

**THE ROLE OF THE WORLD'S LARGEST INTERIM STORAGE
FOR WASTE AND FUEL WITHIN THE DECOM PROJECT OF 6 WWER
REACTORS
IN GREIFSWALD AND RHEINSBERG (GERMANY)**

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ABSTRACT

On the Greifswald site, 8 WWER 440 reactors 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 including a WWER-2 prototype reactor on the Rheinsberg site. Thus, EWN is faced with a major decommissioning project in the field of nuclear power stations. Enormous amounts of contaminated or activated dismantled material - more than 100,000 Mg - have to be treated and a considerable amount of fuel elements (more than 5,000) have to be disposed of. Because the final storage situation in Germany has still not been resolved, the world's largest interim storage and treatment facility for radioactive waste and fuel has been built on the Greifswald site, the **Interim Storage North (ISN)**. The erection work of the ISN was started in 1994 and was finalized in 1998 on schedule.

INTRODUCTION

In the former German Democratic Republic (GDR), 30 - 40 % of the electricity supply was planned to be supplied by nuclear energy. Until 1990, the nuclear power plants in Greifswald and in Rheinsberg provided appr. 11 % of the required electricity. The Greifswald site is located about 200 km north of Berlin on the coast of the Baltic sea. There are in total 8 units of Russian pressurized water reactors type WWER 440. The units 1 - 4 are model 230 and the units 5 - 8 the more recent model 213. There is also wet storage for spent fuel, a warm workshop and additional buildings for the treatment and storage of radioactive waste. The Rheinsberg site is about 70 km northwest of Berlin. Here there is a WWER-2 prototype reactor, which started its operation already in 1966 as the first nuclear power plant in the former East Germany.

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 - 8 was interrupted. The plant in Rheinsberg was switched off in the same year. After serious considerations about refitting and restarting some reactors, the decision to decommission all reactors was finally taken in 1990/91.

Due to the unexpected decommissioning decision, the initial work was focused on the removal of fuel and operational waste to provide the preconditions for decommissioning and dismantling. Parallel to this, EWN worked out the technical concept for the decommissioning and a social plan for the employees. The financing is secured by the Federal Government. The first licenses for the decommissioning on both sites were granted in 1995 and since then, the dismantling activities have been running.

A short overview of the history of the plants is given in table 1.

Table 1
Historic overview and basic data of the Greifswald and Rheinsberg NPP's

Greifswald Nuclear Power Plant (KGR)		Rheinsberg Nuclear Power Plant (KKR)	
History			
1973	Commissioning of unit 1	1966	Commissioning of the power plant
1974	Commissioning of unit 2	1986	Backfitting
1977	Commissioning of unit 3		
1979	Commissioning of unit 4		
1989	Trial operation of unit 5		
1990	Final shutdown of all units	1987	
1990	Final shutdown of all units	1990	Final shutdown
1995	Decom license issued	1995	Decom license issued
Parameter			
Type	WWER 440 - 230 (units 1 - 4) WWER 440 - 213 (unit 5)	Type	WWER 2 (prototype)
Power	1375 MWth, 440 MWeI	Power	265 MWth, 70 MWeI

THE ROLE OF THE INTERIM STORAGE IN THE DECOM PROJECT

On the basis of a thorough technical and radiological registration of the plant, the planning and organization of the overall waste management could be performed. In the pre-planning phase it had already become obvious, that a large interim storage was needed. This was mainly due to the enormous amounts of contaminated or activated dismantled material - more than 100,000 Mg - as well as to the considerable number of fuel elements (more than 5,000), which had to be disposed of. Due to this problems and because the final storage situation in Germany has still not been resolved, a major interim storage and treatment facility for radioactive waste and fuel has been built on the Greifswald site, the **Interim Storage North (ISN)**, see figure 1.



Figure 1 Interim Storage North site

The ISN has a triple function in the project. It is a treatment station, buffer storage and interim storage as well. As **interim storage**, the ISN will take up the spent fuel in CASTOR dry storage casks and other radioactive waste in containers, which will not be treated any further, until the final disposal in Germany is clarified. After the fast and economical dismantling of the large components of the primary circuits, they will be transported into the **buffer storage** space of ISN and then, after decay storage if needed, they will be cut and packed for storage. This strategy will also be applied to the activated reactor pressure vessels and their internals. As a **treatment station**, the ISN is designed to treat nearby every kind of radioactive waste, except nuclear fuel.

So, the treatment and storage of all arising radioactive wastes can be completely separated from the dismantling activities, which allows a maximum of flexibility in logistics and waste management strategy. Various decontamination techniques are combined with decay storage possibilities in order to minimise the amounts of waste needing final disposal.

