

# Ensuring Nuclear and Radiation Safety in the Republic of Slovenia

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## **Purpose:**

The purpose of the article is to present nuclear and radiation safety in Slovenia, operations of the Slovenian regulatory body, the Slovenian Nuclear Safety Administration (SNSA), and its Emergency Response Team.

## **Design/Methods/Approach:**

We used the descriptive method and the method of document analysis. By analysing statistical data, we presented how the competence of the SNSA Emergency Response Team is ensured. The participatory observation will be used to analyse the exercises participated by the SNSA Emergency Response Team in year 2019.

## **Findings:**

Ensuring nuclear and radiation safety is one of the core tasks of the SNSA. SNSA employees conduct expert, administrative, control and development tasks in the field of nuclear and radiation safety. An essential part of ensuring nuclear and radiation safety is emergency preparedness. Regular trainings of SNSA Emergency Response Team members, monthly checks of communication channels and equipment, preparation of procedures that precisely define the activities and work of SNSA and members of the Emergency Response Team, development of tools and exercise participation are necessary to ensure the highest level of preparedness. The Republic of Slovenia has developed comprehensive arrangements for ensuring preparedness and response in the event of a nuclear or radiological emergency, as confirmed by International Atomic Energy Agency (IAEA) in the Emergency Preparedness Review (EPREV) in 2017. Many national and international exercises are carried out annually. Analyses of the exercises carried out in 2019 revealed some challenges that are being addressed immediately or with a trainings and exercise plan for 2020.

## **Originality/Value:**

The article presents activities undertaken in Slovenia in the area of emergency preparedness to ensure nuclear and radiation safety. Due to the possible devastating consequences of over-exposure to ionising radiation on human health and the environment, this topic is important for every citizen of the Republic of Slovenia and also in broader region, as nuclear accidents can have cross-border effects. People living in the vicinity of the nuclear power plant have higher interest in the topic and are treated in a special way.

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**Keywords:** ensuring safety, preparedness, response, emergencies, nuclear accident, radiological accident, regulatory body

## **Zagotavljanje varnosti na jedrskem in radiološkem področju v Republiki Sloveniji**

### **Namen prispevka:**

Namen prispevka je predstaviti zagotavljanje varnosti na jedrskem in radiološkem področju v Sloveniji, delovanje slovenskega upravnega organa Uprave Republike Slovenije za jedrsko varnost (URSJV) ter njene Skupine za obvladovanje izrednega dogodka.

### **Metode:**

Za pripravo prispevka smo uporabili deskriptivno metodo in metodo analize dokumentov. Z analizo statističnih podatkov smo predstavili, kako zagotavljajo usposobljenost Skupine za obvladovanje izrednega dogodka URSJV. Za analizo vaj, v katerih je v letu 2019 sodelovala Skupina za obvladovanje izrednega dogodka URSJV, smo uporabili metodo opazovanja z udeležbo.

### **Ugotovitve:**

Varnost je dobrina, na kateri temelji dobrobit vsake družbe, države in posameznika. Zagotavljanje varnosti na jedrskem in radiološkem področju je ena od nalog URSJV. Zaposleni na URSJV opravljajo strokovne, upravne, nadzorne in razvojne naloge na področjih sevalne in jedrske varnosti. Bistven del zagotavljanja jedrske in radiološke varnosti je pripravljenost na izredne dogodke. Da se zagotovi najvišja možna stopnja pripravljenosti, je nujno potrebno redno usposabljanje članov Skupine za obvladovanje izrednega dogodka URSJV, mesečno preverjanje zvez in opreme, priprava postopkov, ki natančno opredeljujejo delovanje in delo URSJV ter članov Skupine za obvladovanje izrednega dogodka, razvoj orodij in sodelovanje na vajah. V Republiki Sloveniji je dobro poskrbljeno za zagotavljanje pripravljenosti in odziva ob morebitnem jedrskem ali radiološkem izrednem dogodku, kar je leta 2017 potrdila tudi mednarodna pregledovalna misija za to področje EPREV. Na letni ravni izvajajo veliko vaj na državni in mednarodni ravni. Analize vaj, ki so se izvedle v letu 2019, so pokazale nekatere pomanjkljivosti, ki se jih bo poizkušalo takoj odpraviti oziroma z načrtom usposabljanj in vaj za leto 2020.

### **Izvirnost/pomembnost prispevka:**

Prispevek predstavi dejavnosti, ki potekajo v Sloveniji na področju pripravljenosti na izredne dogodke in s tem zagotavljanja varnosti na jedrskem in radiološkem področju. Tematika je zaradi neželenih posledic v primeru prekomerne izpostavljenosti ionizirajočemu sevanju na zdravje ljudi in okolje pomembna tako za vsakega državljana Republike Slovenije kot tudi za širšo javnost, saj so vplivi jedrskih nesreč lahko tudi čezmejni.

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**Ključne besede:** zagotavljanje varnosti, pripravljenost, odziv, izredni dogodki, jedrska nesreča, radiološka nesreča, upravni organ

## 1 INTRODUCTION

According to the past experience nuclear and radiation safety is particularly important, because of the impact of ionizing radiation on human health and the environment. Even though 33 years has passed since the nuclear accident in Chernobyl and 8 years since the nuclear accident in Fukushima, the consequences of these accidents are still present in the environment today (Drobyshevskaya, 2018). It is therefore essential to primarily act in a preventive manner, to ensure the highest level of nuclear safety, including defence in depth in all phases of projecting, siting, constructing and operating of nuclear facility, competence of personnel working in nuclear facility, safety culture, operating and other procedures, control over installed equipment and outside support organisations, safe treatment of spent fuel and radioactive waste, etc. on operator's side and comprehensive regulatory and inspection control on regulatory body's side. As a final stage of nuclear safety both operator and regulatory body (as well as the whole state incident response system) have to be well prepared for all emergency situations, having well defined and tested all essential parts of an effective response system for nuclear emergencies.

