

BRIEFING NOTE

DATE: 21/04/2021

Chernobyl nuclear accident Status of site facilities Safety - Situation in April 2021

I. Background and general condition of the Chernobyl NPP's reactors

Thirty-five years ago, on 26 April 1986 at 1.23 a.m. in Ukraine, the Chernobyl NPP's RBMK Reactor 4 accidentally exploded during a technical test. The accident led to the complete destruction of Reactor 4, resulting in a fire that could only be extinguished by dumping approximately 17,000 tonnes of various materials into the gutted reactor. The explosion of Reactor 4 in the Chernobyl NPP was classified level 7 on the INES¹ scale. This accident had serious consequences both on the health of the surrounding populations and on the radiological state of the environment.

Reactor 4 was hastily confined in a temporary sarcophagus or object shelter (OS). The uncertainties about the structural resistance of this OS beyond a period of approximately forty years led the Chernobyl NPP's operator, with financial and technical support from the international community, to build the New Safe Confinement (NSC), an arch-shaped structural shelter, to protect the environment and allow the OS to be decommissioned. Built on an outdoor area away from the reactor, construction work on the NSC began in 2008 and was completed in 2017 with its installation over the OS.



The New Safe Confinement over the Chernobyl NPP's damaged Reactor 4 (source ChNPP: Viktor Kuchynskiy)

RBMK reactors are thermal neutron reactors using graphite as the moderator and boiling light water as the heat transfer fluid. The fuel is U-235 enriched uranium oxide.

¹ INES: International Nuclear Event Scale

The other three RBMK Reactors, 1, 2, and 3, built on the Chernobyl NPP site continued to operate until December 2000, when the last reactor in operation, Reactor 3, was permanently shut down. The decommissioning of these three reactors is in progress.

The Chernobyl exclusion zone (30 km around Reactor 4) is managed by the State Agency of Ukraine on Exclusion zone management (SAUEZM) on which SSE ChNPP, the Chernobyl NPP operator (*State Specialised Enterprise Chernobyl NPP*), in charge of decommissioning the reactors and managing the waste and spent fuel from the site, and CRME (*State Specialised Enterprise - Centralised Radioactive Waste Management Company*), in charge of managing waste from the exclusion zone around the NPP site, depend.

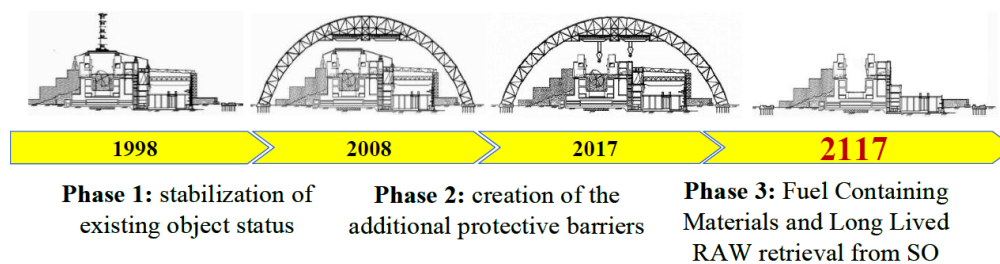
Given the specific situation of the Chernobyl NPP site, SSE ChNPP's overall site decommissioning strategy favours postponed phased decommissioning of all reactors by 2050. This strategy would require the operation of the NSC over Reactor 4 for a hundred years (2017-2117).

II. Decommissioning strategy for Chernobyl nuclear power plant reactors

- **Decommissioning strategy for Reactor 4**

The NSC is 257 m wide, 162 m long, and 109 m high (36,000 tonnes). In July 2020, SSE ChNPP obtained the commissioning authorisation to ensure the proper operation of its equipment (ventilation, handling cranes). The next step, which will be very delicate to achieve, will be to dismantle the OS's unstable structures. This step is expected to be completed by the end of 2023, and will be followed by a waiting period during which additional safety studies on the feasibility and preparation of the recovery of fuel containing material (FCM) will be carried out. During this period, a final disposal solution for the waste produced by this work will be sought. SSE ChNPP's goal is to begin FCM recovery operations by 2050. The operator estimates that these operations, including FCM processing and packaging for final storage, will take forty years. The target end state calls for the decommissioning of the NSC once all of the remaining structures of Reactor 4 have been remediated.

