CENTRAL DEPARTMENT RESEARCH REACTOR

Short Description

Operation of a Transport Supply Hall (TBH)

Helmholtz-Zentrum
Geesthacht
Centre for Materials and Coastal Research

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Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung GmbH
Central Department Research Reactor
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Purpose of the short description

With the application documents of the Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung for the operation of a TBH according to § 7 StrlSchV, “a brief, readily understandable description of the installation and its likely effects on the public and the neighbourhood” is to be submitted.

In this brief description, all essential aspects of the overall planned measures for the operation of a TBH are summarized in an intelligible form in this brief description. The brief description of this includes:

- Information on the site, the facility and operation
- Information on the radioactive waste to be stored and a description of the resulting radioactive residual materials
- The likely effects on the general public and the neighbourhood as well as information about other environmental impacts of the project
- An overview of the examined alternatives

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List of Abbreviations (German abbreviations of places/names etc. preserved in most cases)

approx.	approximately
AtG	Atomic Energy Act
BAnz	Federal Gazette
BSH	Supply hall
cf.	confer
Co-60	Radionuclide cobalt-60
Cs-137	Radionuclide cesium-137
DIN	German Standards Institute (Deutsches Institut für Normung)
e.g.	for example
etc.	Et cetera
EN	European industrial standard
FRG	Research Reactor Plant Geesthacht
FRG-1	Research Reactor Geesthacht - 1
FRG-2	Research Reactor Geesthacht - 2
GGVSEB	Ordinance on the Transport of Dangerous Goods by Road, Rail and Inland Waterways
GGVSee	Ordinance on the Transport of Dangerous Goods by Sea
GmbH	Limited liability company
H-3	Radionuclide hydrogen-3 (tritium)
HAKONA	Hall for Component Follow-up Examination
HL	Hot Laboratory
HZG	Helmholtz-Zentrum Geesthacht - Zentrum für Material- und Küstenforschung GmbH (Helmholtz Centre Geesthacht - Centre for Materials and Coastal research)
ID	Identifier

JEN	Jülicher Entsorgungsgesellschaft für Nuklearanlagen mbH
KBR	Brokdorf nuclear power plant
KKB	Brunsbüttel nuclear power plant
KKK	Krümmel nuclear power plant
KKS	Stade nuclear power plant
ℓ	litres
Mg	Megagrams – A measurement of 1 000 000 g, formerly metric tons
mSv	milliSievert = 1/1 000 Sv (physical unit for the body dose)
Ni-63	Radionuclide nickel-63
no.	number
para.	paragraph
RDB-OH	Reactor pressure vessel with shield tank of the nuclear ship Otto Hahn
Sr-90	Radionuclide strontium-90
StrlSchV	Radiation protection ordinance
SZK	Site interim storage Krümmel
TBH	Transport supply hall
UVP	Environmental impact assessment
UVU	Environmental impact study
WAK	Karlsruhe reprocessing plant

Definition of terms

Activation	Operation in which a material becomes radioactive by bombardment with neutrons, protons or other particles.
Activity	Number of nuclei decaying per second in a radioactive substance. The Becquerel (Bq) is the unit of measurement.
Be metal block reflector	Beryllium metal block reflector of the FRG-1 served for the reflection and bundling of neutrons to the execution of experiments on material samples.
Clearance measurement	Activity measurement, the result of which allows for a decision on the release of the material by comparison with the given exemption levels.
Controlled area	Area in which persons can receive during a calendar year an effective dose of more than 6 mSv or higher organ doses than 45 mSv for the eye lens or 150 mSv for the skin, hands, forearms, feet and ankles.
Decommissioning	The term "decommissioning" refers in the Atomic Energy Act to the measures in the time period between the final termination of operation on the one hand and the beginning of safe enclosure or dismantling of the system or of system parts, on the other hand.
Decontamination	Elimination or reduction of a contamination.
Discharge	Surrender of liquid, aerosol-bonded or gasiform radioactive substances from installations and facilities on ways provided for this purpose.