As nuclear and radiological accidents are extremely rare, and because most people are not familiar with this field (Tzika, 2019), we discuss the potential nuclear and radiological scenarios that could occur in the territory of the Republic of Slovenia. *Hazard assessment for nuclear and radiological emergencies* (Uprava RS za jedersko varnost [Slovenian Nuclear Safety Administration, SNSA], 2017) presents the potential scenarios that could occur in the event of a nuclear or radiological accident. It includes accidents in nuclear facilities (Krško Nuclear Power Plant, TRIGA research reactor, Central storage for low- and intermediate-level waste in Brinje, and nuclear-powered ships entering Slovenian territorial waters). In addition to nuclear accidents, there is potential for a radiological accident in Slovenia, with involved radioactive sources. Radioactive sources can be mobile (sources in radiography, probes for measuring moisture and density of road surfaces, calibration sources) or used in stationary facilities (hospitals and research institutes, industrial radiography).

*Risk assessment for nuclear or radiological accidents* (SNSA, 2015) presents the following scenarios: accident at the Krško Nuclear Power Plant, accident at the TRIGA research reactor, accident at the radioactive waste storage in Brinje, accident in use of radioactive sources, accident due to uncontrolled radiation sources, accident during transport of radioactive and nuclear material, satellite crash with radioactive substances, accident abroad, and accident due to a criminal act. Nowadays, cyberattacks on the nuclear industry are also becoming real threats, as stressed by Tomažič and Bernik (2019). Cyberattacks are becoming more frequent and sophisticated, and their perpetrators extremely motivated. Scenarios differ a lot taking into consideration possible consequences (only nuclear accident at a nuclear power plant can cause large cross-border effects) and some unique challenges deriving from the nature of ionizing radiation. Ionizing radiation cannot be felt by any of human senses, which is in particular dangerous in case of so-called orphan sources (lost, abandoned, stolen, etc.) or in case of criminal acts involving radioactive sources.

As explained a nuclear accident at a nuclear power plant presents the highest risk scenario due to its possible consequences. In the event of a nuclear accident at a nuclear power plant with a containment structure, the structure should restrain the majority of radioactive substances, so that protective actions for the general population are not necessary, or can be minimal. However, in the event of a containment structure failure, a significant amount of radioactive substances can be released into the environment. As exposure to ionising radiation affects human life, protective actions are necessary to protect the population and the environment. As stated in the *Hazard assessment for nuclear and radiological emergencies* (SNSA, 2017), it is important that urgent protective actions are pre-prepared in advance, as there is not much time for their implementation during an accident. A protection and rescue plan must be prepared for every nuclear facility, and it has to be regularly rehearsed. At the SNSA, the responsibility for emergency preparedness and response falls under the Emergency Preparedness Division, whose basic tasks are providing all necessary competences and means of the SNSA Emergency Response Team, ensuring that Emergency Response Team's procedures are current and comprehensive, that the equipment, premises and documentation for the team's needs are adequate and operational and that all members of the team are properly trained for all their envisaged tasks in emergency. In implementation of the *National emergency response plan for nuclear and radiological accidents* (Vlada Republike Slovenije [Government of the Republic of Slovenia], 2010), the SNSA Emergency Response Team assess the situation to provide advice and give recommendations and proposal of protective actions to the Civil Protection Commander of the Republic of Slovenia, who takes decisions in all major emergencies in Slovenia. SNSA is his most important advisory body in taking pre-defined protective actions such as evacuation, sheltering, iodine prophylaxis – ingestion of potassium iodide tablets, food protective actions, etc.

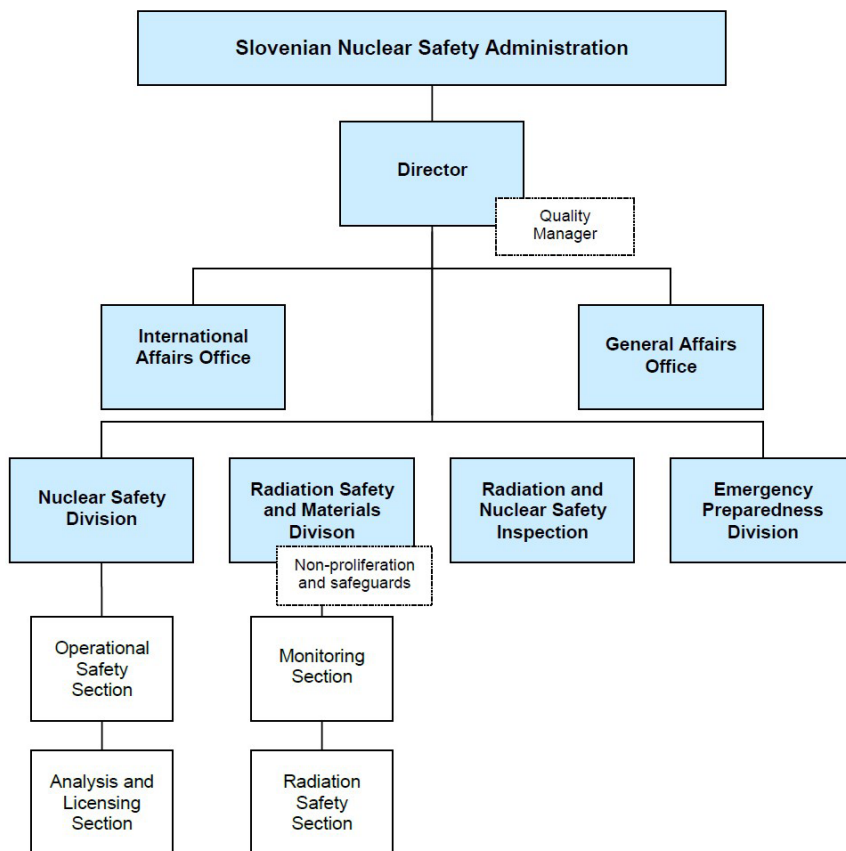
The article presents the work of the SNSA, the methods for ensuring nuclear and radiation safety, preparedness for nuclear and radiological emergencies in the Republic of Slovenia, overview of the Emergency Preparedness Division of the SNSA, SNSA Emergency Response Team and its trainings, as well as exercises carried out to test and evaluate its preparedness for such situations and analysis of the exercises in which the SNSA Emergency Response Team participated in 2019.