TECHNICAL DESCRIPTION OF THE ISN FACILITY

The ISN is located in the northeast of the Greifswald site. As depicted in Figure 2, the main plant parts are:

- 1 Storage building
- 2 Administration building
- 3 Security service building
- 4 Access road
- 5 Security fence
- 6 Retention and release pond (for surface water)
- 7 Drainage canal
- 8 Car park

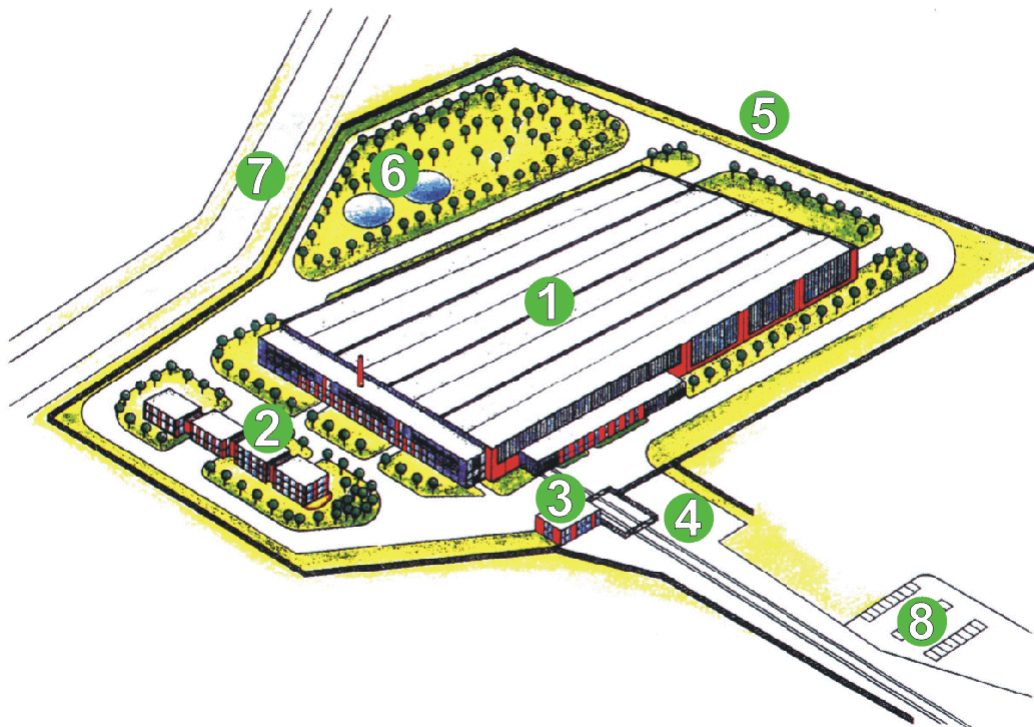


Figure 2 General view of the ISN site

The area inside the security fence comes to approx. 100,000 m². The storage building is shown in the

WM'99 CONFERENCE, FEBRUARY 28 – MARCH 4, 1999

following cross section. The dimensions of this building are:

- Length 240 m
- Width 140 m
- Building height 18 m

The building has a 70 to 100 cm outer concrete cover to guarantee a maximum annular ambient dose rate of less than 0.3 mSv at the site boarder.

