EMPTYING OF THE STORAGE FOR SOLID RADIOACTIVE WASTE IN THE GREIFSWALD NUCLEAR POWER PLANT

Burkhard Hartmann, Jürgen Fischer
Energiewerke Nord GmbH
P. O. Box 1125, Lubmin, D-17507

ABSTRACT

On the Greifswald site, 8 WWER 440 reactor units are located and also several facilities to handle fuel and radwaste. After the reunification of Germany, the final decision was taken to decommission all these Russian designed reactors. Thus, EWN is faced with a major decommissioning project in the field of nuclear power stations. One of the major tasks before the dismantling of the plant is the complete disposal of the operational waste. Among other facilities, a store for solid radioactive waste is located on the site, which has been filled over 17 years of operation of units 1 to 4. The paper presents the disposal technology development and results achieved. This activity is the first project in the operational history of the Russian type serial reactor line WWER-440.

INTRODUCTION

The Greifswald site is located about 200 km north of Berlin at the coast of the Baltic Sea. There are in total 8 units of Russian pressurized water reactors, type WWER 440. The units 1 to 4 are model 230 and the units 5 to 8 the more recent model 213.

Immediately after the reunification of Germany in 1990, the 4 operating units in Greifswald were switched off, the trial run of unit 5 was stopped and the construction work at units 6 to 8 was interrupted. After serious considerations about refitting and restarting some reactors, the decision to decommission all reactors was finally taken in 1990/91.

Beside the main buildings of the 8 reactors, a wet storage for fuel elements, a central active workshop and other buildings for the treatment of radioactive waste including a storage for solid radioactive waste are located on the Greifswald Nuclear Power Plant site.

During the operating time of the NPP, the storage had the task to accommodate all generated solid radioactive waste of units 1 to 4 for an unlimited time period. This concerned filled 200-l-drums as well as loose and unsorted waste.

The storage for solid radioactive waste consists of 7 storage rooms in which the ca. 450m³ waste is stored. Due to the local conditions (accessibility to the storage rooms), the emptying of the storage rooms was carried out via hatches in the building roof.

To avoid a release of radioactive material to the environment and the fact that asbestos was found in the storage rooms, special measures had to be taken before emptying. These measures included a weatherproof construction (cover) above the overall area of the hatches and the erection of a disposal caisson, which can be moved over the individual storage rooms.

After the completion of these preparatory measures, the emptying of the rooms started.

The disposal technology includes the removal of the waste from the storage rooms, sorting and packaging of this waste into transport containers as well as the release from the disposal caisson.

Following, the waste is conditioned in the Interim Storage North and will be intermediately stored until a final storage will be put into operation in Germany.

DESCRIPTION OF THE STORAGE FOR SOLID RADIOACTIVE WASTE

For the solid radioactive waste generated during the operation of the power plant units, a store for solid radioactive waste was foreseen in the project of the Greifswald NPP. Originally, this storage was designed as a final storage. During the operation of the plant from 1973 to 1990, conditioned and unconditioned waste was stored. Since the store was designed as a final storage, an emptying was not foreseen. The emptying of the building, which is necessary for the demolition, caused due to the structural design several technological difficulties.

The storage rooms are located in Special Building 1. The Special Building 1 is situated in the eastern part of the power plant site, in the monitored area of the plant.

The storage building is 90m long and 38m wide. The building consists of a high and a low part below which the seven storage rooms are located. Access to the storage rooms is only possible via the hatches in the roof of the low part.

Fig. 1: Special Building 1

The walls between the storage rooms and the roof ceiling consist of 300 – 500mm reinforced concrete. The roof ceiling is additionally provided with a multilayered concrete layer.

Table I: Dimensions of the storage rooms and hatches.

room no.	room name	room dimensions L x W x H (in m)	room volume (in m³)	shape/dimension of the openings (hatches)
BK028/1	Storage for low-active solid waste	6.00 x 3.85 x 7.80	180	○ 2 x ∅ 1000 mm
BK028/2	Storage for high-active filters	35 x[0.75 x 0.65 x 7.80]	137	□ 35 x [750 mm x 650 mm]
BK028/3	Storage for low-active filters	6.00 x 2.00 x 7.80	126	▭ 5400 mm x 2700 mm
BK028/4	Storage for low-active filters	6.00 x 2.70 x 7.80	126	▭ 5400 mm x 2700 mm
BK028/5	Storage for low-active solid waste	6.70 x 4.20 x 7.80	220	○ 4 x ∅ 1000 mm
BK028/6	Storage for low-active solid waste	6.70 x 1.50 x 7.80	78	▭ 5500 mm x 700 mm
BK028/7	Storage for low-active solid waste	11.70 x 6.00 x 7.80	548	○ 6 x ∅ 1000 mm

The information about waste type and radiological situation recorded in the documentation during the operational phase were very incomplete. For this reason, a comprehensive inspection of the inventory in the individual rooms had to be executed.