## 2 SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

SNSA is a body within the Ministry of the Environment and Spatial Planning. Employees of the regulatory body conduct expert, administrative, control and development tasks in the field of radiation and nuclear safety, radiation practices and activities of using sources of ionising radiation (except in healthcare and veterinary medicine), protection of the environment against ionising radiation, physical protection of nuclear materials and facilities, non-proliferation of nuclear weapons, and security of nuclear goods. Employees at the Radiation and Nuclear Safety Inspection Service conduct inspection and enforcement tasks in the areas mentioned above. The Nuclear Safety Division supervises and monitors the safety in nuclear facilities and issues licences and authorisations to nuclear

facilities in the Republic of Slovenia, and reviews and approves safety analyses and assessments. The task of the Radiation Safety and Materials Division is to supervise and monitor radiation safety in nuclear and radiation facilities, issuing authorisations, approving changes, confirming programmes and approving construction in areas of limited use of space due to nuclear facilities (Figure 1). It also conducts supervision of nuclear non-proliferation, security measures for nuclear goods, physical protection of facilities, including cybersecurity in the nuclear sector, and monitors nuclear security (SNSA, 2019a).

**Figure 1:**  
SNSA  
organigram  
(SNSA, 2019a)



SNSA prepares drafts of legislation and regulation related to its work, oversees the legislative framework for its field of work, fulfils international obligations in all fields of work, prepares reports, analyses and assessments (e.g. threat assessment, risk assessment), and participates in the preparation of other documents in cooperation with other stakeholders. The General Affairs Services provides legal assistance in procedures for issuing administrative act and participates in the implementation of international treaties. SNSA has implemented a system of management, which allows uninterrupted and effective operation of the organisation, combining all requirements on safety, health, the environment, physical security, quality and economy (SNSA, 2019a).

The work of the entire administration is to ensure nuclear and radiation safety in the Republic of Slovenia (SNSA, 2019a). The key task of SNSA in ensuring nuclear safety is to carefully monitor operations of the Krško Nuclear Power Plant and the TRIGA research reactor in Brinje. In accordance with the provisions of the Ionising Radiation Protection and Nuclear Safety Act (Zakon o varstvu pred ionizirajočimi sevanji in jedrski varnosti [ZVISJV-1], 2017), SNSA maintains the Central register of radioactive waste and spent fuel. Transportation of radioactive and nuclear material in the Republic of Slovenia is governed by the Transport of Dangerous Goods Act (Zakon o prevozu nevarnega blaga [ZPNB], 2006). Transport authorisations for radioactive materials under ZPNB (2006) are issued by SNSA, which also issues import/entry authorisations for radioactive and nuclear material, except for import/entry and export/departure of radioactive material used in healthcare of veterinary medicine.

An essential part of ensuring nuclear and radiation safety is emergency preparedness, which is one of the key processes of SNSA, managed by the Emergency Preparedness Division. The Emergency Preparedness Division ensures the preparedness of SNSA for responding to nuclear or radiological emergencies, works with many organisations and bodies in planning and responding to emergencies on the national level, and also cooperates in this field on the international level. SNSA must ensure preparedness for responding to emergencies, which could represent a radiological threat to the territory of the Republic of Slovenia. In other words, in the event of a nuclear or radiological emergency, SNSA personnel is activated to perform SNSA's envisaged tasks within the state's response system. In the event of a nuclear or radiological emergency, one of the key tasks of SNSA is to provide immediate data on the radioactivity in the environment, and to propose protective actions to the Civil Protection Commander of the Republic of Slovenia. Main tasks of SNSA in the event of nuclear or radiological emergency are defined by the *National emergency response plan for nuclear and radiological accidents* (Vlada Republike Slovenije [Government of the Republic of Slovenia], 2010).

Pursuant to ZVISJV-1 (2017), SNSA each year coordinates the preparation of the Annual Report on Radiation and Nuclear Safety in the Republic of Slovenia, which is approved by the Government of the Republic of Slovenia. The Report summarises all previous year's findings related to ionising radiation and nuclear safety, thus representing the main method of informing the general public of the annual findings on nuclear and radiation safety in the Republic of Slovenia.