Dismantling	Dismantling a nuclear plant includes the removal of structures (buildings, systems, components), which were the subject of the approval for the construction and the operation of the plant pursuant to § 7 para 1 AtG or are to be evaluated accordingly[1].
Dosimeter	Measuring instrument for the determination of the dose and/or dose rate.
Exemption levels	Values of activity and specific activity of radioactive substances as specified in Appendix III StrlSchV, under which a release is permissible in accordance with § 29 StrlSchV.
Exhaust air	Exhaust air emitted to the environment.
Final Disposal	Plant for the final storage of radioactive waste, in which radioactive waste is disposed maintenance-free, for a temporally unlimited period and secure.
Incident	Sequence of events the occurrence of which prevents the continued operation of the installation or the work activities for safety-related reasons and for which the installation has to be designed or for which precautions have to be taken to protect the work activities concerned.
Operational waste, radioactive	Radioactive waste that occurs or has occurred during operation.
Processing	Processing of radioactive waste into waste products (e.g. by solidifying, embedding, casting or dehydration).
Radiation protection	The protection of people and the environment against the harmful effects of ionised radiation.

[1] Guide for the decommissioning, secure entrapment and dismantling of facility or facility components in accordance with § 7 Atomic Law, 12 August 2009 (BAnz 2009 no. 162a)

Radioactivity	Property of certain substances being able to transform without external influence and thereby emit a characteristic radiation.
Research Reactor Plant	The Research Reactor Plant (FRG) consists of the FRG-1 and the still existing plant components of the FRG-2.
Residual material, non-radioactive	Substances, movable objects, systems and system parts resulting during decommissioning and dismantling which are neither contaminated nor activated.
Residual material, radioactive	Substances, movable objects, systems and system parts resulting from the decommissioning and dismantling which are contaminated and/or activated and will be harmlessly recycled or disposed of properly as radioactive waste.
Supervised area	Operational area which not belong to the controlled area in which persons can receive during a calendar year an effective dose of more than 1 mSv or higher organ doses than 15 mSv for the eye lens or 50 mSv for the skin, hands, forearms, feet and ankles.
System	Summary of components of a technical device that performs independent functions as part of the plant.
Waste, conventional	Non-radioactive substances which will be taken for recovery or disposal under the rules of the law on recycling management.
Waste, radioactive	Radioactive substances pursuant to § 2, para. (1) of the Atomic Energy Act, which, according to § 9a of the Atomic Energy Act, are to be disposed of in a regulated manner, except discharges pursuant to § 47 StrlSchV.
Wipe test	Examination of surfaces for wipable contamination.

1 Introduction

The “New” Experimental Hall of the Research Reactor Plant Geesthacht (FRG) of the Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung (HZG) is intended to be operated as a Transport Supply Hall (TBH) for the storage of non-heat-generating low and intermediate radioactive waste.

Radioactive waste should be stored in the TBH until its transfer to the Federal Final Disposal. This radioactive waste consists of existing operational waste as well as waste arising during the dismantling of the Research Reactor Plant Geesthacht (FRG) and the Hot Laboratory (HL). Only conditioned waste and empty waste containers will be stored in the TBH. In addition, in the TBH waste drums will be packed into the corresponding waste containers and then cemented, if necessary.

2 Alternatives

It is planned to store the non-heat-generating low and intermediate radioactive waste in the Transport Supply Hall (TBH). As a process alternative the storage of the low and intermediate radioactive waste within the FRG and HL was also analysed. However, this scenario was rejected both for logistical (time-consuming infrastructure to retrofit, a limited space, hindrance of the dismantling project) and radiological reasons (avoidable additional radiation exposure).

Moreover, the existing storage facilities at the site are not sufficiently dimensioned to accommodate all waste that will arise.

3 Location

3.1 Geographical Location

The TBH is located at the site of the Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung GmbH (HZG), see Figure 3-1.

Figure 3-1: Aerial view of the TBH next to the FRG and the HL (from 2016)

The HZG site (cf. Figure 3-2) is approx. 35 km to the south-easterly of the city centre of Hamburg in the District of Lauenburg (Schleswig-Holstein). The city of Geesthacht designated the area (approx. 200 hectare) as special use area or forest. It is bordered to the South, toward the Elbe, by the Elbuferstrasse located parallel to the river in southeast-northwest orientation. To the northwest are the site of the Krümmel nuclear power plant (KKK) and the upper basin of the pumped-storage unit Geesthacht. The Geesthacht district of Grünhof and Tesperhude are located to the East of the site.

Figure 3-2: The HZG site and its surroundings within a radius of 10 km and sectorization

3.2 Settlement

About 63 000 people live in the towns and municipalities within a radius of 10 km around the HZG site. The average population density is approximately 200 inhabitants/km² in the entire 10 km radius, which is below the average of the Federal Republic of about 230 inhabitants/km².

