

NUCLEAR SAFETY, SECURITY AND SAFEGUARDS IN UKRAINE

Summary Report by the Director General

24 February – 28 April 2022



IAEA
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INTRODUCTION

On 24 February 2022, the International Atomic Energy Agency (IAEA), through its Incident and Emergency Centre (IEC), was notified by the State Nuclear Regulatory Inspectorate of Ukraine (SNRIU), in its capacity as a national competent authority under the Convention on Early Notification of a Nuclear Accident, of the imposition of martial law on the territory of Ukraine and of an alert at the Chornobyl nuclear power plant (NPP). Since this information was received, the IAEA has activated the IEC, has established regular contact with Ukrainian authorities and has been closely monitoring the situation at nuclear facilities as well as activities involving radioactive sources on the territory of Ukraine, focusing on the implications for nuclear safety, security and safeguards.

In accordance with established operational arrangements¹ on reporting and information exchange that apply for situations in which prompt action is warranted to mitigate any adverse effects or situations of considerable media and public interest, the IAEA published relevant information on its 24/7 secure communication channel, the Unified System for Information Exchange in Incidents and Emergencies (USIE), and has been issuing daily public statements and updates regarding the situation concerning nuclear safety, security and safeguards in Ukraine. Through sharing such transparent, factual and authoritative information, the IAEA substantively responds to heightened media and public interest, supports public understanding and aims to counteract potential misinformation. This information shared by the IAEA includes its assessment of potential emergency consequences and the prognosis of possible emergency progression, where appropriate.

During an emergency meeting of the IAEA Board of Governors on 2 March, the IAEA Director General called for restraint from all measures or actions that could jeopardize the security of nuclear and other radioactive material, and the safe operation of nuclear facilities in Ukraine. On 3 March, the Board adopted a resolution on the safety, security and safeguards implications of the situation in Ukraine, which “deplores the Russian Federation’s actions in Ukraine”, expresses “grave concern that the Russian Federation’s aggression is impeding the Agency from fully and safely conducting safeguards verification activities”, and “requests that the Director General and the Secretariat continue to closely monitor the situation, with a special focus on the safety and security of Ukraine’s nuclear facilities and report to the Board on these elements, as required”².

¹The IAEA Secretariat maintains preparedness to respond appropriately and efficiently to any incident or emergency, irrespective of its origin, that may have actual, potential or perceived radiological consequences for health, property or the environment, and that requires the Secretariat’s involvement and prompt action, including responding to requests for assistance. The Secretariat’s emergency preparedness and response arrangements derive from the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, as well as from the IAEA Statute, IAEA safety standards (primarily Preparedness and Response for a Nuclear or Radiological Emergency (IAEA Safety Standards Series No. GSR Part 7)), relevant decisions of the Policy-Making Organs, inter-agency agreements and international best practice. Operational arrangements for notification, reporting and information exchange, for coordinating the provision of assistance and for inter-agency coordination are elaborated in the Operations Manual for Incident and Emergency Communication (Emergency Preparedness and Response Series, EPR-IEComm 2019), IAEA Response and Assistance Network (Emergency Preparedness and Response Series, EPR-RANET 2018) and Joint Radiation Emergency Management Plan of the International Organizations (Emergency Preparedness and Response Series, EPR-JPLAN 2017) publications, respectively. The Secretariat fulfils its related roles through the IAEA’s Incident and Emergency System (IES) and the IEC. The IEC serves as the IAEA’s focal point for emergency preparedness and response and as the custodian of the IES.

²IAEA Board of Governors resolution GOV/2022/17 (3 March 2022).

This report provides a summary of the situation in Ukraine regarding nuclear safety, security and safeguards of nuclear facilities and activities involving radioactive sources in Ukraine. It is based on information made available to the IAEA since the beginning of these unprecedented circumstances and consolidates information that the IAEA has been communicating to the public since 24 February, including actions taken by the IAEA in response to Ukraine's request for assistance in re-establishing, as appropriate, a sound nuclear safety and security regime at its nuclear facilities and in activities involving radioactive sources. In addition, the report includes some initial findings of the IAEA expert missions led by the Director General to Ukraine in March and April 2022.

This report also summarizes relevant aspects of the implementation of safeguards in Ukraine under the Agreement Between Ukraine and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons and the Protocol Additional thereto under the current circumstances.

SAFETY AND SECURITY OF NUCLEAR FACILITIES IN UKRAINE

At 6.41 a.m. on 24 February 2022, the IAEA Emergency Response Manager was informed that the SNRIU had reported that Russian troops were at the Chornobyl NPP site. The IAEA's IEC invoked a response comprising staff of the IEC that were on-call and enhanced standby staffing to ensure that an escalation to full response mode could be achieved expeditiously.



IAEA Incident and Emergency Centre.

(Photo: IAEA)

Since 24 February, the IEC has been in continual contact (daily through telephone calls and emails) with the SNRIU. The IAEA has been monitoring the safety and security of Ukraine's nuclear facilities and of radioactive sources and has issued regular updates to the public via social media and the IAEA website, mainly based on information provided by the SNRIU.

