Building No. 5 - Spent Nuclear Fuel Storage at Andreyeva Bay

Andreyeva Bay BTB-569 technical base of the Russian Northern Fleet, was built between 1961 and 1963, and is located on the northwest coast of the Kola Peninsula approximately 50 kilometers from the Russian-Norwegian border and is part of Motovka Bay on the Barents Sea.

The main purpose of BTB-569 was storing spent nuclear fuel (SNF) from nuclear submarines, as well as storage and handling of solid and liquid radioactive waste (RW). For the temporary storage of SNF ("wet storage" - cooling water in casings and in pools), a basin-type storage facility (Building No.5) was built on the grounds of the base, the first stage of which was put into operation in 1962 and the second in 1972. The "wet" SNF storage in Building No. 5 was formed of rectangular chambers (basins), lined with thin-walled sheets of ordinary steel from within. The spent nuclear fuel was stored in cassettes (5 or 7 spent nuclear fuel assemblies) with chain suspensions on special brackets under a protective layer of water (about 4 meters), which served to protect personnel from radiation.

The dimensions of Building No. 5 are: length - 70 m, width - 15 m, maximum height - 18 m. The dimensions of the first stage are the following: length - 18.5 m, width - 3 m, depth - 6 m; the length of the basin in the second stage is 36.5 m. The storage facility comprises two autonomous basins with a single transport corridor and a common control room. The initial design capacity of the storage facility envisioned storing 2000 casing-cassettes with spent fuel assemblies (SFAs), which was subsequently increased to 2,550 cases by introducing the second stage of Building No. 5 and reducing the distance between the casings.

According to eyewitnesses, building No 5 had design flaws and technological shortcomings from the beginning and the construction work itself was not of high quality: all facilities on the BTB-569 were built by military conscripts working in the severe weather conditions of the far north. Another contribution to the brewing emergency that occurred in 1982 was operating the building in an extreme manner without proper control over the safety of the structure and its elements.

The technological manner handling the casings, equipment and mechanisms were imperfect. When transporting casings in the basins, the casings often fell to the bottom, which led to the formation of chaotic radioactively hazardous debris not only from SNF casings, but also specific SFAs and their fragments. But the true state of affairs at the bottom of the basins was learned only after officials began trying to deal with the emergency. Cooling water in the basins had sufficiently large amounts of radioactivity and was opaque because there was no stationary system for any water purification from radionuclides.

In February 1982, a leak of cooling water was detected in the right basin of Building No. 5 with a release of radioactive water into the environment. In September, the leakage reached 30 tons per day, and there was a real danger of stripping the spent nuclear fuel, which could lead to a significant deterioration of the radiation situation in the storage facility. It was decided to block the right pool with a biological shield consisting of concrete, lead and iron. Most likely, the installation of this heavy covering caused distortions in the structure and caused the leakage of the left pool in Building No 5. Leakage in the left basin by the end of 1982 reached three tons per day, and the right basin by that time was almost completely drained.

In February 1983, a special commission of the Ministry of Defense banned further operation of the storage facility at Building No.5 and it stopped receiving SNF. The decision was made to unload all casings from the spent fuel assemblies in Building No. 5 and put them into so-called "dry storage blocks." For this purpose, three buried reservoirs with a volume of 1000 m3 each that were designed to hold liquid radioactive waste were used. Between 1983 and 1986m, all three of these reservoirs were retooled to “dry storage” for 3200 SNF cassettes.

Between June 1983 and January 1984, more than 1,100 SNF casings were unloaded from the left-hand basin, some of which were retrieved from the bottom. But 25 severely damaged cases remained in the basin until 1989. The second stage of SNF unloading from the stricken storage facility was completed in 1989 - about 1500 casings from all the basins, including fallen and damaged casings and assemblies, were unloaded. Since then, Building No. 5 has not been used and , preliminary work to decommission it is underway.

The radiation situation of the troubled storage facility was characterized by the following data: equivalent dose rate on the external surface of the building walls - up to 20 mSv / h; similar measurements at the bottom of the basins showed areas of up to 600 mSv / h; Samples of concrete and brick had a specific radioactivity of 90Sr and 137Cs in the range of 108 - 109 Bq / kg. The emergency storage of SNF (Building No. 5) was in extremely unsatisfactory condition, especially if we speak of the radiation situation inside; the surface contamination exceeded permissible levels by several orders of magnitude. Decontamination was not carried out. According to experts, all internal structures and equipment placed there can be classified as high- and intermediate-level radioactive waste.