In the result of the inspection, 450m³ waste was found which consists of metals, different unsorted mixed waste (insulating mats, textiles, foils, paper, etc.), and a large number of 200-l-drums with unknown content. The rooms BK028/1 with 160m³ and BK028/7 with approx. 280m³ are the most filled rooms.

Fig. 2: View into room BK028/1

Since the roof of the low part of Special Building 1 and thus also the access hatches to the storage rooms were permanently exposed to the weather, water was found nearly in all rooms (water level up to 4m). Analyses showed that rainwater seeped into the rooms. This water was immediately pumped off to the controlled area.

The determined radiological values (in a distance between 10 and 50cm to the waste) were below 1mSv/h. It has to be taken into account that

a) a complete evaluation of all visible inventory could not be executed from geometrical and radiation protection view (arrangement of hatches/multitude of cover plates),

b) an evaluation of the covered inventory in the rooms BK028/1 and BK028/7 was not possible.

The dose rate on the surface of some drums (room BK028/3) was in some cases clearly higher than 1mSv/h.

Under these initial conditions it was not possible to solve the problems by smaller facility adaptations. Therefore it was necessary to develop a new project with corresponding licensing procedures. The following main problem had to be solved:

- Isolation of the intervention area from the open environment to avoid any activity release,
- Creation of save working conditions for all activities to be executed including protection against asbestos.

The final design solution is presented below.

WEATHERPROOF CONSTRUCTION

The weatherproof construction has been erected on the roof of the low part of Special Building 1. Thus, water intrusion into the rooms below could be prevented. The necessary preparation and disposal activities (inside this construction) can be executed irrespective of weather influences, and the radiation protection conditions can be sufficiently guaranteed.

The weatherproof construction is designed as a steel lightweight construction. The wall lining consists of cassettes with heat insulation and metal sheets.

The construction was mainly fastened on the building walls and supports of the ceiling plates. The individual supports are equipped with cams and fastened with anchors on the roof of Special Building I. The result was a hall with three open sections in which two central metal supports are arranged above of load-bearing reinforced steel walls (west/east direction).

The weatherproof construction has the following dimensions:

length	ca. 54m
width	ca. 38m
lower clear height	ca. 8.00m (up to ridge ca. 10m)

The construction was provided with natural ventilation.

The roof of the weatherproof construction has the following 2 openings for dismantling:

- north side (8500mm x 15000mm) for putting the disposal caisson in,
- southwest side (6000mm x 5930mm) as an additional opening.

Due to the complete covering, the existing loading bridge had to be removed. Alternatively, a cat carriage with cantilever to the outside and electric wire rope (lifting capacity 5t) was installed. In both, the northern and the southern hall section, a suspension crane with a lifting capacity of 5t was installed.

Fig. 3: Weatherproof construction

DISPOSAL CAISSON

Due to the asbestos containing waste that was found during the inspection, a caisson was installed inside the weatherproof construction to give protection during disposal. The ground dimensions of the caisson are 10.23m x 13.55m, and the total height is 4.98m. Since open radioactive material is handled, it is assigned to the controlled area. The caisson is sealed outwards to the monitored area, there is negative pressure, and the exhaust air of the caisson is filtered.

The caisson is a steel construction. The caisson bottom, the inside walls and the roof consist of 6 or 5mm steel sheet, which is fastened on steel supports and tightly welded. The inside surfaces of the caisson are provided with decont-paint.

The caisson is self-supporting deposited on 3 rail carriers (surface of polished high-grade steel). There is a mounting hatch in the bottom area for taking of the operational waste. The clear dimensions of the mounting hatch in the caisson bottom are 4.22 m x 5.60m.

On these 3 rail carriers, which rest on the reinforced concrete walls of Special Building I and overstretch the ceiling construction of the building, the caisson is horizontally moved to the individual caisson and disposal places.

Fig. 4: Caisson on the rail carrier construction

Before the caisson is moved into working position over the storage room, which has to be emptied or cleaned, the additional concrete layer has to be removed except of the statically constructive concrete of the reinforced concrete ceiling. This is necessary to hermetically connect the caisson with the reinforced concrete ceiling. For this, a compensator is used.

