EMPTYING, DISMANTLING AND DEMOLITION OF RADIOACTIVE WASTE DISPOSAL "ALFR" ON SITE OF NPP RHEINSBERG

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ABSTRACT

The Nuclear Power Plant Rheinsberg (KKR) is one of the first NPP's in Germany and is now under decommissioning.

On KKR-site exists a waste disposal (so called ALfR). A main part of decommissioning KKR is the emptying, dismantling and demolition of the waste disposal ALfR.

The first step is to remove the waste out of the different stores and tanks. After emptying stores and tanks of the ALfR in the second step follows the dismantling of the equipment and the demolition of the buildings. The third step will be to rehabilitate the environment.

This paper describes the emptying

- of the *cemented liquid waste* out of the "Betonmonolith",
- of the *mixed solid waste* out of the "ALfR-solid",
- of the *encapsulated "hot-cell-waste*" out of the "ALfR-solid"

and

- of the mixed liquid waste out of the "ALfR-liquid".

Besides the paper describes the dismantling of the equipment and the demolition of the buildings of the waste disposal "ALfR".

All stores are emptyed now and the dismantling of the equipment and the demolition of the buildings is ongoing now.

INTRODUCTION

The nuclear power station Rheinsberg (KKR), see Figure 1, is located about 90 km north of Berlin (Germany). KKR was the first NPP of the Soviet type WWER which was exported from the Soviet Union and was built in the former German Democratic Republic. The NPP WWER-70 had an electrical output of 70 MW. KKR was commissioned in May 1966. Because in this time a final waste disposal for radioactive waste did not exist, it was built on the present site. The so-called "ALfR", for low and medium active liquid and solid waste disposal, was foreseen to store waste for an unlimited period. Figure 2 shows the site plan of ALfR.

"ALfR" consists of

- "Betonmonolith",
  a monolithical concrete container, lined with 2 mm plastic foil, for depositing cemented evaporiser concentrates for solidification.

- "Pumping-house",
  a building, which contains the mixing equipment for cement and liquid waste as well as the pumps. The cementing unit, the pumps and the feed pipes to the "Betonmonolith" were dismantled in 1980.

- "AlfR-solid",
  an underground concrete-building, consisting of eight chambers for the deposition of solid mixed waste. Four of the eight chambers were filled with waste. The four chambers each have a volume of 175 m^3. Amongst the waste are eight so called "Hot-cell-drums". These drums contain medium active waste from hot cell operation encapsulated into concrete.

The ALfR-solid building is covered by a structure for weather protection.

- "ALfR-liquid",
  consists of five underground storage tanks, each of them has a volume of 500 m^3. All the concrete-tanks are lined with stainless steel, two of them have only a single wall, the other three have a double wall liner. The three double-walled tanks were filled with sludges, resins and evaporator concentrates. Due to suspected leakages the two single-walled tanks were emptied in 1982.

The main part of the "ALfR-liquid" is a covering building for liquid waste handling and control purposes.

The KKR was finally shutdown in June 1990 and is now under decommissioning. As described below, in the first step all waste was removed out of the "Betonmomolith", the "ALfR-solid" and the "ALfR-liquid".
The waste-chambers and tanks are now empty. They are cleaned or decontaminated and ready for demolition. However, up to now we could not discharge the "Hot-cell-drums".

The second step follows: the dismantling and demolition of the store chambers and tanks. In October 1999 KKR started the demolition of the "Betonmonolith".
The third step will be to rehabilitate the environment.

EMPTYING OF WASTE DISPOSAL "ALfR"

Emptying of cemented liquid waste store "Betonmonolith"

The content of the "Betonmonolith" was demolished and packed by remote controlled equipment because of the radiological and aerosol situation.

To keep the personnel and surroundings safe, an active ventilation system was installed. This equipment was installed in a container, which was docked on at the wall of the "Betonmonolith".

Using this ventilation container and a tarpaulin covering the roof, we reached an air-barrier and low-pressure inside of the "Betonmonolith".

A container for personnel access, health physics instrumentation and remote control equipment for filling and handling of drums, was docked on. For transport of filled drums out of BM and for equipment inlet and outlet an sluice-container was docked on.
Inside the "Betonmonolith" a partition ceiling was installed, keeping the inside surface of the wooden roof clean during emptying.