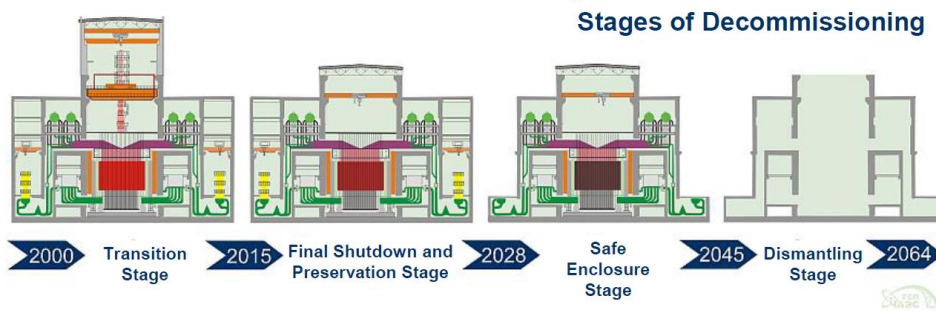
Strategy of Shelter object Transformation into environmentally safe system



(source SSE ChNPP: Viktor Kuchynskiy)²

- **Decommissioning strategy for Reactors 1, 2, and 3**

The decommissioning strategy developed by SSE ChNPP for Reactors 1, 2, and 3 was approved by the Ukrainian Safety Authority in 2008. The decommissioning stages for Reactors 1, 2, and 3 provide for partial decommissioning (removal of activated guide tubes, reconstruction of reactor roofs, and dismantling of handling cranes and fuel assembly loading/unloading machines), monitoring for a little less than twenty years, and then decommissioning the reactors themselves from 2045. The work is expected to be completed in 2064, following the clean-up of the three reactors' civil engineering structures.



(source SSE ChNPP: Viktor Kuchynskiy)²

- **Final state of the Chernobyl NPP**

Given the uncertainties regarding the decommissioning of Reactor 4, subsequent industrial use of the site is preferred.

III. Management of spent fuel from the Chernobyl NPP

Central storage pool: ISF-1

During the operation of the reactors from 1977 to 2000, the Chernobyl NPP used 21,284 fuel assemblies. Since the end of 2016, all these fuel assemblies have been stored in a central storage pool (ISF-1). Pool ISF-1 was commissioned in 1986. This facility is not designed for the long-term storage of spent fuel, and its operation is planned until 2028. All spent fuel assemblies will then be transferred to a new dry storage facility (ISF-2).

Dry storage: ISF-2

ISF-2 was designed with a service life of a hundred years and consists of two parts; a facility for processing spent fuel assemblies and a storage area made up of horizontal concrete storage modules. The facility is designed with a processing capacity of 2,500 fuel assemblies per year. On 18 November 2020, during live testing of the ISF-2 facility, the first package loaded with spent fuel assemblies was inserted into one of the concrete modules in the facility's storage area. The active phase of hot testing ended on 14 December 2020. The authorisation to operate ISF-2 is expected to be issued by the Ukrainian Security Authority in April 2021.



Source: SNRIU website - The first drum containing spent nuclear fuel being placed in the 'dry' spent nuclear fuel storage facility – ISF-2³

² https://inis.iaea.org/collection/NCLCollectionStore/_Public/48/047/48047388.pdf

³ [The first drum containing spent nuclear fuel being placed in the 'dry' spent nuclear fuel storage facility – ISF-2 \(dazv.gov.ua\)](#)

IV. Management of waste produced by activities on the Chernobyl NPP site

There are two types of waste produced by activities on the Chernobyl NPP site:

- waste produced by the normal operation of site facilities;
- waste from the 1986 accident, including waste from the OS.

The Chernobyl NPP's operator estimates that there will be around 177,255 m³ of radioactive waste from the decommissioning operations on the four reactors. Liquid radioactive waste is estimated at 36,148 m³ and solid waste, at 141,107 m³⁴. Currently, 22,645 m³ of solid and liquid waste are stored on the site, the majority of which is liquid waste (20,133 m³) requiring subsequent treatment (Cf. LRTP below).

Treatment of solid and liquid waste produced on site

- **Solid waste management:** an Industrial Complex for Solid Radioactive Waste Management (ICSRM) was built between 2001 and 2009 to treat all solid waste from the Chernobyl site. This facility was designed to treat 3,500 m³ of solid waste per year. After processing and storage on site, the waste packages produced will be transferred to the surface storage facility located on the Buryakovka site, in the Chernobyl exclusion zone. The ICSRМ is made up of various sub-assemblies (sorting, processing, storage), all of which should be commissioned in 2021, for thirty years.
- **Liquid Waste Management:** liquid radioactive waste will be treated by a cementation process at the Liquid Radioactive waste Treatment Plant (LRTP) and encapsulated in 200-litre steel drums. This facility is designed to treat 2,500 m³ of liquid waste per year. The 200-litre drums are packed in fours in a reinforced concrete container which is then stored before being transferred to a surface storage facility located on the Vector industrial site. The LRTP was commissioned in 2014 and, to date, has only treated 3.4 m³ of liquid waste generating forty packages of solid waste.

Interim and final storage of radioactive waste produced by the Chernobyl NPP

The storage facilities on the NPP site are expected to be saturated within two to three years. A storage facility is being built in Reactor 1's engine room to temporarily store 16,000 m³ of waste packaged in 200-litre drums (3,200 packages).

⁴ <https://chnpp.gov.ua/en/activity/radioactive-material-management/radioactive-waste-management>