On 2 March, at a meeting of the IAEA's Board of Governors, and subsequently in a press release issued on 4 March, the IAEA Director General outlined seven indispensable pillars for ensuring nuclear safety and security in relation to the situation in Ukraine:

1. The physical integrity of the facilities – whether it is the reactors, fuel ponds or radioactive waste stores – must be maintained;
2. All safety and security systems and equipment must be fully functional at all times;
3. The operating staff must be able to fulfil their safety and security duties and have the capacity to make decisions free of undue pressure;
4. There must be secure off-site power supply from the grid for all nuclear sites;

5. There must be uninterrupted logistical supply chains and transportation to and from the sites;
6. There must be effective on-site and off-site radiation monitoring systems and emergency preparedness and response measures; and
7. There must be reliable communications with the regulator and others.

These seven pillars highlight the key nuclear safety and security related issues that are of special significance during these unprecedented circumstances in which military forces are near or on the site of nuclear facilities. They derive from the IAEA safety standards and nuclear security guidance, reflecting high levels of safety and security to protect people and the environment against the harmful effects of ionizing radiation. The IAEA regularly expressed concerns when these pillars were compromised at the nuclear facilities in Ukraine.

From 29 to 31 March, the Director General and a high-level IAEA delegation travelled to Ukraine to initiate the implementation of the IAEA's assistance aimed at reducing the risk of a major nuclear accident. During his meetings with senior Government officials, including the Minister of Energy Mr Halushchenko, the Chairman of the SNRIU Mr Korikov, the CEO of Energoatom, Mr Kotin, and the Director of the South Ukraine NPP Mr Polovych, he discussed concrete steps to immediately start the delivery of IAEA assistance to ensure the safety and security of nuclear facilities and of radioactive sources in Ukraine, and to help avert the risk of an accident that could endanger people and the environment. As a result of these discussions, agreement was reached on the scope of the technical support and assistance to Ukraine for safety and security, and on the fact that the IAEA, working with Member States, would be the single point of contact for this technical assistance.



Meeting between Ukrainian senior Government officials and the IAEA delegation.

(Photo: IAEA)

Director General Grossi also had the opportunity to speak with the staff of the South Ukraine NPP and thanked them personally for their endurance and resilience during these extremely difficult times.



IAEA Director General meeting with the staff of the South Ukraine NPP during his visit to Ukraine, 30 March 2022.

(Photo: IAEA)

From 25 to 28 April, the second IAEA mission in Ukraine took place, at the Chornobyl NPP site. It comprised a high-level delegation, led by the IAEA Director General, of IAEA experts in the areas of nuclear safety, security and safeguards. This mission allowed the IAEA to carry out an assessment in the field to enable it to have a better understanding of the current nuclear safety and security issues in relation to nuclear facilities in Ukraine. Such issues relate to the actual status of the installations (including key safety and security equipment), the status of radiation monitoring systems, priority needs for delivery of equipment, supply issues, etc. It also enabled the IAEA to make first-hand observations on the ground, with initial radiation measurements carried out at the Chornobyl site to be used to conduct a comprehensive assessment of potential radiation exposures. Finally, some priority equipment requested by Ukraine was also delivered during this mission comprising radiation monitoring equipment and personal protective equipment.

During the mission, the Director General agreed on the urgent and medium- to long term tasks with the Ukrainian authorities for ensuring nuclear safety, security and safeguards at the Chornobyl NPP. The IAEA and Ukraine have agreed to set up a working group on the Chornobyl NPP to coordinate IAEA assistance and support to staff who are endeavouring to keep Ukraine's nuclear sites safe and secure. The Director General also met with staff at the Chornobyl NPP and thanked them for their resilience and courage during what has been an extremely difficult time of conflict.

On 26 April, Director General Grossi met with the President of Ukraine, Volodymyr Zelenskyy, and reiterated the IAEA's continued support to Ukraine in ensuring the safety and security of its nuclear sites.



President Zelenskyy and the IAEA Director General Grossi meeting to discuss the safety and security situation at Ukrainian facilities, 26 April 2022.

Overview of the Situation at Nuclear Facilities in Ukraine

Chornobyl NPP site

The Chornobyl NPP site consists of six reactor units (Units 1 to 4 are permanently shut down, and Units 5 and 6 were never commissioned), including Unit 4 which was partially destroyed in the 1986 accident and is now covered with a shelter facility known as the New Safe Confinement (NSC), two spent fuel interim storage facilities (ISF-1 and ISF-2) and a variety of waste management facilities. Further waste management facilities exist within the wider Chornobyl Exclusion Zone, including numerous radioactive waste disposal facilities.

A Central Spent Fuel Storage Facility (CSFSF) has been constructed in the Chornobyl Exclusion Zone. Once commissioned, the CSFSF will receive and store spent fuel from reactors at the Rivne, Khmelnytsky, and South Ukraine NPPs.

On 24 February, Ukraine informed the IAEA that Russian forces had taken control of all facilities of the Chornobyl NPP. The site includes the decommissioned reactors as well as radioactive waste management facilities. On that day, the IAEA Director General expressed his grave concern at the situation and said it was of vital importance that the safe and secure operations of the nuclear facilities in that zone should not be affected.

Operating staff: On 31 March, the Russian forces withdrew. During the period of Russian presence, Ukrainian staff continued to manage day-to-day operations at the Chornobyl NPP site. For nearly four weeks, staff were not able to rotate and return to their homes.



IAEA Director General meeting with the staff of the Chernobyl NPP during his visit to Ukraine, 26 April 2022 .
(Photo: IAEA)

The Director General repeatedly expressed his grave concern about the well-being of the staff and stated that these extremely stressful and tiring conditions, with their potentially adverse consequences for safety, contravened the third of the seven indispensable pillars for ensuring nuclear safety and security, which states that “operating staff must be able to fulfil their safety and security duties and have the capacity to make decisions free of undue pressure”. From 24 February to 19 April, operating staff rotation at the Chernobyl NPP occurred only three times. Ukraine has informed the IAEA that staff rotation is now taking place regularly and according to plan.