The solidified (cemented) evaporation concentrate was demolished by a remote controlled vehicle "AM-100". This vehicle could be equipped either with a jack-hammer or with a bucket. It was used for loosening and for loading the material. The broken concrete was filled into 180 l-drums lined with a plastic bag. The filled 180 l-drums were put into 200 l-drums and stored in the final repository "ERAM" in Morsleben.
Details of emptying "Betonmonolith" are given in Table 1.

Table 1 Emptying of store "Betonmonolith"

Waste (concrete)	(m^3)	80
activity	(GBq)	310
200-l-drums	(pieces)	1717
av. dose rate at drums	(mSv/h)	0.1
pers. dose	(mSv)	19.9
start of works	(date)	02/05/94
finish of works	(date)	05/05/95

Emptying of mixed solid waste store "ALfR-solid"

To protect the surroundings against contamination, a movable caisson was erected above the chambers inside the weather protection building. This caisson is equipped with a grab.

In addition, an access container and a container with the ventilation system is docked on outside the weather protection building.

The mobile ventilation system is connected to the KKR-ventilation system and ensures an low pressure in the caisson. Drum filling and ventilation equipment, used for emptying the "Betonmonolith", is used again for emptying the "ALfR-solid".

The concrete ceilings of the chambers have been cut to reach the necessary working conditions for emptying each vault. Wastes are taken out by the grab, using remote control. To fill the waste into the 200-l-drums it was necessary to separate large and bulky parts from small parts. Therefore, we used a manually operated sorting table. To correspond to the acceptable conditions for the "ERAM"-repository each filled 200-l-drum was dried, using drying-equipment.
Details of emptying "ALfR-Solid" are given in Table 2.

Table 2 Emptying of store "ALfR-solid"

Nr. of chamber		**2**	**6**	**4b**	**4a**	**all together**
Waste (mixed sol.w.)	(m^3)	121.6	119.2	86.2	107.4	434.4
activity	(GBq)	122	22	184	111	Σ 439
200-l-drums	(pieces)	608	596	431	537	Σ 2172
av. dose rate at drums	(mSv/h)	0.25	0.04	0.45	0.15	∅ 0.22
pers. dose	(mSv)	8.3	3.4	11.5	15.5	Σ 38.7
start of works	(date)	12/01/96	17/11/96	12/05/97	12/02/98	12/01/96
finish of work	(date)	27/08/96	09/04/97	18/12/97	25/06/98	25/06/98

Disposal of concrete encapsulated waste "Hot-cell-drums"

The eight "Hot-cell-drums" (HCD), which were found amongst the mixed waste, were packed firstly into 400-l-drums. These remain standing in the chambers until their disposal. It was proposed to discharge them to the final repository "ERAM". However this only German final repository "ERAM" has been closed since September 1998.

Therefore, we can only dispose the hot cell drums into the Interim Storage North "ZLN".
The disposal to ZLN requires:

- To pack the HCD into a container, corresponding with the accepted conditions of ZLN;
- to declare the radioactive inventory of the container.

This requires determining the partial unknown content of the Hot-cell-drums.
Therefore, it is planned to crush each of the HCD to measure the isotope-composition. For crushing we will use the remote controlled vehicle "AM-100", described above. The crushed waste then will be filled in "Mosaik"-containers or into lost-concrete-shielding-containers "VBA". The type of containers depends on the activity-inventory, which is found. The container will be stored at the ZLN.
Details of demolition and packaging of HCD are given in Table 3.

Table 3 Demolition and packaging of "Hot-cell-drums" (HCD)

		Maximum (Nr. of HCD)	**all together**
Waste (emb. sol. w.)	(m^3)	0.38 (Nr. 1)	2.37
activity	(Bg)	2.9 E+12 (Nr. 8)	3.79 E+12
dose rate at HCD's	(Sv/h)	2 (Nr. 8)	10...120
start of works	(date)	-	March 2000 (planned)
finish of works	(date)	-	May 2000 (planned)

Emptying of mixed liquid waste store "ALfR-liquid"

This liquid waste contained evaporator concentrates, sludges and resins with a high content of boric acid. Due to the length of storage time, a sediment formed at the bottom of the tanks.

There were also hard crystallised layers of boric acid on the walls and installations inside the tanks. To whirl up the sediments and to dissolve the crystalised layers a stirring and pumping equipment was installed inside the tanks.