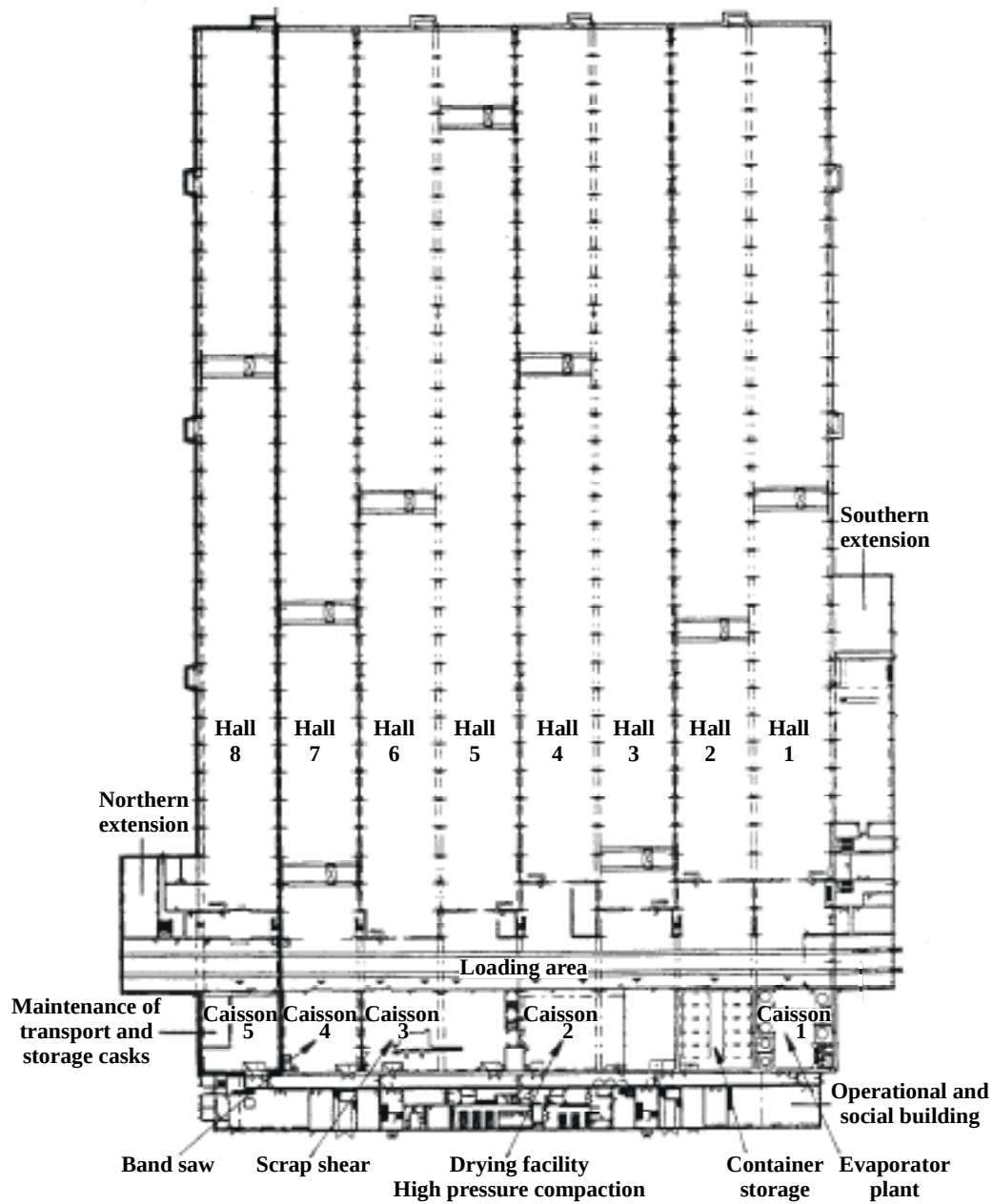


Figure 3 Cross section ISN

The building comprises:

- Storage area
- Loading area
- Conditioning/treatment area
- Operational and social building
- Northern extension
- Southern extension

The storage area is divided into 8 halls and has a usable total storage area of approx. 20,000 m², the usable height is approx. 10 m, so that the total storage volume comes to 200,000 m³. The storage halls are connected at their front end by the loading hall. The halls 1 - 5 take up all kinds of waste packages and will serve as buffer storage of untreated material. The halls 6 and 7 are used to store the large components of the primary circuits, which will be dismantled and transported to the ISN as a whole or in as large parts as possible. After decay storage, they will be cut and packed for final storage.

Hall 8 will accommodate the spent fuel in CASTOR casks, from which 64 are needed for the dry storage of 5,048 fuel elements from the Greifswald and Rheinsberg sites. In total 80 storage places are available, and the remaining 16 places will serve as a reserve and for the storage of e. g. core internals and radioactive sources in CASTOR casks too.

The storage halls are equipped with bridge cranes, which cover the whole storage areas. They can be moved into the loading area and the neighbouring treatment area. The crane capacities of halls 1 - 5 are 320 kN each, halls 6 and 8 1400 kN each and hall 7 two times 1400 kN. The amount of contaminated and/or activated material to be stored in hall 1 - 7 is about 110,000 Mg with a total activity of 4,5 E+17 Bq. The amount of heavy metal to be stored in hall 8 comes to 585 Mg with total activity of 7,5 E+18 Bq. The total decay heat power is 1 MW.

The loading area is for the acceptance of the transport and storage casks, containers and single components. A double railway track goes into this area. The loading hall can also be used by heavy trucks, for which locks in the entrance and exit areas are installed. Connected to this loading hall, opposite to the storage halls, the conditioning and treatment area is located. It comprises an area of approx. 2,450 m² and consists of

- Caissons 1 to 4 for the treatment and conditioning of solid and liquid radioactive waste and residues. The following equipment is installed in these caissons:
 - Evaporator plant (throughput 1 m³/h)
 - High pressure compactor "FAKIR" (throughput 50 200-l-drums/day)
 - Drying facility "PETRA" (throughput 10 200-l-drums/day)
 - Scrap-shear "MARS" (cutting power 7 MN)
 - Box for manual thermal cutting

For the cutting of large components after decay storage, e. g. steam generators, the installation of an ice-saw in one of the caissons is possible. Additionally, the water abrasive suspension cutting technique can

also be used. It is presently being tested for its applicability.