Communication: About three weeks after the Russian forces took control, the Ukrainian regulator reported that it had lost contact with the Chernobyl NPP site. The regulator continued to receive information about the situation at Chernobyl NPP through senior off-site managers of the plant. Ukraine has now been gradually restoring regulatory control of nuclear and radiation safety at the Chernobyl NPP. However, the general situation in the area around the Chernobyl NPP remains difficult due to destroyed bridges and reported demining activities.

Physical integrity: Since Russian forces withdrew from Chernobyl, Ukraine has taken significant steps to support the safe and secure operation of the site. There is no significant damage to the structures and systems of the spent fuel storage pool, and their original safety functions are maintained. However, much work remains to be done to return the site to normality. During the visit of IAEA experts to the Chernobyl NPP site, the Ukrainian authorities confirmed the need to further investigate any impacts on the safety and security of the facilities prior to returning to normal operation.

Radiation monitoring: Radiation monitoring data from the Chernobyl site, regularly provided through the online radiation monitoring system, have not been received through the International Radiation Monitoring Information System (IRMIS) since 24 February. However, the SNRIU has reported some radiation measurements from the Chernobyl site. Some of these measurements from the Chernobyl Exclusion Zone indicated an increase in the gamma dose rates that was attributed to the displacement of soil due to heavy machinery movements in the area. Based on these data, the IAEA assessed radiation levels as low and within the operational range measured in the exclusion zone since it was established, and therefore considered that they posed no hazard to the public. In the absence of relevant data or observations, the IAEA has not been able to confirm reports of Russian forces receiving high doses of radiation while being in the Chernobyl Exclusion Zone.

Wildfires were reported near the Chernobyl NPP in the second half of March. The area has seen such outbreaks also in previous years, and the wildfires in March did not constitute a significant radiological hazard.

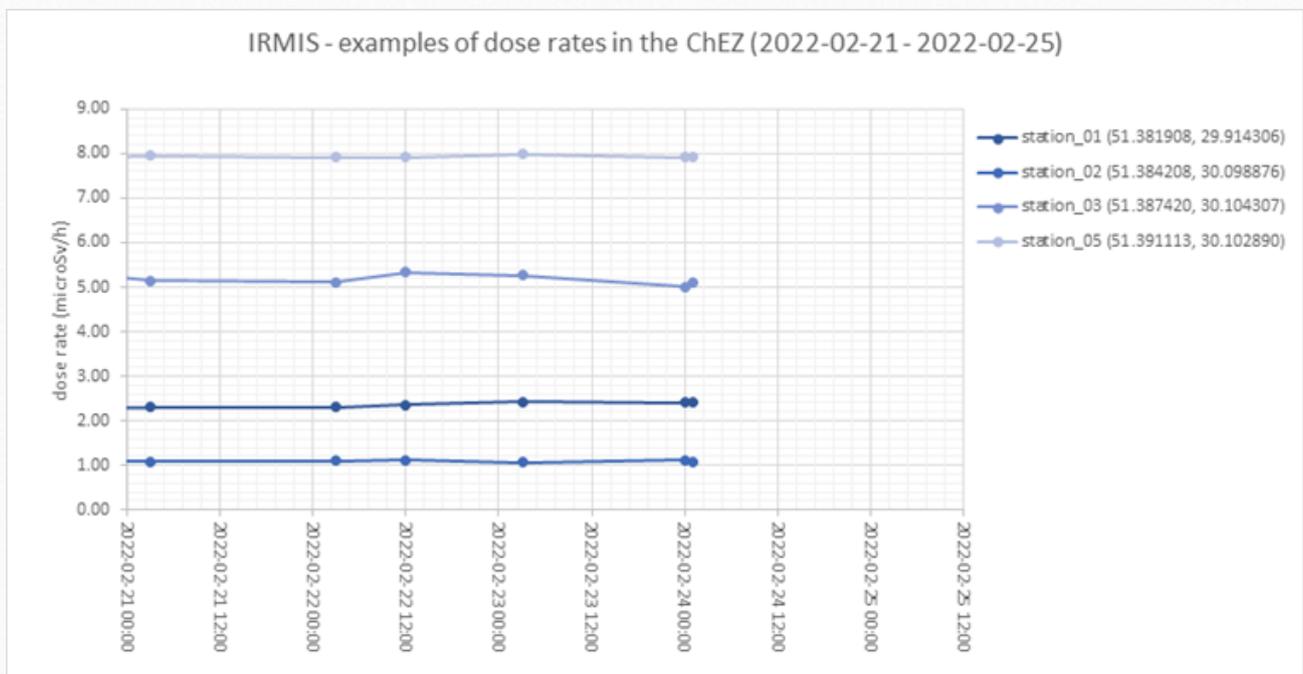


Fig. 1: Single dose rate measurements at four locations within the Chernobyl Exclusion Zone received by IRMIS before 24 February. Despite events within this area, radiation measurements taken by staff at the Chernobyl NPP site indicated that rates remained low and did not pose any radiological hazard.