In the operation-building a decanter was installed. Using this mobile centrifuge unit, the pumped liquid waste mixture was separated into the dried waste and the liquid decantat.

The separated solids with approx. 30 % of moisture were filled into 200-l-drums. Because free water didn't exist, an additional drying process wasn't necessary. While the drums were being filled, they were standing on a shielded transport wagon. After measuring the product quality of the filled drums, they were set into a lost concrete shielding container, "VBA", and closed there.

Most of the VBA's were transported to "ERAM" and stored there.
The decanted liquid was collected in one of the tanks and used for adjustment of centrifuge feed.

This decantat, which contains a high part of boric acid, was transported to the main site of our company EWN near Greifswald.

In a rotary thin film evaporator, "RDVA", it was solidified.
Cleaning of emptied storage tanks was performed using a high pressure water jet and hot water.

Following cleaning, the tank walls were decontaminated manually.
Details of emptying "ALfR-liquid" are given in Table 4.

Table 4 Emptying of store "ALfR-liquid"

Nr. of tanks		**474/1**	**474/2**	**474/3**	**all together**
Waste (liqu. w.)	(m^3)	23	426	212	661
activity	(GBq)	2334		460	Σ 2794
dryed waste	(m^3)	51		7.8	58.8
200-l-drums	(pieces)	255		39	Σ 294
av. dose rate	(mSv/h)	5...10		5...10	∅ 5...10
VBA's-volume	(m^3)	306		46.8	Σ 352.8
av. dose rate at VBA's	(mSv/h)	-		-	< 0.5
pers. dose	(mSv)	54.26		9.74	Σ 64
start of works	(date)	17/04/97	20/10/96	29/09/98	20/10/1996
finish of work	(date)	25/09/98	16/09/98	06/11/98	06/11/1998

DISMANTLING AND DEMOLITION OF WASTE DISPOSAL "ALfR"

Dismantling of tanks and equipment

Tanks and equipment (pipes, valves, pumps a.s.o.) were installed in the "ALfR-liquid"-building. First the tanks were dismantled.

Before the beginning of the dismantling works it was necessary to enlarge the manhole of the tanks. This made it easier for the personnel to get in and out of the tanks and to transport the tools and the filled drums in and out of the tanks. A movable platform was installed inside the tanks, to make possible the dismantling works on the top and at the walls.

As well as this, a ventilation system was installed, to guarantee the necessary fresh-air influx.

The demolition of the first two single-walled tanks is now finished, by using abrasive-wheel-cutting-off machines. To reduce aerosol-spreading, industrial vacuum-cleaners are used while cutting. For the same reason we use metal-shears to cut the dismantled metal-plates on drum-size.
Because the cutting of the 3 mm -austenitic sheet-metal using abrasive cutting machines is very strenuous, EWN now prepares laser-tools for use.
The equipment will be dismantled in the usual way, using saws and other mechanical tools.

Demolition of buildings

In preparation of the demolition of buildings, the radiological situation of buildings surfaces, the inside of walls, the ground surrounding and under the buildings is checked.

The radiological limits are given in Table 5. Depending on the radiological situation after cleaning and surface decontamination of walls, the procedure is the following:

Table 5 Radiological limits for the ground of the ALfR

free release of ground to fill holes on "ALfR" (KKR-site) **total activity**	**< 1 Bq/g**
free release of very low active waste for disposal to landfill **total activity**	**< 5.4 Bq/g**
unrestricted release **total activity**	**< 0.61 Bq/g**

- Walls, contaminated only on the surface (inside) will be decontaminated using a concrete-wall-shaver. The decontamination will be done at the standing building-surfaces or at dismantled wall-plates. In result of on-site decision-measurements, the concrete is released for unrestricted use or for conventional or nuclear waste-disposals.

- Walls, contaminated inward, are demolished by using crushing devices to reduce concrete to small pieces. By using a grab, the concrete-pieces are filled into 200-l-drums and measured in the free-release-measurement-machine (FRM). Depending on the results the concrete pieces will be used unrestricted or disposed to conventional or nuclear waste-disposals.

- Buildings will be covered by housing, to ensure that no contamination of environment happens. The use of ventilation equipment inside the housing produces low-pressure.