- Caisson 5 for the maintenance of transport and storage casks for spent fuel
- Additional container buffer storage place for the received raw waste and other decom waste to be treated further.

The operational and social building is located in the west of the conditioning area and has three floors. Here the measurement equipment (chemistry and radiation protection laboratories) and a warm workshop for maintenance are accommodated within the controlled area. In the northern and southern extension buildings further laboratories and technical equipment are installed.

ERECTION OF THE ISN

The construction work of the storage building started in November 1994. Only one year later hall 7 was finished ahead of time. In March 1996 a license for the storage of radioactive waste and residues according to § 3 Radiation Protection Ordinance was granted for this hall. With the transport and storage of the first steam generator of unit 5, the ISN commenced its active operation of hall 7. Figure 4 shows a view of hall 7 (Status May 1998).



Figure 4 View into hall 7 of ISN

WM'99 CONFERENCE, FEBRUARY 28 – MARCH 4, 1999

On November 13, 1997, after a three year erection period, the authorities of the federal state of Mecklenburg-Vorpommern confirmed the completion of the storage building (exactly on the same date 24 years before, Greifswald's unit 1 started its operation). After the cold operation of the technical equipment under control of authorized experts, on February 20, 1998 the license for the conditioning and storage of radioactive waste and residues according to § 3 Radiation Protection Ordinance was granted. At the same time, EWN started the operation of the overall facility as a new operation unit within the company. Since Neckarwestheim (GKN 2) in 1989, this was the first time, that in the 1990s in Germany a large nuclear facility could start its operation.

For the storage of the spent fuel in CASTOR casks in hall 8 and the maintenance of these casks in caisson 5, a separate license according to § 6 of German Atomic Law is needed. This is expected to be granted in the first quarter of 1999. After EWN will have received this license, the loading, transport and storage of the casks will start.

For a complete and long term utilization of the storage space and treatment capacities, EWN is able to offer services for other nuclear operators in Germany. Table 2 gives an overview of the different kinds of material and the corresponding amounts which can be treated resp. stored in the ISN, according to the license, and the accepted amounts of other nuclear facilities:

Table 2
Material and amounts per year according to license

Intermediate storage and conditioning		KGR/KKR		Other nuclear facilities	
Intermediate storage of radioactive waste/residues	X	-	-	-	-
Buffer storage	X	X	max. 6700 Mg		
High pressure compaction of solid waste	X	X	250 Mg/year		
Cutting of metals with scrap shear	X	X	1000 Mg/year		
Flame cutting	X	X	1000 Mg/year		
Cutting with band saw	X	X	2000 Mg/year		
Drying of wet packages	X	X	1)		
Cementation	X	X	75 Mg/year		
Decontamination of water with evaporator facility	X	X	350 Mg/year		
Drainage of evaporator concentrates	X	X	130 Mg/year		
Total activity [Bq]	4,5 E+17	1,4 E+16			

1) Packages from high pressure compaction and dismantling

COST AND PERSONNEL

The total cost of the ISN facility comes to approx. 465 million DM, which is only a few percent more than estimated in 1992. For the operation, the estimate is about 8.6 million DM per year including personnel cost. Of this amount, about 2 million DM is calculated for the electricity supply. The cost of the ISN has to be seen in relation to the cost of the overall decommissioning project in Greifswald and Rheinsberg, which were estimated in 1995 as shown in table 3.

Table 3
Total cost of the decommissioning project
Greifswald and Rheinsberg (price basis 1995)

Position	Mio DM
Post- and site operation	1,650
Final storage costs for fuel elements (fees and transport)	1,051
Construction of the ISN	444
Operation of the ISN for 40 years	395
Casks and final storage fees after 2002	674
Dismantling cost for 6 NPP's in Greifswald and Rheinsberg	1,995
Total cost	6,209

The operation of the ISN is planned for a 40 year period. From the year 2000, there will be a staff of 85 people, 18 of them will be occupied with the documentation of the waste management and disposal.

CONCLUSIONS

The erection work of this interim storage was started in 1994 and could be finalized in 1998 on schedule. Since March 1998, the ISN is in operation and guarantees, with its storage capacity of approx. 200,000 m³ and its modern radwaste treatment facilities, the continuous execution of the dismantling works in Greifswald as well as in Rheinsberg. For a complete and long term utilization of the storage space and treatment capabilities of the ISN, services for other nuclear operators in Germany in these areas are offered. Since the final repository in Morsleben has been closed in September 1998, it has been shown that the strategy of erecting an independant ISN was the correct way to proceed.