On 27 April, IAEA experts conducted initial radiation monitoring in the Chernobyl Exclusion Zone, including in the reported excavations, and collected environmental samples for analysis. Measurements were limited to a restricted area with dose rate measurements performed at about 10 cm and 1 meter above the ground. The results ranged from 0.2 $\mu\text{Sv/h}$ to 0.75 $\mu\text{Sv/h}$, which is 3–5 times above the dose rate on the nearby road. Environmental samples taken during the visit will be analysed at the IAEA laboratories in Seibersdorf.



IAEA experts performing dose rate measurements in the Chernobyl NPP Exclusion Zone, 27 April 2022.

(Photo: IAEA)

Power supply: On 9 March, the site lost all off-site electric power. Diesel generators were used to power systems that are important to the safety of the facilities, including ISF-1, ISF-2 and the NSC. Despite the difficult situation outside the site, the off-site electric power lines were restored and the power supply to the Chernobyl NPP has been stable since 14 March. The disconnection from the grid did not have a critical impact on essential safety functions at the site, as the volume of cooling water in the spent fuel facility was sufficient to maintain heat removal without any supply of electricity. In addition, backup diesel generators were available to power systems important for safety, including those for spent nuclear fuel and water control and chemical water treatment. However, the operator was not able to maintain some functions such as radiation monitoring, ventilation systems, and normal lighting. The Director General repeated that this contravened the fourth indispensable pillar for ensuring safety and security that “there must be secure off-site power supply from the grid for all nuclear sites”.

Safety and security systems and equipment: Ukraine reported that the premises of the site’s analytical laboratories for radiation monitoring had been destroyed and the analytical instruments stolen, broken or otherwise disabled. In addition, Ukraine reported that an associated information and communication centre had been looted, and parts of its communication lines destroyed, and automated transmission of radiation monitoring data was stopped due to damage to a computer server in the facility.

Ukraine also reported that the Central Analytical Laboratory in Chernobyl town had been “looted by marauders” and that it could not confirm the safety and security of its calibration sources, nor the condition of environmental samples stored there. Based on the information provided, the IAEA assessed that the incident did not pose a significant radiological risk.



IAEA experts measuring the dose rate at the reported trenches in the Chernobyl NPP Exclusion Zone, 27 April 2022.

(Photo: IAEA)

Ukraine has reported that the Chernobyl Exclusion Zone is gradually recovering from the Russian military actions. The road to the exclusion zone is being improved in places, power lines are being overhauled, voice communication is already in place around the Chernobyl NPP, and mobile telephone networks are under repair.

On 27 April, the IAEA experts assessed the status of the physical protection system at the Chernobyl NPP. Whilst the operator managed, in extremely challenging circumstances, to maintain the holistic security integrity of all major nuclear facilities, experts observed the extent of the damage and made an initial assessment of the scope of assistance required to restore optimal physical protection. Further in-person field missions will be needed to comprehensively assess the nuclear security needs.

The IAEA and Ukrainian experts agreed to have a complementary fact-finding mission to evaluate the situation of the safety and security of all facilities and activities at the site. The areas to be covered during this mission will include radioactive waste and spent fuel management safety, radiation protection and nuclear security.

Zaporizhzhya NPP

The Zaporizhzhya NPP consists of six VVER-1000 reactors operated by Energoatom. As of 27 April, two units were in operation to meet Ukraine's power needs, while the remaining units were under maintenance or in reserve.

Physical integrity: On 4 March, Ukraine informed the IAEA that Russian forces had taken control of the Zaporizhzhya NPP site. Ukraine reported that the facility's training centre – located a few hundred metres from the reactor units – had been hit by a projectile and a localized fire had broken out that was later extinguished. The training centre suffered significant damage. There had also been damage to the site's laboratory building and to an



Administrative buildings of the Zaporizhzhya NPP on 5 March.

(Photo: Energoatom via Telegram).

administrative structure. It was also later reported that the transformer of reactor Unit 6 had been damaged and was subsequently repaired some days later.

As a result of these events at Zaporizhzhya NPP, the IAEA's IEC was placed on its highest full response mode to be able to closely monitor the evolution of the situation.

Ukraine reported that the physical integrity of the plant's six reactors and their safety and security systems had not been affected, the NPP continued to be operated by its regular staff, radiation monitoring systems at the site were fully functional, and there has been no release of radioactive material. The site's spent fuel pools operated normally, and later visual inspections of the dry storage facility did not detect any damage.

At that time Unit 1 was shut down for maintenance, Units 2 and 3 had undergone a controlled shut down, Unit 4 was operating at 60 per cent power, and Units 5 and 6 were being held "in reserve" in low power mode.

On 15 March, Ukraine informed the IAEA that the Russian military had detonated unexploded munitions left on the site following the events of 4 March.

The IAEA Director General stated that he was gravely concerned about the situation at Ukraine's largest NPP. The events there had put at risk a number of the seven indispensable pillars for ensuring nuclear safety and security, in particular the first pillar which states that "the physical integrity of nuclear facilities must be maintained".



Rafael Mariano Grossi, IAEA Director General, during a press conference on 4 March in Vienna, Austria, on the situation at the Zaporizhzhya NPP in Ukraine.

(Photo: IAEA)

Operating staff: Since 4 March, the regular management and staff have continued to operate the Zaporizhzhya NPP and carry out their day-to-day work, but the site remains under the control of the commander of the Russian forces there. Some representatives of the Russian Federation’s State Atomic Energy Corporation “Rosatom” also came to the site a few days after the Russian military took control, and about ten Rosatom staff members are still there. The IAEA considers that the presence of Rosatom senior technical staff could lead to interference with the normal lines of operational command or authority, and potential frictions when it comes to decision-making.

