr><td>Repository NSRAO of the ARAO in Vrbina</td></tr>
<tr><td rowspan="2">Application of decree UV3 conditions in review of projects built in area of limited use of space near the Krško NPP</td><td>New buildings OPC and BB1 as part of Krško NPP SUP</td><td rowspan="2">Transboundary impacts evaluation</td></tr>
<tr><td>Impact of the new HPP Brežice and required modifications of Krško NPP cooling systems</td></tr>
</table>

4 PREPARATION OF SITING GUIDELINES FOR JEK2

Cooperation of SNSA with GEN started in 2021 following the meeting of GEN and SNSA managements where GEN presented the basic characteristics of the planned project. It was arranged that regular working meetings shall be established to exchange information on project progress, to discuss licensing requirements for JEK2 and to prepare guidelines for siting of JEK2 based on the IAEA standards. Some reports and analyses from 2009 were reviewed again as well as updated.

According to the GEN initiative for preparation of national spatial plan for JEK2, the new NPP will be located next to the existing Krško NPP (Figure 1). The plant location will be determined by the procedure of the national spatial plan preparation. The investor must submit a documented initiative to the ministry responsible for energy to enable the start of the preparation of the national spatial plan. GEN Energija has already done it.

Figure 1: The location of the new JEK2 will be by the river Sava next to the existing Krško NPP (picture from website of GEN Energija, https://www.gen-energija.si/investiramo-in-razvijamo/drugi-blok-jedrske-elektrarne-jek2-)

After reviewing the requirements for a new NPP, the first conclusion is that the legislation changed significantly since the Fukushima accident. The Ministry of the Environment and Spatial Planning was very active in 2021 and prepared new revisions of the Spatial Management Act, the Environmental Protection Act, as well as the Building Act. The amendments to these important laws, governing both licensing of the site and construction of the facility, affect the process of licensing since SNSA cannot act as an independent subject in preparation of guidelines for the site selection. The new laws envision a formation of a decision-making body lead by the Ministry's Environment Directorate that will contain representatives of different regulatory bodies that shall issue conditions of guidelines from their area of competence. The decision-making body will review the fulfilment of all conditions and at the end of the licensing process will be responsible for approval of the project. Other participating regulatory bodies will not issue separate decisions.

The SNSA regulations are also in preparation and contain new requirements based on the WENRA 2020 SRL and the IAEA standards for NPP design. The WENRA 2020 SRL [5], in its Issues C, SV and TU, introduced important new contents for assessment of internal and external hazards and the management system of operator. The licensing processes for the new NPP are defined by the Ionising Radiation Protection and Nuclear Safety Act. The Rules on radiation and nuclear safety factors (JV5), which were prepared according to the WENRA Safety Reference Levels, define more in detail the requirements for the site and the design of the new NPP. The Rules JV5 contain probabilistic acceptance criteria for the site selection. Both natural hazards and human activities in the vicinity must be analysed to define required plant design or protection of the site against hazards by active means. The NPP design must ensure that molten core accidents that would lead to early or large releases are practically eliminated.

The Decree on areas of restricted use due to nuclear facilities and on the conditions for construction in these areas (UV3) contains requirements for siting of the new NPP in the vicinity of existing nuclear facilities. The UV3 decree outlines the criteria for determining the areas of restricted use of space due to a nuclear facility, the criteria for prohibiting construction in areas of restricted use of space and the type of construction in these areas. Based on the decree, JEK2 may be built in the Krško NPP exclusion zone (500m) upon obtaining a positive opinion from SNSA in the construction permit process. The compliance with the conditions from the decree shall be demonstrated, to limit the impacts on the existing Krško NPP. The area of restricted space use for JEK2 shall be defined in the process of obtaining construction permit.

The IAEA requirements for siting [6] address the management of both safety and non-safety aspects to be considered in the siting and site evaluation processes for an NPP and its supporting facilities. Thus, it includes important factors, such as considerations on nuclear safety and nuclear security, technology and engineering aspects, economics and cost, land use planning and preparation, availability of water, non-radiological environmental impacts, emergency planning, socioeconomic impacts, and involvement of stakeholders.

A lot of data on the new NPP site is already available from past activities. The assessment of the JEK2 site can rely on the already existing analyses for the Krško NPP site, including the regularly updated data on the site characteristics, population density, relevant external hazards, meteorological and hydrological data, etc. The most important is to consider the nearby Krško NPP and adapt the design of JEK2 accordingly to ensure that the safety and operation of the existing Krško NPP will not be jeopardized in any way. The emergency preparedness plan of the Krško NPP needs to be upgraded, too.

The guidelines for content of the Safety Analysis Report [7] define structure and content of the safety analysis report to be submitted by the investor in the processes of siting, construction, commissioning, operation and decommissioning of an NPP. The guidelines of

IAEA SSG-61 ensure that the information on the safety of the NPP is comprehensive and is sufficient to demonstrate compliance with the relevant IAEA safety requirements and recommendations.

5 CONCLUSIONS

The paper shows that the regulatory framework is ready for the new NPP licensing processes to begin. SNSA found out that regarding nuclear facilities, the spatial planning legislation determines basic requirements, but these are not sufficiently detailed. The formulation of guidelines for the process of spatial plan preparation will therefore also need to rely on the international IAEA or US NRC standards which shall supplement the national regulatory requirements.

The process of licensing this new NPP and its construction and commissioning will last between 10-20 years, and therefore it is important to prepare well for the process and to strive for good cooperation between investor and the regulator, as this can make the whole process more time efficient and productive. Any delays can significantly increase the project cost. This means that the regulatory body needs to be reinforced with additional staff and these newcomers must be appropriately trained to gain knowledge and experience required for such complex licensing process. On the national level, it is also important to upgrade the nuclear industry and research organizations that are relied upon as essential support to the regulator in the licensing processes and the supervision of constructing this new NPP.

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