- To prepare the demolition of the buildings, the surrounding ground will be removed up to the foundation. Results of radiological measurements certificate local ground contamination's on different radiological levels.

- When demolition of the buildings is completed, the holes are filled with ground of max. activity 1 Bg/g.

Figure 3 shows the mass balance of ALfR. This shows that the demolition first of all needs an effective release-measurement and handling of ground.

Figure 4 shows the site - view of ALfR.

Handling of surrounding ground

To keep the regulations and the radiological limits, an time-extensive procedure requires the following steps:

- to fix the correct nuklidvektor for these grounds.

- to realise "hot-spot"-measurements at the excavator-fills.

- to homogenise the excavated ground. This is the prerequisite for the radiological release-measurements.

- to fill the homogenised ground in transportcontainers, each has a volume of 6 m^3. Each week 24 container are filled (6 containers each day).

- to measure the ground of each filled container by the proper anthorities, a γ-spectrometry is used. When the max. activity is < 1 Bq/g, the ground is free and can be used to fill the holes.

- to deposit the released ground temporary on area Nr. 95 of ALfR. Using plastic foil, a recontamination of the underground is prevented.

- The ground with activity < 5.4 Bq/g is disposed to conventional deposit. The ground with a higher activity is disposed to the nuclear-waste-deposit.

This procedure was successfully used to prepare the dismantling of the building "Betonmonolith".

To expose the foundation of the "Betonmonolith", 3035 m^3 of earth was removed from around the was removed and measured. This takes 14 weeks. To minimise the expenses in the future, a simplified procedure is in preparation.

CONCLUSIONS

The waste removal from site disposal "ALfR", using as well remote controlled equipment as tried and tested technology's, is successfully accomplished. The chosen technology and the radiation protection precautions stood the test.

Prerequisite for emptying, dismantling and demolition of ALfR is a disposal for nuclear waste.

The nuclear waste has been disposed to the subterranean nuclear waste disposal "ERAM". After closing "ERAM" in September of 1998, the waste was disposed to the temporary waste storage "ZLN" near NPP Greifswald.

It has taken a long time to develop and to verify by authority the free-release-procedure, especially for the ground. Realising the project, an improvement of tools and free-release-procedures leads to more efficiency.

The disposal of the remaining "hot-cell-drums" is now in preparation. The dismantling of the equipment is ongoing and the demolition of the first building - the "Betonmonolith"- has begun.

Fig. 1. Nuclear power station Rheinsberg (KKR).