Energoatom operating teams at the plant have been able to rotate in three shifts per day but the situation has had a negative impact on staff. The regulator has been informing the IAEA that the morale and the emotional state of staff working at the Zaporizhzhya NPP has been very low since the Russian military forces seized the site.

Director General Grossi has repeatedly expressed grave concern about these extremely stressful and challenging working conditions for the Ukrainian operating management and staff, which is unacceptable and unsustainable. He has also emphasized that the current situation contravenes the third indispensable pillar that operating staff “must be able to fulfil their safety and security duties and have the capacity to make decisions free of undue pressure”.

Communication: Communication between the site and Ukraine’s regulator has been severely affected with many lines of communication either not functioning or unreliable. Some communication is now possible through mobile phones and email, but there have been no

Ukrainian regulatory inspections of the facilities on site. The Director General has stated that this contravenes the seventh indispensable pillar: “There must be reliable communications with the regulator and others.”

Power supply: Another concerning matter has been the impact on the power lines that connect the NPP to the grid. The site has four high voltage (750 kV) external power lines plus one on standby. Two of the four were damaged in the early days of Russian control of the site, and the plant also lost a third line for a period of time. The IAEA assesses that the plant is able to operate safely with the lines available, and the site is equipped with 20 emergency diesel generators that can provide the required power for safe operation of the reactors (and ability to bring them to cold shutdown) should off-site power be lost. Nevertheless, this loss of two power lines has impacted the defence in depth of the facility. The Director General has emphasized that this puts at risk the fourth indispensable pillar that “there must be secure off-site power supply from the grid for all nuclear sites”.

The NPP continues operation in compliance with national nuclear, radiation and environmental safety standards; ecological, fire and radiation conditions are within the national norms; and radiation background at the industrial site corresponds to the natural radiation background.

South Ukraine NPP, Rivne NPP and Khmelnytsky NPP

South Ukraine NPP, Rivne NPP and Khmelnytsky NPP respectively consist of three VVER-1000 reactors (one in operation), two VVER-1000 and two VVER-400 reactors (two in operation), and two VVER-1000 reactors (one in operation).

Since 24 February, South Ukraine, Rivne and Khmelnytsky NPPs have not been impacted by the Russian Federation’s actions. Communications between these NPPs and the SNRIU can be conducted through all channels available. On-site personnel can rotate. No event affecting, or related to, the on-site safety and security has been reported to the IAEA by the SNRIU.

All the NPPs are continuing routine safe operation: radiation, fire and environmental conditions are within the established national norms.

Radon facilities

Radon facilities are specialized in the management of radioactive waste originating from the use of radiation sources in medicine, science and different industries in Ukraine. There are five Radon facilities for the interim storage of such radioactive waste in Ukraine, located in Dnipro, Kharkiv, Kyiv, Odesa and Lviv.

Since 24 February, communications between the five Radon facilities and the SNRIU have been conducted through all channels available and on-site personnel have been able to rotate. On 27 February, the off-site radiation monitoring system at Radon Kyiv was lost due to a missile but was restored a day later. Between 11 and 18 March, the connection to the video surveillance system at Radon Dnipro by the SNRIU was lost due to damage to a communication cable. Nevertheless, access to this video surveillance is not required by national regulation.

Since the start of the conflict, the SNRIU has not reported any increase in radiation levels in the off-site data monitored around the five Radon facilities that would constitute a hazard to public health or the environment.

Kharkiv Institute of Physics and Technology

The subcritical Neutron Source installation at the Kharkiv Institute of Physics and Technology (KIPT) is used for research and development and radioisotope production for medical and industrial applications. On 24 February, the facility was transferred to a deep subcritical state – ‘long term shutdown mode’. Its nuclear material is always subcritical – there can be no self-sustained nuclear fission chain reaction – and the radioactive inventory is low.

On 6 March, the Neutron Source installation came under significant shelling. As a result of the shelling, the following damage was reported to the IAEA by the SNRIU:

- the substation RU-0.4 kV was completely destroyed;
- cables of the air conditioner cooling systems of the linear accelerator cluster gallery have been damaged;
- in some places there was surface damage to the main building of the installation;
- the heating lines of the complex of buildings and structures of the Neutron Source have been damaged; and
- windows in the pumping building, cooling towers and the isotope laboratory have been broken.



Destroyed substation RU-0.4 kV.

(Photo: SNRIU via Facebook)

The IAEA was subsequently informed that no electrical power was available at the Neutron Source due to military actions. There is significant damage to building structures. Regular communication has been maintained with the KIPT. It has also been reported that there is no external power supply to the Neutron Source due to the ongoing hostilities in the Pyatykhatky district of Kharkiv, which resulted in damage to the power supply lines.

Based on the IAEA's assessment, the reported damage caused to the facility contravenes one of the indispensable pillars, the first pillar, that "physical integrity of the facilities must be maintained". However, it did not give rise to any radiological consequences and did not result in the loss of the fundamental safety functions for the confinement of radioactive material. The impact on the facility's physical protection requires further assessment once conditions in the field allow.