### **3 PREPAREDNESS OF THE REPUBLIC OF SLOVENIA FOR NUCLEAR AND RADIOLOGICAL EMERGENCIES**

Because an essential part of ensuring nuclear and radiation safety (last barrier of protection of people against harmful effects of ionizing radiation) is emergency preparedness, all authorities and organisation in the country, composing an overall incident response system, must have and maintain all the competences needed to implement their roles and responsibilities in accordance with pre-prepared action plans, in the event of a nuclear or radiological emergency. Nuclear and

radiological accidents are emergencies that directly impact the population and the environment, and therefore require protective actions. Every emergency does not result in an accident. An emergency might involve only a reduction of nuclear and radiation safety, which also requires an appropriate response of especially operator of a facility, but as well as also other competent organisations, in first place regulatory authority (SNSA, 2019a).

If the nuclear or radiological emergency occurs, tasks within the national competence are performed according to the National emergency response plan for nuclear and radiological accidents (Vlada Republike Slovenije [Government of the Republic of Slovenia], 2010) by:

- Government of the Republic of Slovenia,
- Ministry of Defence, Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, Slovenian Armed Forces,
- Ministry of the Environment and Spatial Planning, Slovenian Nuclear Safety Administration, Environmental Agency of the Republic of Slovenia,
- Ministry of Health, Slovenian Radiation Protection Administration, Health Inspectorate of the Republic of Slovenia,
- Ministry of Agriculture, Forestry and Food, Veterinary Administration of the Republic of Slovenia, Inspectorate of the Republic of Slovenia for Agriculture, Forestry and Food,
- Ministry of the Interior, the Police,
- Ministry of Transport,
- Ministry of Education, Science and Sport,
- Ministry of Infrastructure,
- Ministry of Labour, Family, Social Affairs and Equal Opportunities,
- Ministry of Foreign Affairs,
- Ministry of the Economic Development and Technology,
- Ministry of Public Administration,
- Ministry of Finance, Customs Administration of the Republic of Slovenia,
- Communication Office of the Government of the Republic of Slovenia,
- The Protection, Rescue and Relief Forces: the Civil Protection Commander of the Republic of Slovenia, the Deputy of the Civil Protection Commander of the Republic of Slovenia and the Civil Protection Headquarters,
- civil protection units and services,
- fire-fighting units, and units and services of associations and other non-governmental organisations,
- protection, rescue and relief units, services and centres organised by government, and
- other bodies.

They have to be prepared, knowing which are their response roles and how to undertake safety actions in a case of emergency.

Goal 10 of the Resolution on Nuclear and Radiation Safety in the Republic of Slovenia – for the period 2013–2023 (Resolucija o jedrski in sevalni varnosti v Republiki Sloveniji za obdobje 2013–2023 [ReJSV13–23], 2013) also states that, in the use of nuclear energy and radiation practice in the Republic of Slovenia,

emergency preparedness must be ensured in order to reduce the impact on humans and the environment in such events. Furthermore, the Inter-ministerial commission for monitoring the implementation of the National emergency response plan for nuclear and radiological accidents convenes regularly ones or twice per year, to direct and coordinate the preparedness on the national level (SNSA, 2019b).

Emergency preparedness is one of the key processes of SNSA, coordinated by the Emergency Preparedness Division, with cooperation of the entire SNSA. This means that, in the event of any nuclear or radiological emergency, the SNSA Emergency Response Team is activated immediately (Tomažič, 2019). SNSA is only one of the stakeholders that would start implementing actions in the event of a nuclear or radiological emergency. All organisations with a response role in the event of a nuclear or radiological emergency are defined by the *National emergency response plan for nuclear and radiological accidents* (Vlada Republike Slovenije [Government of the Republic of Slovenia], 2010). This is a pre-prepared action plan in the event of a nuclear or radiological emergency that requires the activation of national forces, including ministries and other authorities, civil protection service, healthcare, firefighters, police and other responding organisations. The main body responsible for the preparation and maintenance of the national plan is the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief (ACPDR), while SNSA participates in preparation of all parts of the plan.

In 2017, International Atomic Energy Agency (IAEA) conducted an international EPREV mission to determine how Slovenia ensures nuclear and radiation safety. An EPREV mission is one of the services provided by the IAEA to member states, in the field of peaceful use of nuclear energy, and nuclear and radiation safety. Its purpose is to provide an expert review of the country's preparedness for nuclear or radiological accidents, and responses to such accidents, based on IAEA safety standards. As part of the two-week review, the international mission reviewed the entire national framework in this field, including legislation and regulation, plans and procedures on all levels, as well as personnel and material capacities of Slovenia for responses in the event of nuclear or radiological accident. It made 19 recommendations representing actions to address non-compliance with IAEA requirements and standards, 12 proposals that represent actions to more effectively implement requirements and standards and 3 good practices (International Atomic Energy Agency [IAEA], 2017). The main recommendations of the EPREV mission were finalization of revision of national plan; overall protection strategy (including monitoring strategy) for all phases of emergency, especially arrangements for the later phases of response; concept of operations for a nuclear or radiological emergency; detailed assessment of needs and available resources of all stakeholders; overall trainings and exercise programs for all response organizations; arrangements for dosimetry of all emergency workers and arrangements for general practitioners and emergency medical services to be trained to recognize the symptoms of radiation exposure and national response procedures (IAEA, 2017).