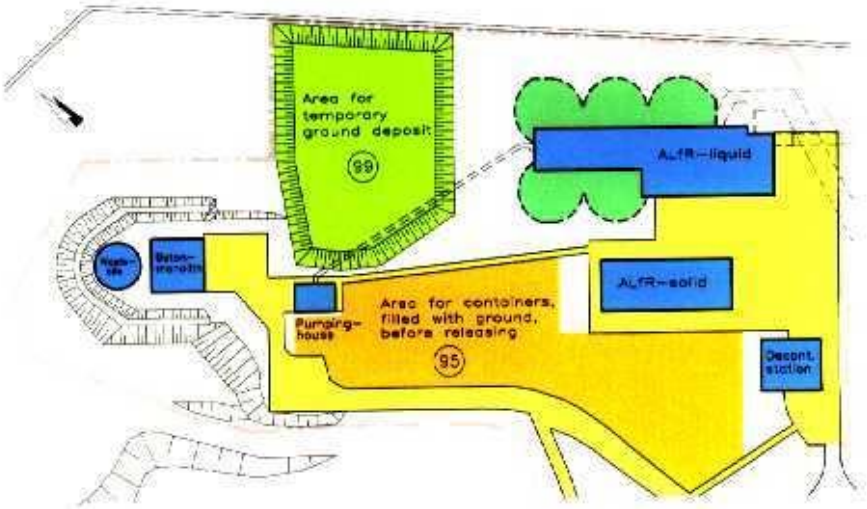

Figure 2 Site plan of ALfR

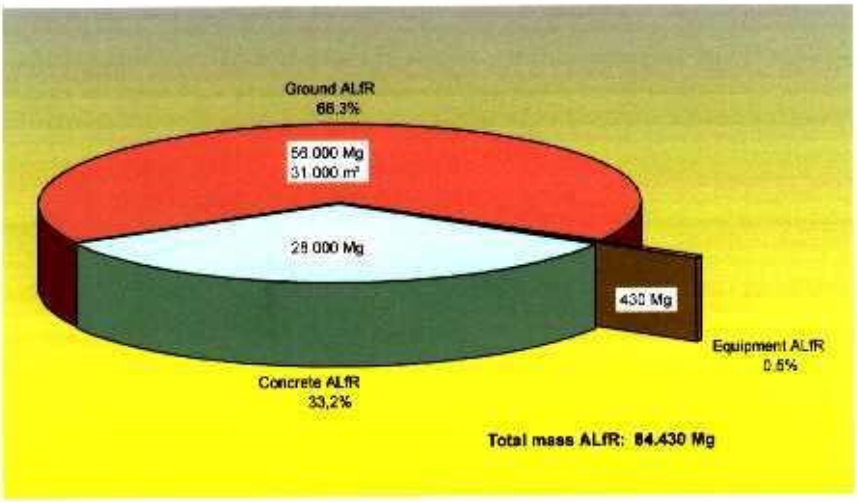

Figure 3 Mass-balance of ALfR

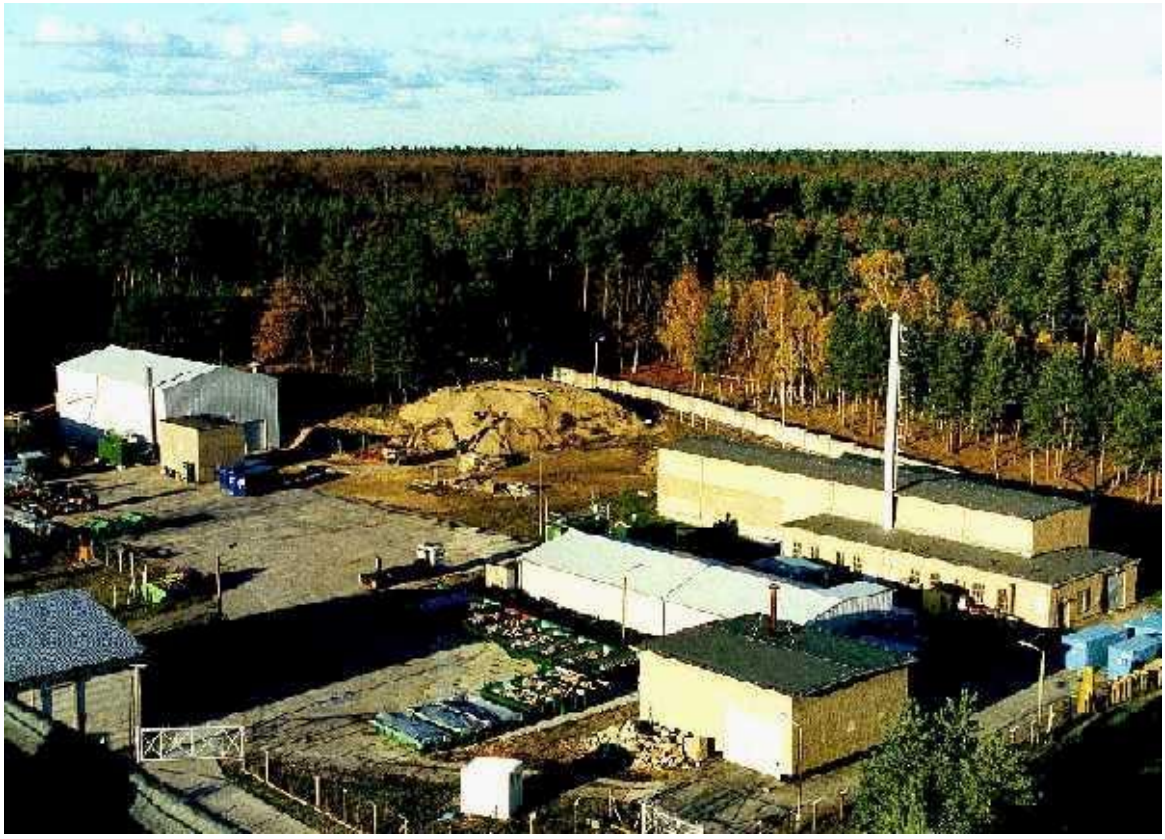

Fig. 4. View of AlfR.