Building No. 5 and Andreyeva Bay as a whole is linked to one of the first international projects mounted by Russian and Norway. In 1997 a radioactive leak was discovered flowing from under Building No. 5 building, which was running into Andreeva Bay. Measures had to be taken to prevent the release of radioactivity into the environment. Despite existing organizational difficulties, Norway allocated $ 817,000 for the construction of a bypass trench around Building No 5. The project was completed in 1999 and Norway received a report on the work done in the form of photographs.

Between 2007 and 2011 urgent repair and restoration work was carried out at Building No 5: roof and cornices, reinforcement of the brickwork in the eaves of the building, replacement of gates in the transport corridor, sealing of unused apertures in the building, repair of the external surface and application of waterproof coating, replacement of metal stairs, metal constructions, anticorrosion coating. This work was carried out to preserve the integrity of the building for the next 7 to 10 years The crane in the building was also repaired.

After eliminating the consequences of the accident, it was thought that the now empty Building No 5 didn't contain nuclear materials, and that the accumulated radioactivity was due to the remaining spot spills of the fuel composition. But in 2010, with a comprehensive engineering and radiation survey of Building No. 5, six defective SFAs and several elements of destroyed assemblies were found on the bottom of the right basin. The length of each assembly is about three meters, weighing up to 20 kg. These radioactively hazardous facilities are coated with a

layer of radioactive silt and sediments accumulated over decades, and create an unfavorable radiation situation in the basin and the technological hall.

To continue The first priority for continuing decommissioning work on Building No. 5 is bringing the radiation situation in the facility under control. One main issue is the problem of extracting the remaining SFAs at the bottom of the basin. These cannot be removed by conventional means. Choosing the technology to solve this problem took more than five years. Eventually, an international tender was held and a company called Spetstekhomplekt won.

The engineering systems of Building No. 5, including the heating and ventilation, systems, and the water supply and sewerage systems are completely inoperative and cannot be restored. The right pool is covered with metal consoles. These consoles are covered by a chaotic array of biological shielding, which consists concrete beams and other objects used during SNF unloading, and which have a variety of dimensions and weights. Beneath the consoles there are also structural elements that prevent access to the SFAs. The surface of the consoles and the existing biological protection is covered with debris and dust layers.
Silt deposits and foreign objects at the bottom of the pool may prevent the installation of equipment to move the fuel out. The radiation conditions in the work area is unfavorable. Operations within the basin fall into Class I works according to Principle Sanitary Radiation Rule 99/2010.

Russian specialists plan to use mechanical arms with a set of special attachments that can work in constrained conditions and in an unfavorable radiation environment. The operations will be managed from the operator's are, which will be located at a considerable distance from the basin. Video surveillance systems will make it possible for personnel not to enter the dangerous radiation conditions, and will also allow for each step of the work to be recorded. Spetstekhomplekt, located in the Novgorod Region, is assembling a full scale site for testing equipment and training personnel. Two robotic manipulators will be manufactured to perform operations to extract SFAs and then place them in containers.

In November 2017, in connection with certain changes in the technical process, the Assembly of Donor Countries approved a € 675,000 allocation of additional funding to prepare the retrieval of six SFAs from Building No. 5.

According to Rosatom's Decommissioning Concept for Nuclear Installations, Radiation Sources and Storage Points, the obligatory end goal of this process is to restore the facility to a brownfield state. After an expert review of the decommissioning options for Buildling No. 5 the following option emerged, which is officially described as "phase-out liquidation with delayed dismantling of the building and foundation." After it is brought into a radiation safe condition, Building No. 5 will be preserved for several years. Various sorption solutions will be used to treat the building's surface for insulation and dust suppression. The effort to preserve the building is crucial to coordinate activities within Building No. 5 and remove SNF from the dry storage units.

According to expert estimates some 15,3000 tons of waste will likely arise from decommissioning Building No. 5. Some 32 % of this is medium-level radioactive waste; 22% is low-level radioactive waste; 8% is very low-level radioactive waste and 38% is industrial waste.

Bellona is of the opinion that the information currently available to the public on building no.5 is insufficient. A public hearing on the issue would mitigate this problem. The responsible parties should inform the public about the progression at the site, plans and current goals.