The mission report was the basis for the action plan, adopted by the Government of Slovenia, which includes tasks needed to be undertaken by



Slovenia to improve the system of preparedness. An action plan with 31 actions, which include the mission's observations and findings, the action to be taken, the leading and participating organizations and deadlines for the implementation. Some of the actions (amendment of the Hazard assessment for nuclear and radiological emergencies, analysis of the notification and activation system of the SNSA emergency response team, poster for emergency workers, including for the purposes of providing non-designated emergency workers with just-in-time trainings, a poster on information for general public on the health hazards and health effects in case of radiological emergency, addressing also the most vulnerable members of the public, amended procedures for requesting and receiving international assistance, exercise of SNSA's officer on duty to provide advice remotely during initial response to a radiological emergency, etc.) were completed in 2018. Less than a half of actions is still ongoing, including revision of national emergency plan, protection strategy, decontamination procedures, guidelines for treatment, or for the designation of medical personnel to treat radiation injuries, etc. In general, the mission praised the preparedness of Slovenia to nuclear and radiological accidents, and highlighted, amongst other things, the excellent cooperation of all stakeholders and organisations involved in responding to such accidents (SNSA, 2018).

The mission also highlighted three cases of good practices, which serve as examples of great performance in certain area to all countries around the world. The first one is communication and coordination system, called KID, which allows rapid sharing of technical and operational information across a wide range of national and international response organizations. The second one is a Geographic information system of regional emergency notification centres that includes the location of all High Activity Sealed Sources in the country which provides for a rapid assessment of the hazard and appropriate emergency response. The third good practice was conducting a simulated EPREV mission which provided a good basis for improving emergency preparedness and response arrangements in the country and updating the national self-assessment before the mission itself (SNSA, 2018).

### 3.1 Emergency Preparedness Division

Coordination of emergency preparedness is one of the key processes of SNSA and is one of the tasks of the Emergency Preparedness Division. The task of the Emergency Preparedness Division is to ensure the highest possible level of preparedness of SNSA for emergency response, with cooperation of the SNSA Emergency Response Team members. To ensure the highest possible level of preparedness, it is necessary to conduct regular trainings of SNSA staff as they are all SNSA Emergency Response Team members, to check emergency connections and equipment once per month, and to prepare procedures that precisely define the activities and work of SNSA and SNSA Emergency Response Team members, development of tools, etc. The tasks of the Division therefore include: providing trainings, ensuring personnel and responsiveness of the SNSA Emergency Response Team, ensuring that Emergency Response Team's procedures are current

and comprehensive, and that the equipment, premises and documentation for the team's needs are operational. The SNSA emergency response capability is ensured through regular trainings of SNSA Emergency Response Team members, regular maintenance and review of the operation of software and other equipment, regular review of all relevant organisational regulations and instructions, participation in international activities, review of responsiveness in all circumstances, and review of full system preparedness using domestic and international exercises. As the tasks during an emergency generally differ significantly from the regular work of SNSA employees, trainings of SNSA Emergency Response Team members is very important. An analysis of previous year's trainings is conducted at the end of each, to review the number of trainings courses conducted in the year and the average number of trainings hours undertaken by SNSA Emergency Response Team members. In 2019, 112 individual and group trainings courses, tests and exercises were conducted for SNSA Emergency Response Team members, for a total of 442 hours with SNSA Emergency Response Team member participation. Almost a third of the trainings constituted of exercises (30%) – 15 different types in 2019. The implementation of the professional trainings and preparedness programmes of the Nuclear Accident Analysis Expert Group and the Dose Assessment Expert Group is the responsibility of the Head of the Nuclear Safety Division and the Head of the Monitoring Section. The Head of Emergency Preparedness Division is responsible for planning, management, and coordination of programmes (Kuhar, 2020).

### 3.2 Emergency Response Team

In the event of an emergency, the SNSA Emergency Response Team is activated (Tomažič, 2019). It is composed of sub-groups, whose roles are pre-defined. The Emergency Team Director is responsible for managing an emergency, making all key decisions and communicating with external stakeholders and public. The Emergency Team Director approves all outgoing documents prepared by the Emergency Response Team.

According to Tomažič (2019) the Head of the SNSA Emergency Response Team helps the Emergency Response Director with operational management of the SNSA Emergency Response Team and is the Director's deputy. Additionally, the SNSA Emergency Response Team includes: Nuclear Accident Analysis Expert Group and the Dose Assessment Expert Group, incoming and outgoing communicators, technical support, representatives in the Off-site Support Center of the Krško Nuclear Power Plant, in the Civil Protection Headquarters of the Republic of Slovenia, and in the inter-ministerial operating group. SNSA Emergency Response Team members are appointed by the SNSA director. The work is organised in two shifts, meaning that the members' shifts are limited to 12 hours.

Tomažič (2019) also explains that the Nuclear Accident Analysis Expert Group is activated only in the event of a nuclear accident. The task of the Nuclear Accident Analysis Expert Group is to use the available data to analyse a nuclear accident, assess the situation in the nuclear facility where the emergency is

underway, to determine its likely course, and to forecast the potential development of the incident. Their main tool of assessment is Emergency Response Data System (ERDS), the system which is directly connected with the Krško Nuclear Power Plant providing all essential parameters of safety and other systems of the nuclear power plant. Using the ERDS the SNSA has the same information of the nuclear power plant parameters as the operator of the facility, allowing SNSA Emergency Response Team to perform its own independent evaluation of the emergency situation. The Nuclear Accident Analysis Expert Group is also tasked with assessing the amount of radioactive material during an actual or potential release. The Head of the Nuclear Accident Analysis Expert Group reports directly to the Emergency Team Director.

The task of the Dose Assessment Expert Group is (Tomažič, 2019) to propose protective actions, based on the situation at the site of the accident (radiological situation in the field, level of risk at the Krško Nuclear Power Plant), with potential consideration of dose assessment model results, primarily for the purpose of protective actions optimisation. In case of a nuclear accident in Slovenia or abroad, their main tools are the real-time on-line decision support systems DOZE and RODOS which provide consistent and comprehensive information on the present and future radiological situation, in order to help members of the Dose Assessment Expert Group to decide on emergency response strategies. The Head of the Dose Assessment Expert Group reports directly to the Emergency Team Director.