The settlement closest to the site is the Geesthacht district of Grünhof and Tesperhude. The community of Krümmel lies about 1 km away in northwest direction. The town centre of Geesthacht is approx. 5 km away.

3.3 Land Use

In the Duchy of Lauenburg and Stormarn districts, the countryside of the Geest is almost exclusively used for agricultural and forestry use. In the districts of Harburg and Lüneburg as well as in the easternmost included part of the marshes and Vierlande belonging to Hamburg, there are, however, almost entirely marsh areas with very high proportion of agricultural land. Corresponding to the soil conditions, here also grassland usage is to be found on a large scale.

Characteristic surface water in the vicinity of the HZG site is the Elbe. It runs approximately in the south-east to north-west direction between Lauenburg in the south and Geesthacht in the north. There are also smaller natural and artificial watercourses (e.g. Elbe-Lübeck Canal), which flow into the Elbe. These rivers and other open waters in the vicinity of the HZG are also used for recreation, for inland navigation, for sports boat traffic or for sport fishing.

There are six nature reserves located within a radius of 10 km. Moreover, within this radius, there are natural reserves and areas, which, according to Natura 2000, are listed as a flora and fauna habitat area or as a bird sanctuary and offer special protection of the habitat.

The forests surrounding the site area are important for recreation associated with the landscape. The long-distant cycle route along the bank of the Elbe is also worth mentioning.

3.4 Commercial and Industrial Areas, Military Facilities

Several industrial areas are located within a radius of 10 km. To the northwest of the HZG site, for example, are the "Grüner Jäger" industrial areas with a quartz producer, a machine factory, a manufacturer of machine parts and a wholesaler as well as "Düneberg" with a larger number of industrial plants, such as electrical plants or machine factories.

In addition, there is the Krümmel nuclear power plant (KKK) in the north-west of the site.

There are no military installations within a radius of 10 km.

3.5 Traffic Routes

The Federal Highway 5 (B 5) connects the plant site to the city of Geesthacht and the town of Lauenburg. On the northern bank of the Elbe runs the Elbuferstrasse, from which several connecting roads to the B 5 branch out. The highway L 217 between Marschacht and Artlenburg runs at a distance of around 800 m along the southern bank of the Elbe.

The track system, which runs along the HZG, has been shut down and dismantled in the area of the radioactive waste storage facilities and the Disassembling Hall to be erected.

The Elbe shipping route passes the site directly in the Southwest. Due to the proximity to Hamburg, the easy access to trans-regional waterways and the North Sea the Elbe has a high traffic activity in terms of inland waterway.

Hamburg international airport (37 km Northwest), the airfield at Uetersen-Heist (54 km Northwest), as well as the landing sites of Lüneburg (17 km South-Southeast), Hamburg-Finkenwerder (41 km West-Northwest) and Lübeck Blankensee (48 km North-Northwest) are located within a radius of 50 km around the site.

Within a radius of 2 km of the site of the HZG and nuclear power plant Krümmel (KKK), and up to an altitude of about 670 m above sea level, there is an area with aircraft flight restrictions. An overflight ban exists for visual flight traffic in this area.

3.6 Meteorological Conditions

The climate is strongly influenced by the proximity of the North and Baltic Sea. Accordingly, maritime weather is dominating but during easterly winds also continental air masses become relevant. Typical there are relatively mild winters and often only moderately warm summers, usually with unsettled weather.

In recent years, there was a dominant prevailing wind direction from the south-west. Seasonally, the highest wind speeds are in winter (on average about 5.4 m/s) and autumn (4.9 m/s). The average annual precipitation amounts to 721 mm. Thermal inversion conditions occur mainly in the months of November to February.

3.7 Geological and Hydrological Conditions

The HZG site is located directly on the well wooded Geest Slope, consisting of sandy and gravelly deposits of the Saalian sub-glacial moraines and end moraines. The northern Geest slope, which extends from Hamburg-Bergedorf to Geesthacht, formed the former shore of the Elbe glacial valley. Incipient erosion created both ravine-like incisions into the Geest Slope both as low-relief and low-waterbody areas.

In this regard, the geology of the region has remained unchanged over the last millennia and extends from Hamburg-Bergedorf via Escheburg to Geesthacht.

The groundwater level is located at the site at the level of the Elbe water level. The Elbe is not influenced by the tide in the area of HZG anymore. However, the area influenced by the tide extends from its mouth into the North Sea near Cuxhaven to the weir in Geesthacht. The plant site is far above the groundwater level, due to its altitude.