For the disposal of the rooms in Special Building I, eight different working positions of the caisson are needed to which it is pulled or pressed on the rail carriers by hydraulically operated spindles after the corresponding preparatory work. Before starting the work, the caisson is pushed to working position, all supply and disposal lines will be connected, the compensator installed between caisson bottom and ceiling plate of the building, and the ventilation system put into operation after hermetical sealing to the environment. The filter facility is located in the caisson

To have access to the rooms which are provided with hatches, the opening of the ceiling to the storage room has to be cut open with a concrete saw before starting the disposal.

To execute the work, the following facilities are integrated in the caisson:

- crane with a lifting capacity of 2t (to remove cut out concrete ceiling parts and stored operational waste); operation and monitoring is executed from the control stand,

- personnel lock consisting of four chambers, it is needed due to the asbestos problems,

- a material lock with two chambers,

- a control stand for the operation of the crane and monitoring of activities and installed facilities in the caisson (with radiation protection shielding between operation and working area in the caisson); for the supervision and control of the activities, TV cameras will be used in the caisson and monitors in the control room,

- a ventilation system for keeping negative pressure and cleaning the caisson air:

  The ventilation system serves for caisson and lock ventilation and for keeping negative pressure. It is designed according to TRGS519 "Asbestos demolition, refurbishment and maintenance work" and meets the requirements for radiation protection.

  All parts of the ventilation system as channels, channel internals, exhaust air devices etc. are gas-tight.

  The exhaust air is filtered in different stages and removed outwards.

  The filter load is measured and the necessary exchange is optically and acoustically displayed in the control stand.

  A continuous measurement of the differential pressure with records in the control stand will signalise an eventual pressure decrease and the operational personnel will be informed via an optical and acoustical signal.

- a sorting table with a carrying capacity of 2t for the filling of four 200-l-drums or compactable drums (including shielding wall to the personnel),

- an intermediate depository/pre-cutting place for size reduction of bulky, geometrically inappropriate components (carrying capacity 2t),

- a place for tools (e.g. lid closing machine for compactable drums).

The waste material is taken out from the storage rooms by the crane with appropriate grippers and put on the sorting table. For bulky and geometrically inappropriate waste, the intermediate depository place is used for manual pre-cutting. The waste is then filled into 200-l-drums or compactable drums. The whole inside area of the caisson is radiologically monitored. In case of higher dose rates, appropriate radiation protection measures will be initiated. The filled waste packages will then be let out through the material lock and transported to the Interim Storage North (ISN) for further treatment. Here, the waste will be compacted by high pressure and dried. Up to the opening of a final storage in Germany, the material is intermediately stored in the ISN.

State of work

The disposal activities started in room BK028/4 in September 1999.

After the disposal of the operational waste will be completed, the cleaning of the rooms will start. The aim of the cleaning activities is the removal of the worst dirt and loose contamination. .

The following requirements must be fulfilled:

The construction of the weatherproof building started in 1997 and finished in the middle of 1999. After the delivery and commissioning of the disposal caisson, the disposal activities started in room BK028/4 in September 1999.

After the disposal of the operational waste will be completed, the cleaning of the rooms will start. The aim of the cleaning activities is the removal of the worst dirt and loose contamination.

- the caisson above the rooms to be cleaned meets the same requirements as for the disposal of operational waste,

- the radioactive waste is removed from the storage rooms and a safe stay is possible.

The following cleaning procedures are mainly used:

- removal of worst dirt with different tools,

- removal of loose contamination (dust) and at inaccessible places (corner areas) with industrial vacuum cleaners for liquid and solid material,

- removal of loose contamination and cleaning of low-contaminated surfaces by wet cleaning.

A basket is used to enter the rooms. The work is executed under permanent supervision of radiation protection. Measures for breathing protection will be defined according to the radiological values.

After the rooms are emptied and cleaned, cover plates will close them.

Since the disposal has started, approximately 1500 compactable drums or 200-l-drums have been produced, which will further be conditioned (high pressure compaction, drying) in the Interim Storage North.

Table II: Present state of the work

Storage room	**Condition of the room**
BK028/4	emptied, cleaned, closed with cover plates
BK028/3	emptied, cleaned, closed with cover plates
BK028/6	emptied, cleaned, closed with cover plates
BK028/5	emptied, cleaned, closed with cover plates
BK028/7	emptying of the room is still going on
BK028/1	- has still to be emptied -
BK028/2	- has still to be emptied -

According to plan, the emptying and cleaning of all storage rooms will be completed in the first quarter of 2003.