Five communicators, who report directly to the Head of the Emergency Response Team, are according to Tomažič (2019) planned for communication with external stakeholders. One shift is composed of two incoming communicators and three outgoing communicators whose key tasks are informing the public, neighbouring countries and international community (European Union [EU] and IAEA). Uninterrupted operation of the necessary devices is the responsibility of the technical support person. SNSA representatives at Civil Protection Headquarters of the Republic of Slovenia, the Off-Site Support Center of the Krško Nuclear Power Plant, and the inter-ministerial operating group are responsible for direct information and presentation of SNSA position regarding the emergency situation.

SNSA has an employee (a Duty Officer) on permanent duty (24/7), who must have a mobile phone and some emergency procedures with him at all times. Their task, within the framework of emergency preparedness, is activation of the Emergency Team Director, followed by the activation of all SNSA Emergency Response Team in the extent determined by the Emergency Team Director. An important task of the Duty Officer is also providing advice on call to first responders or users of radioactive sources in case of radiological accidents. In case of this kind of accidents, the SNSA Inspector can be sent to the emergency location.

All tasks and duties of the Emergency Response Team members are pre-defined and trained regularly.

All written communication of the SNSA Emergency Response Team is conducted using the KID (Communication during the emergency). According to Kuhar (2019) KID is an online communication system for communication during

the nuclear or radiological emergency. Communication can be carried out on two levels, specifically on internal level between SNSA Emergency Response Team members and on the inter-ministerial (and even cross-border) level. Communication by KID is:

- *immediate*: a sent message is immediately received,
- *direct*: a message is received by all users,
- *secure*: internal and inter-ministerial KID operate on an independent and secure network,
- *full*: unlimited number of messages with attachments,
- *private*: private messages are possible,
- *controlled*: it is possible to confirm and check the delivery of messages and
- *recorded*: messages and attachments are archived.

In addition to communication, the KID website includes a sub-page StatusID, which shows all important information on the emergency on one page. SNSA regularly maintains and updated the KID, and conduct trainings for external users (Kuhar, 2019).

According to Kuhar (2020) 36 organisations<sup>1</sup> involved in responding to nuclear or radiological accidents were included in the KID in end of 2019. KID communication represents one of the best known solutions in this area, both in Europe and throughout the world, as it represents a safe, quick, reliable, controlled and transparent tool for communication and coordination of protective actions for all stakeholders in the country when responding to a nuclear or radiological accident, and also provides effective and quick cross-border communication with the Croatian Civil Protection Directorate, allowing appropriate and timely harmonization of protective measures which is essential, considering the location of the Krško Nuclear Power Plant in the vicinity of the border.

#### **4 DESCRIPTION OF THE METHOD, SURVEY DESIGN AND THE PRESENTATION OF NUCLEAR AND RADIATION SAFETY EXERCISES ATTENDED BY THE SNSA IN 2019**

To ensure the highest level of competence, SNSA Emergency Response Team members participate in various exercises. As a minimum, every SNSA Emergency Response Team member attends at least one exercise per year (Kuhar, 2020), while employees of the Emergency Preparedness Division generally participate in all exercises. Participation in exercises represents the main basis for the evaluation of

<sup>1</sup> *The Notification Centre of the Republic of Slovenia, Civil Protection Commander of the Republic of Slovenia, Administration of the RS for Civil Protection and Disaster Relief, Krško Nuclear Power Plant - Technical Support Center, Krško Nuclear Power Plant – Off-Site Support Center, Slovenia Nuclear Safety Administration, Civil protection Posavje, Zasavje, Dolenjska, E Štajerska, W Štajerska, Ljubljana, Krško, Brežice, Sevnica, Kostanjevica, Regional Notification Centre Brežice, Novo mesto, Trbovlje, Celje, Maribor, Ljubljana, Communication Office of the Government of the Republic of Slovenia, Slovenian Environment Agency, Mobile unit/mobile laboratory of Jožef Stefan Institute, Rapid Response Unit, Radioactive Waste Management Agency, Institute of Occupational Health, Ministry of Interior, Police, Ministry of Health, Ministry of Infrastructure, Ministry of the Environment and Spatial Planning, Ministry of Foreign Affairs, Ministry of Agriculture, Forestry and Food, Croatian Civil Protection Directorate.*

competence of SNSA Emergency Response Team members, and consequently the capability of SNSA to respond to emergencies. After every exercise an analysis of SNSA Emergency Response Team members' work and performance in carrying out the necessary actions, in relation to the event played during an exercise, is conducted. The analysis is the foundation for the preparation of action plans, which act as a basis for further trainings or improvements of equipment or procedures.

In the following sections we will outline the types, frequency and analysis of the exercises in which the members of SNSA and the SNSA Emergency Response Team participated in 2019. The data collection method will be participatory observation, and for the purposes of analysis we will analyse the following data: the number of participants or participating organizations, the activation time of Emergency Response Team, the public information performance and the main findings of the analysis after the exercise will be summarized. The analysis will include data that do not represent any degree of secrecy in their content. The discussion will present proposals for the future improvements in the coming period, based on the analysis. Individual exercises will be presented in each section in accordance with the analysis approach described earlier.