At a distance of approx. 1.5 km from the site is the Krümmel water works with four delivery wells with a delivery depth between 70 m and 120 m. The drinking water recovery area extends from Kümmel in north-northeasterly direction to Schwarzenbek. The HZG-site is located approximately 500 meters southeast of drinking water recovery area. About 5.3 km to the northwest, other deep wells are to be found for public water supply to Geesthacht.

3.8 Seismic Conditions

The HZG site is located in the North German lowlands. The regional unit is not located in a seismic zone according to DIN EN 1998-1/NA:2011-01.

3.9 Radiological Initial Loading

The radiological situation at the HZG site is primarily influenced by:

- the Krümmel nuclear power plant (KKK),
- Krümmel interim storage site (SZK) and
- the dismantling of the FRG, the HL and the disassembling of the reactor pressure vessel of the nuclear ship Otto Hahn (RDB-OH).

The KKK and the SZK are located northwest at a distance of about one kilometre from the plant site. The discharge limits authorized for the operation of the KKK result in a radiation exposure below the limits defined in the StrlSchV. The Krümmel interim storage site has no influence on the radiological initial loading because of the distance to the HZG site. The potential contribution of the direct radiation is negligible.

The effective dose for the radiological initial loading induced by the KKK as a result of gaseous discharges is below the value of 0.1 mSv in a calendar year, taking into account the authorized maximum discharge values of the KKK.

On the HZG site are located several facilities (Supply Hall, HAKONA) and institutions (Federal State Collecting Facility) with a license for handling radioactive substances in accordance with § 7 StrlSchV (or § 3 in earlier versions). For these facilities no radioactive gaseous discharges are intended during normal operation. They have no ventilation systems which allow any systematic discharge from the respective buildings. Therefore, there is no significant activity emission from these facilities or installations. This also applies, even if activity concentration in the respective interior have exhausted the activity exemption levels of annex VII part D table 4 in conjunction with § 47 para. 4 StrlSchV.

The effective dose for the radiological initial loading by the KKK through the liquid discharges (HZG local area) is below 0.1 mSv in a calendar year, taking into account the authorized maximum discharge values of the KKK. In addition, possible other initial loadings from other plants and facilities are taken into account, such as research facilities and hospitals (e.g. through radionuclide emissions from patients in nuclear medicine).

For the distant area (Elbe downwards, tide region near Brunsbüttel), in addition the radiological initial loading of the power plants Stade (KKS), Brokdorf (KBR) and Brunsbüttel (KKB) are taken into account including their authorized maximum discharge values. The result is an effective dose value of less than 0.2 mSv per calendar year.

4 Information on Radioactive Waste

Radioactive waste should be stored in the TBH until its transfer to the Federal Final Disposal. This radioactive waste consists of existing operational waste as well as waste arising during the dismantling of the Research Reactor Plant Geesthacht (FRG) and the Hot Laboratory (HL). Below the anticipated activity inventories, waste masses, number and type of the waste drums are estimated or summarised.

4.1 Activity Inventories

A differentiation of the waste into dismantling waste and operational waste occurs from the operational history of the FRG and HL.

4.1.1 Dismantling Waste

Radioactive dismantling waste of the following material types occur from the dismantling of the FRG and HL:

- Regular concrete (tiles and pre-concrete from the reactor pool)
- Barite concrete (from the reactor pool and drill cores of the irradiation tubes)
- Ferritic steel (reinforcements, steel liners and containers)
- Stainless steel
- Aluminium
- Be (Beryllium) metal block reflectors
- Miscellaneous contaminated waste

The estimated total activity inventory of the FRG and HL is approx. 1.5 E15 Bq at the beginning of the dismantling.

4.1.2 Operational Radioactive Waste

The following material types are primarily to be considered as radioactive operational waste:

- Be metal reflectors
- Mixed waste (combustible, metallic & aluminium) in concrete cells 2 to 4
- Preparation (Tristan PA1, enclosed)

- Cs-137 preparation
- γ-absorber shields (4 pieces)
- Irradiation equipment (8 pieces) Z1–Z8
- Other operational waste in pool no. IV

The total activity inventory of the radioactive operational waste is approx. 2.5 E15 Bq.