Radioactive Sources in Ukraine

Since 24 February, the communication lines between the SNRIU and operators of activities involving radioactive sources in medicine and industry in areas across the country that were subjected to increased shelling and fighting (e.g. in Kharkiv and Mariupol) have been interrupted. A lack of information from operators has made it difficult for the SNRIU and the IAEA to accurately assess the current status of radioactive sources in these areas and their safety and security. Based on its experience and expertise in this area, the IAEA will develop a programme with Ukraine to support authorities in accounting for and locating radioactive sources for which regulatory control has been lost and which might end up in a public domain and, if needed, to transfer them to safe and secure locations.

IAEA Technical Support and Assistance

Upon Ukraine's request for assistance, the IAEA has drawn up a concrete and detailed technical plan for safety and security assistance to Ukraine's nuclear facilities and activities involving radioactive sources. This plan has been discussed and agreed with Ukrainian officials on a number of occasions, including during the March visit of the IAEA Director General to Ukraine. The technical support and assistance for safety and security are focused on four areas: remote assistance, delivery of equipment, in-person assistance, and rapid deployment assistance.

The first area of remote assistance concerns the provision of external based support in relation to safety and security assessments of nuclear installations, including radioactive waste management facilities, as well as activities with radioactive sources. It also includes external support for the assessment of requirements to adapt safety and security procedures to the current circumstances.

The second area of technical support and assistance relates to the delivery of any equipment needed for the safe and secure operation of nuclear installations, including radioactive waste management facilities and facilities with radioactive sources.

The third area relates to in-person assistance with on-site missions to cover various aspects of nuclear safety and security in Ukraine. Such areas include:

- Provision of advice related to approaches for maintaining safety and security of the structures, systems and components of the nuclear installations, including radioactive waste management facilities and facilities with radioactive sources.
- Assisting the operator and regulatory authority in formulating approaches to new situations as they arise regarding maintaining the facilities' safety and security, with experts familiar in the corresponding technical field.
- Providing updated information to the IAEA on the status of the installations, including providing input regarding further needs for NPPs and other facilities, and serving as a contact point for organizing additional assistance to Ukraine.
- Assessing the integrity of the nuclear installations, including radioactive waste management facilities, other facilities storing or using radioactive sources or nuclear material and their safety and security equipment.
- On-site-assistance in implementing new procedures.
- On-site-assistance in implementing or strengthening radiation protection measures and environmental monitoring.
- As needed, search, recovery, identification and collection of radioactive sources, their removal when needed, and subsequent safe and secure storage and disposal.
- Assistance to the regulator in addressing safety and security regulatory issues, including assistance in assessing the need for reviewing regulatory activities (licensing, inspections, safety and security reviews) and providing support as needed.

The fourth area of technical support and assistance concerns deploying rapid assistance in case of an emergency at a nuclear facility or related to radioactive sources. Such assistance would consist of the deployment of an IAEA expert team to provide immediate assistance on the ground, to assess the consequences and the status of the facility or source with regard to safety and security, to provide immediate in-person support in managing the consequences, and to liaise efficiently to mobilize the resources needed to address safety and security issues.



Staff from the IAEA Department of Nuclear Safety and Security, headed by Deputy Director General Lydie Evrard, delivering equipment during the mission to the Chornobyl NPP, 26 April 2022.

(Photo: IAEA)

In addition, the IAEA has received the following requests for assistance:

- A request for assessing the state of the Neutron Source installation located at the KIPT in terms of safety and physical protection (5 April); and
- Requests for equipment delivery: after a preliminary request on 7 April by the State Emergency Service of Ukraine for a limited number and type of equipment, SNRIU has completed and submitted a comprehensive list of equipment on 22 April.

In response to the request of 5 April on the Neutron Source facility in Kharkiv, the IAEA assessed the safety and security issues of the facility, which were considered as not significant, and expressed its readiness to provide remote assistance as deemed appropriate by Ukrainian authorities and its willingness to continue monitoring the situation as it evolves. The in-person mission will be performed when security allows travel to the site.

The comprehensive list of equipment requested by Ukraine was communicated by the Chairman of the SNRIU to the Director General. This request was posted on USIE on 22 April. Continuous discussions between the IAEA and the Ukrainian counterparts enabled the IAEA to better understand the priority needs of Ukraine and, thus, to guide the IAEA's further steps in mobilizing adequate resources and mechanisms to provide the requested equipment in a timely manner, under the statutory functions of the IAEA and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

The requested equipment targets different end users in Ukraine with responsibilities for ensuring continued nuclear safety and security including emergency preparedness and response in relation to existing nuclear facilities and use of radioactive sources. The requested equipment, in general, comprises:

- Radiation monitoring equipment for source, workplace, individual and environmental monitoring and associated equipment aimed at restoring monitoring services and reinforcing respective laboratories;
- Personal protective equipment; and
- Communication systems, vehicles, power batteries, diesel generators, spare parts, video surveillance, IT and similar equipment intended to reinforce regulatory control, safety and security of facilities and provision of technical services, as appropriate.

The provision of the requested equipment will be coordinated by the IAEA and delivered under the coordination of the Response and Assistance Network mechanism as well as other available mechanisms in the IAEA.

The IAEA is working with a number of Member States and international organizations towards ensuring coordination in the provision of support to Ukraine and securing the necessary funding. The IAEA will also work with the European Bank for Reconstruction and Development, which has been instrumental in assisting Ukraine over decades through the International Chernobyl Cooperation Account.