### **4.1 Krško Nuclear Power Plant Exercises**

The Krško Nuclear Power Plant organises two exercises each year, with the participation of SNSA. The goal of the exercises at SNSA is to review emergency operations of SNSA and SNSA Emergency Response Team, communication and coordination between Krško Nuclear Power Plant and SNSA. At the same time, organisational procedures and instructions are also reviewed. Exercises can be announced or unannounced, and run for few hours to a day or even more, starting at various times of the day. Exercises can also include practical (on the job) trainings of individual new members of the Emergency Response Team. During exercises, members practice performing their pre-defined tasks and duties and providing expected products of the SNSA in emergency situation – proposals of protective actions and measures for affected public, press releases for the domestic and foreign public and notifications for neighbouring countries, IAEA and the EU. All these products are based on the information received from the Krško Nuclear Power Plant operator, data provided by early notification network and other measurements in the environment, if available, and on assessment and analyses of the expert groups of the SNSA Emergency Response Team. Besides Krško Nuclear Power Plant (its Technical Support Center, Off-Site Support Center, occasionally also main control room and operational support centre) and SNSA the following organisations also usually participate in these exercises: regional notification centre Brežice, Notification centre of the Republic of Slovenia and Slovenian Environment Agency. Other stakeholders participate occasionally. For the past few years some stakeholder with important role during a response (such as the Civil Protection Commander of the Republic of Slovenia, The Government Communication Office, etc.) were simulated by the SNSA Emergency Preparedness Division as a part of the leadership of exercises. It would be advisable for this stakeholders to participate in future exercises more often.

## 4.2 Emergency Response Team Activation Exercise

The purpose of the Emergency Response Team activation exercise is to check the response time of the SNSA Emergency Response Team and the activation time of the SNSA Emergency Response Team shift in all circumstances. These exercises are therefore unannounced and are performed twice per year. The area of SNSA Emergency Response Team notification and activation is regulated by two SNSA documents, the organisational procedure and the work instructions. Notification and activation is carried out in accordance with a specific procedure. The goal of the exercise is to determine the response time of SNSA Emergency Response Team members and the time necessary to form an effective (operative) SNSA Emergency Response Team shift in the event of an emergency outside SNSA working hours.

Both team response exercises that were conducted in year 2019 started by the Emergency Notification Centre of the Republic of Slovenia informing the SNSA Duty Officer to start the exercise. The response of SNSA Emergency Response Team was quick and the activation would be on time according to pre-defined target times.

## 4.3 IAEA Exercises

The main tasks of the IAEA in case of nuclear or significant radiological emergency anywhere in the world are exchanging information, providing assistance, and informing the public. The legal basis that defines the role of IAEA and its member states are two international conventions, specifically the Convention on Early Notification of a Nuclear Accident (IAEA, 1986a) and the Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency (IAEA, 1986b). The country, where the emergency occurred, notifies IAEA via fax or Unified System for Information Exchange in Incidents and Emergencies (USIE). Notification of IAEA and other countries is obligatory in all cases where cross-border effects occur or may occur. In other cases (low-level emergencies) notification is highly encouraged.

IAEA conducts three types of exercises (Nizamska, 2019), called Convention Exercises (ConvEx), attended also by members of the Emergency Response Team. The basis type of exercise involves communication tests, aimed at checking whether notification centres, which must operate on 24/7 basis (in Slovenia this is the Emergency Notification Centre of the Republic of Slovenia) and competent authorities (SNSA) received the first notification of emergency within the expected timeframe, and whether the primary communication channels were correct.

Small-scale or medium-scale exercises are conducted with hypothetical scenarios. Their purpose is to check whether organisations can correctly fill reporting forms and whether they conduct appropriate procedures for exchanging information and requesting and/or offering assistance. The most extensive exercise, which usually lasts two to three full days, without interruptions, is conducted once every three to five years. It is used to test national and international emergency response arrangements for a severe nuclear or radiological emergency (Nizamska, 2019).

In 2019 SNSA participated in four IAEA exercises. Two of them were conducted for communication tests where only the Duty Officer and a member of Emergency Notification Centre of the Republic of Slovenia participated. Their mission, response to the received notification, was completed successfully and within the stipulated time. The purpose of the third exercise was to allow member states and international organizations to exercise the national and international processes for requesting and/or offering assistance following a nuclear or radiological emergency. The Republic of Slovenia was a member state who offered the assistance and because of this the SNSA Emergency Response Team was activated the second and third day of exercise. Administration of the Republic of Slovenia for Civil Protection and Disaster Relief also participated in this exercise. That was important, since this administration in all emergencies situations prepares proposals for the Government of the Republic of Slovenia to decide in immediate time. The analysis of the exercise showed that there was a need to make some further improvements to the SNSA's procedures for preparation of an offer of international assistance. In addition, the Response and Assistance Network (RANET) database had to be refreshed, as some new features were introduced by the IAEA. The goal of the fourth exercise was to complete and submit the appropriate emergency communication forms and to practice the International Radiation Monitoring Information System (IRMIS) which issued for collection of radiation monitoring data. The analyses of both exercises revealed that the SNSA Emergency Response Team was activated at the time planned for activation, all tasks were completed on time and in accordance with procedures.

#### 4.4 KiVA

Because cybersecurity is becoming more and more important for nuclear and radiation safety, the first such exercise in the nuclear sector, called KiVA<sup>2019</sup>, was organised in 2019. All domestic stakeholders (nuclear facility operator, competent authority, technical support organization and suppliers of computer equipment), which would take action in the event of such a cyberattack were participating in the exercise (Tomažič, Bernik, & Tomažič, in press). The exercise was of table-top nature and its scenario involved a cyberattack in a nuclear facility, with access to the physical security control system and theft of sensitive information. Participants received different injects, based on their field of work, so the exercise heavily emphasised mutual communication and exchange of information. All participating organisations actively participated in the exercise. The analysis of the exercise revealed that the communication between the stakeholders caused some difficulties. Public information has also proved to be both a weakness and a security challenge. There were some questions about with whom to share information, when to share, and what should be the criteria for sharing information. Despite the identified challenges the exercise was extremely successful and, as such, represents the cornerstone for further conduct of this type of exercises – the next one is under preparation for 2020.