4.1.3 Radioactive Waste to be Recovered

Radioactive and residual materials (mixed waste) resulting from the operation of FRG and HL have been partially conditioned externally in Karlsruhe (at WAK) and in Jülich (JEN). The conditioned radioactive waste should be recovered after completion of conditioning and then stored in the TBH until their transport to the Federal Final Disposal.

In addition, other waste drums from the research activities of the FRG and HL are also stored in the Supply Hall (BSH) on site. These drums should also be stored in the TBH in the future.

The total activity inventory of the radioactive waste to be recovered is approx. 2.4 E11 Bq.

4.1.4 Overall Activity of the Radioactive Waste

The total activity is determined from the total of the activity inventories and equals approx. 5 E15 Bq. The activity contributions are summarised in Table 4-1.

Table 4-1: Activity inventories und overall inventory (reference date 1.1.2014)

Waste	Activity inventory in Bq
Ferritic steel	9.2 E10
Regular concrete	2.8 E11
Barite concrete	5.6 E10
Aluminium	1.3 E10
Stainless steel	2.8 E13
Be metal block reflectors	1.5 E15
Tristan preparation	7.0 E14
Cs preparation	2.3 E12
Mixed waste	3.6 E13
γ-Absorber	1.0 E13
Radiation equipment	8.0 E13
Miscellaneous operational waste in pool no. IV	9.6 E12
Be metal reflector elements	2.5 E15
Recovery WAK/JEN*	1.7 E10
Recovery BSH*	2.2 E11
Total	**4.9 E15**

*Reference date 31.12.2015

The total activity is primarily caused by the nuclides H-3 (73 %), Sr-90 (13 %), Ni-63 (9 %), Co-60 (4 %) and Cs-137 (1 %). The activity distribution varies according to the different types of waste.

4.2 Expected Waste Volume

The expected waste volume/mass consists of the operational waste, the dismantling waste of the FRG and the HL as well as the conditioned radioactive waste to be recovered from Karlsruhe (WAK), Jülich (JEN) and the Supply Hall (BSH). The total radioactive waste mass is approx. 550 Mg. The number of individual contributions is summarised in Table 4-2.

Table 4-2: Presentation of mass distribution of the entire radioactive waste mass

Radioactive Waste:	**Approx. Mass (Mg)**
Dismantling of FRG and HL	300
Operational waste	147
Radioactive waste to be recovered	103
Total approx.:	**550**

4.3 Waste Containers

The low and intermediate active waste is packed into waste packages and stored in the TBH. The waste packages are generally produced outside of the TBH. For this purpose, the conditioned waste is separated into the corresponding waste containers according to type of waste (metals, concrete, etc.) and level of the radioactivity or dose rate. The waste will be fixed, if necessary. Finally the waste packages are tightly sealed.

Suitable waste containers are:

- 200-ℓ-, 280-ℓ-, 400-ℓ- and 600-ℓ-drums
- Container type I – IV
- Concrete container type I & II
- Cast iron container type I & II

A portion of the stored waste packages does not fully meet the requirements for final disposal yet (mainly barrel drums such as 200-ℓ-drums). They are transferred to final disposal-capable packages before their transport. To do this, the concerned drums in the TBH are packed into the corresponding final disposal-capable containers and fixed, if necessary. The requirements for the storage depending on the packages and the waste will be defined in the regulations of operation.

4.4 Expected Number of Waste Drums

Regardless of the activity, all radioactive waste was standardized to a container type III or IV. The layout of the storage areas of cast iron containers is not taken into account for this analysis. The estimated number of containers resulted in a value of 77 pieces.

5 Description of TBH

5.1 TBH Plant Facility

The TBH is located on the site of the building complex of the Research Reactor Plant, Hot Laboratory as well as other ancillary buildings and the plant fence. These are shown in Figure 5-1.