Areas of Nuclear Safety and Security that Require Further Assessment

Based on currently available information on the status of facilities and activities in Ukraine, the following areas of nuclear safety and security are expected to require further assessment and potential technical assistance in the future:

a) Nuclear facilities

- The physical integrity of the facilities in general, and the structures, systems and components important to safety and security in existing nuclear facilities in Ukraine;
- Operability of safety systems, including those ensuring nuclear criticality safety and confining radioactive materials in all plant states, as well as maintenance programmes/activities at existing NPPs;
- Operability and efficacy issues relating to existing physical protection measures and impacts on their restoration/maintenance under the current circumstances;
- Availability of adequately qualified operating personnel, including their rotation, and accessibility to sites with respect to damaged infrastructure;
- Human factor implications of working in a highly stressful operating environments;
- Operating organization leadership and management decision making autonomy under the unprecedented circumstances;
- Operational safety procedures/measures (including aspects associated with ensuring overall radiation protection and radiation monitoring);
- Redundancy and reliability of external electrical power supply and emergency power supply;
- Status of emergency arrangements in place to allow for effective emergency response on site and off site, including the provision of emergency services, and impact on infrastructure to provide for critical response functions;
- Continuity of supply chain, including any disturbance to routine delivery, stock of spare parts, contingency plans/procedures for acquiring spare parts important for safety and security, and other associated logistics;

- Availability of communication lines and existence of a clear line of command;
- Aspects associated with wildfires (e.g. monitoring and fire-fighting capabilities); and
- Aspects associated with restoring regulatory control.

b) Other facilities and activities using nuclear or radioactive material for research, medicine, industry and similar purposes

- Physical integrity of facilities and operability and efficiency of systems important to safety and security where nuclear or radioactive material is used;
- Current inventory of nuclear or radioactive material, including the physical integrity of radioactive sources, as appropriate;
- Need for search and recovery of nuclear or radioactive material that could not be accounted for;
- Need for transfer of sources not under control to a safe and secure location;
- Availability and reliability of necessary safety and security measures, including radiation protection measures and emergency arrangements;
- Availability of operating procedures and qualified operating personnel to continue operations safely and securely;
- Availability of emergency procedures and emergency services to support response to any potential emergency involving radioactive sources found in the public domain;
- Accessibility to sites with respect to damaged site infrastructure;
- Availability and reliability of communication lines and existence of a clear line of command; and
- Aspects associated with restoring regulatory control.

IMPLEMENTATION OF SAFEGUARDS IN UKRAINE

The IAEA continues to implement safeguards in Ukraine under the Agreement Between Ukraine and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons (INFCIRC/550) and the Protocol Additional thereto (INFCIRC/550/Add.1).

The IAEA implements safeguards in more than 35 nuclear facilities and 10 locations outside facilities holding small quantities of nuclear material in Ukraine. Most of the safeguarded facilities are NPPs and spent fuel storage facilities located on the sites of Rivne, Khmelnytsky, South Ukraine, Zaporizhzhya and Chornobyl³.

In order to maintain continuity of knowledge regarding the nuclear material located at these facilities and to optimize the IAEA's verification efforts, as well as to ease the burden on facility operators, the IAEA uses unattended monitoring systems, including surveillance cameras, to ensure that nuclear material under IAEA safeguards is not removed from the facilities concerned without notification to the IAEA.

Such systems are installed at all NPPs and associated spent fuel storage facilities in Ukraine. The data generated by the IAEA's unattended monitoring systems are transmitted in real time to the IAEA's Headquarters in Vienna and analysed by safeguards inspectors to ensure that nuclear material has not been removed from safeguarded facilities without due notification to the IAEA. This measure, which is also implemented in safeguarded facilities in other States, is called remote data transmission (RDT).

Each calendar year, the IAEA prepares an annual implementation plan (AIP) for each State with a safeguards agreement in force. AIPs specify the in-field and Headquarters safeguards activities to be conducted by the IAEA, and the frequency and intensity with which they are to be implemented during the year. AIPs take into account planned operational activities and changes thereto notified to the IAEA by State or regional authorities responsible for safeguards implementation (SRAs) and facility operators (e.g. plans for refuelling reactors or transferring spent fuel), which enable the IAEA to plan, adjust and conduct in-field verification activities that require the physical presence of safeguards inspectors. AIPs also take into account State-specific factors such as the continuous functioning of RDT installed at facilities which allows the IAEA to reduce the frequency of its in-field verification activities at those facilities.

³In recent years, the IAEA has been unable to verify nuclear material subject to safeguards under Ukraine's CSA and AP which Ukraine had informed the IAEA was no longer under its control.

Despite the current very challenging circumstances, the IAEA has continued to implement safeguards in Ukraine, including in-field verification activities in accordance with Ukraine's comprehensive safeguards agreement (CSA) and additional protocol (AP) and on the basis of the AIP for Ukraine for 2022. The Ukrainian SRA and facility operators have continued to provide to the IAEA reports and declarations required under the CSA and the AP. The IAEA also received updated information on planned activities, as some operational activities at facilities had to be postponed by facility operators. This included, for example, the postponement of the transfer of spent fuel from the storage pool at an NPP to a permanent dry storage location. In such instances, the IAEA made adjustments to the AIP to reflect those changes. Under the current circumstances, several less time-critical verification activities under the AP, e.g. complementary accesses with advance notice to the SRA of 24 hours or less, have been postponed or replaced with other safeguards activities for which longer notification time has been provided to the SRA.