## 4.5 KID Exercises

As the KID is essential for an organisation participating in the emergency response – nuclear or radiological emergency, SNSA conducts KID exercise once a year, with participation of all KID users. The goal is to include all external KID users in the exercise, and to test the capacity of the KID server (SNSA, 2019c).

82% of all organizations with access to KID participated in the exercise in 2019. The exercise consisted of two short tasks: the use of attachment messages and the simultaneous upload of large-scale files to the system to verify that the KID server was carrying the load. The tasks were successfully completed in 98% of the cases. Despite this success some suggestions and comments were made by participants regarding the operation and improvements of the communication system.

## 4.6 On-call Advice

One of suggestions of EPREV mission was also for the SNSA to conduct regular yearly based trainings and exercises for SNSA Duty Officers, who provide on-call advice to persons with less adequate knowledge on ionising radiation and measures to be taken for proper response and their own protection. Such advice would be needed in cases of radiological emergencies where no experienced staff of the facility operator would be available (finding of an orphan source, detection of elevated level of ionizing radiation, traffic accident involving radioactive source, field work with radioactive source, etc.). In 2019 all SNSA staff, performing tasks of the Duty Officer, were trained and exercised. Training consisted of lectures on duties and procedures to be used by the Duty Officer and the exercise consisted of a simulated call from the trainer asking for advice in specific situation. Different scenarios are foreseen for this type of exercise.

## 4.7 Radiological Exercises Under the ENRAS Project

Exercises for ensuring the safety of first responders in the event of nuclear or radiological emergencies in the framework of the ENRAS project (Ensuring Radiation Safety [ENRAS], 2018) were carried out in 2019, with further exercises planned in 2020. These are joint exercises of Slovenian and Croatian firefighting units, used to exercise procedures used in different scenarios. Their purpose is to improve the preparedness of firefighters in the event of a nuclear and radiological accident, and to ensure appropriate safety during response. The goal of the project is to develop and implement a new system of trainings, and to sign an agreement on the implementation of a new structure, which will promote cross-border cooperation for ensuring safety in the event of accidents involving the threat of radiation. The project includes 31 fire-fighting units of wider importance in Slovenia, with the authorisation to respond in accidents involving dangerous materials. The planned approach aims to provide the trainings and cross-border integration of intervention teams and administrative bodies responsible for such accidents, to ensure safety for the entire population of the cross-border area and wider region.



Practical exercises have revealed some of the challenges that can occur in the event of a firefighter's response to a radiological emergency, but the details about this because of the project's progress cannot be disclosed.

## 5 DISCUSSION AND CONCLUSION

Ensuring nuclear and radiation safety is a complex matter. One of the key stakeholders in this field in Slovenia is the SNSA, which performs its work professionally and successfully. SNSA must ensure preparedness to respond during emergencies, which could represent a radiological threat to the territory of the Republic of Slovenia. To prevent nuclear or radiological emergency and to minimise the impacts from nuclear and radiological incidents and emergencies if they occur effective national response arrangements and capabilities are essential.

In 2017, the EPREV mission was conducted in Slovenia. The mission reviewed the activities of all organisations involved in response to a nuclear or radiological emergency under the National Protection and rescue plan in case of nuclear or radiological accident. The mission found that Slovenia ensures good nuclear and radiation safety and made some recommendations and proposals that represent actions to more effectively implement requirements set in international safety standards. These represent useful guidance for continued improvements in this field. Although the preparedness of Slovenia is on a high level, following the lessons learned from the accidents at the nuclear power plant in Chernobyl in Ukraine and Fukushima in Japan the necessary steps have to be taken for upgrading the safety actions to prevent nuclear or radiological emergencies and to improve the means for the successful mitigation of their consequences. If nuclear or radiological emergency occurs, the SNSA Emergency Response Team is activated, which has at its disposal working equipment, infrastructure, and the competence and knowledge of necessary actions. Regular trainings, exercises and updated procedures help to ensure that personnel are well trained and can conduct their work effectively.

To further improve overall emergency preparedness in Slovenia, the fulfilment of all EPREV Action plan from 2018 is required. A lot of actions were concluded in 2018 and 2019 while some very important ones still need to be completed. The most important are revision of the current National emergency response plan for nuclear and radiological accidents, adoption of the Draft Protection strategy of the Republic of Slovenia in the event to nuclear or radiological accident and drafts of other related documents (Decontamination procedures, etc.). After fulfilment of the EPREV Action plan Slovenia will invite EPREV follow-up mission to assess the progress done since the 2017 mission.

In the future a lot of work needs to be done also at the field of practical arrangements between SNSA and Croatian Civil Protection Directorate to facilitate harmonized response to nuclear or radiological emergencies that impacts both countries or are of common interest.

Exercise analyses in 2019 revealed some challenges that will need to be addressed in the future with additional trainings and exercises. In addition, it will be necessary to improve certain SNSA procedures, continue to participate

in similar exercises and train informing the public. It would be advisable for the nuclear power plant's future exercises to include the Civil Protection Commander of the Republic of Slovenia and The Government Communication Office, now simulated by a member of SNSA Emergency Response Team.

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