As indicated above, RDT is an integral component of the State-level safeguards approach established by the IAEA for Ukraine. Except for the safeguarded facilities at Chornobyl, data from the RDT systems installed at other safeguarded facilities in Ukraine have been continuously transmitted to IAEA Headquarters. In a few instances, data transmission from one facility was temporarily interrupted for several days and then re-established; the data were recovered in full and continuity of knowledge regarding nuclear material at that facility re-established. At the Chornobyl site, the data transmission was interrupted as of 27



The new satellite communication system for RDT installed by the IAEA at the Chornobyl NPP, 27 April 2022 .

(Photo: IAEA)

February 2022. On 26–27 April, IAEA inspectors travelled to the Chernobyl site and verified nuclear material present, thus re-establishing continuity of knowledge regarding nuclear material at that site. In addition, IAEA technicians upgraded the unattended monitoring systems installed at the site and deployed new transmission channels based on satellite technologies.

Since then, the RDT at the Chernobyl facility has been partially re-established as additional technical work is required by the facility operator.

Notwithstanding the benefits of RDT, the timely and unrestricted access of IAEA inspectors to safeguarded facilities and locations in Ukraine is an essential component of safeguards implementation in Ukraine. The IAEA maintains regular contact with Ukraine's SRA and facility operators to ensure that it can continue to implement safeguards in Ukraine as planned.

Based on the evaluation of all safeguards relevant information available to the IAEA to date, the IAEA has not found any indication of the diversion of declared nuclear material or any indication that would give rise to a proliferation concern.

CONCLUSIONS

A nuclear accident can have serious impacts beyond the borders of the country in which it occurs, and the international community is relying on the IAEA to keep it informed with accurate and timely information. From the very beginning of the conflict, the IAEA has been monitoring the safety and security of Ukraine's nuclear facilities. Through the IEC, the IAEA Secretariat has been receiving updates from the SNRIU and has been publishing daily updates on the IAEA website.

The situation in Ukraine is unprecedented. It is the first time a military conflict has occurred amid the facilities of a large, established nuclear power programme, which in this case also include the site of the 1986 accident at the Chornobyl NPP.

The staff at all of Ukraine's nuclear facilities have had to show endurance and resilience in keeping the sites running in a safe and secure way amid the conflict. One of the seven indispensable pillars for ensuring nuclear safety and security in Ukraine that the IAEA outlined at the beginning of the conflict states that "operating staff must be able to fulfil their safety and security duties and have the capacity to make decisions free of undue pressure." The Director General has continuously stressed the IAEA's commitment and readiness to help ensure that these seven indispensable pillars are maintained.

Despite the unprecedented circumstances, all nuclear facilities, including four operational NPPs (Zaporizhzhya, Khmelnytsky, South Ukraine and Rivne) continued operation since the beginning of the conflict. The radiation levels have remained within normal range and no radioactive releases have occurred that may impact the staff at the plants, the public or the environment.

The situation in the area around the Chornobyl NPP site, known as the Chornobyl Exclusion Zone, remains difficult, in part due to damaged bridges. The work associated with the management of spent fuel and radioactive waste at the Chornobyl NPP site and the exclusion zone were halted owing to the conflict. Efforts are needed to restore safe and secure management of nuclear facilities at the Chornobyl NPP site and to better characterize the current radiological situation within the exclusion zone. During his visit to the Chornobyl NPP site in April 2022, the IAEA Director General agreed with the Ukrainian authorities to set up a working group on the Chornobyl NPP to coordinate and implement the technical assistance for ensuring nuclear safety, security and safeguards at the NPP.

The situation at Zaporizhzhya NPP continues to be challenging and requires continued attention owing to the presence of Russian forces and Rosatom personnel at the site while operational management remains with Ukrainian plant operators. Although the IAEA continues to adjust its safeguards activities, the situation will become unsustainable. Therefore, the Director General has proposed to lead a visit to the Zaporizhzhya NPP after the necessary consultations and at the earliest possible opportunity.

In addition, the IAEA stands ready to support efforts to better assess the impact of the damage to the Neutron Source facility in Kharkiv and to support its safe and secure operation for its intended purpose. The safety and security of radioactive sources is a critical issue for Ukraine. Therefore, the IAEA will need to work closely with the relevant authorities over a considerable period of time to assist Ukraine in accounting for and locating radioactive sources for which regulatory control has been lost and which might end up in the public domain, and, if needed, in transferring such sources to safe and secure locations.

The IAEA has the technical expertise needed to support Ukraine in keeping its nuclear sites safe and secure, as well as to account for radioactive sources over which radioactive control has been lost. In close coordination with its Member States, the IAEA will provide the required technical support and assistance, including by delivering the required equipment directly to Ukraine's nuclear sites and relevant authorities.

In relation to safeguards, the IAEA has continued to implement safeguards in Ukraine, including in-field verification activities in accordance with Ukraine's CSA and AP and on the basis of the AIP for Ukraine for 2022. Based on the evaluation of all safeguards relevant information available to the IAEA to date, the IAEA has not found any indication of the diversion of declared nuclear material or any indication that would give rise to a proliferation concern.

The IAEA's unique mandate makes it the sole independent international technical organization providing regular updates on the safety and security of Ukraine's nuclear facilities and radioactive sources. The IAEA will continue to closely monitor developments in Ukraine, with a special focus on the safety and security of Ukraine's nuclear facilities, in particular those at the Chornobyl NPP site, nuclear power reactors and radioactive sources and will provide technical assistance for ensuring their safety and security.