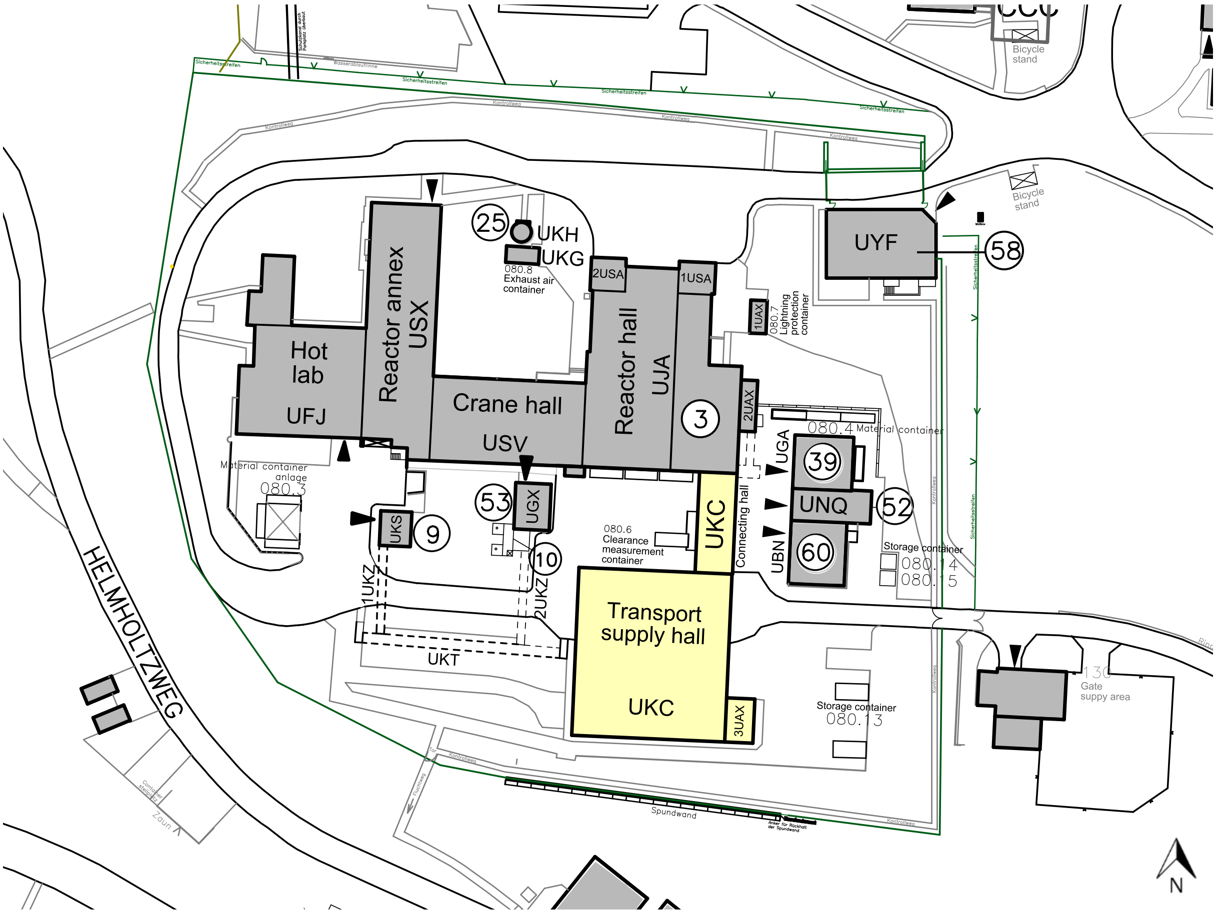

Figure 5-1: Location map of building and plant areas of FRG and HL

Table 5-1: Legend of buildings on the plant site

Building	ID	Name
03	UJA	Reactor hall
03	USV	Crane hall
03	USX	Reactor annex
03	UFJ	Hot laboratory with dosimetric annex
03	UKC	Connecting hall

Building	ID	Name
03	UKC	Transport supply hall
03	UKT	Service passage for radioactive waste water tanks
03	1/2UKZ	2 connective shafts to the radioactive wastewater tanks
09	UKS	Deco station
-	UKG	Exhaust air container
25	UKH	Vent stack
39	UGA	Well house
52	UNQ	Compressor building
53	UGX	Acid warehouse I
58	UYF	Guard building
60	UBN	Emergency power building

5.2 The TBH Building

In 1987, the existing “Old” Experimental Hall of the FRG was expanded by the “New” Experimental Hall to allow a better and larger experimental setup. After the shutdown of FRG-1, the experimentation equipment was handed over. After that, structural changes were performed in the area of the “Old” and “New” Experimental Hall in order to be able to use the “New” Experimental Hall as a TBH in future. The TBH should serve as the building for the storage of radioactive waste that results from the operation and dismantling of the FRG and the HL.

The external dimensions of the TBH are approximately 31.0 m × 28.0 m with a ridge maximum height of approx. 8.5 m. The effective area is 825 m². The hall has a deep foundation by reinforced concrete poles and bar grid due to the low permissible settlements. The permissible floor area load is increased in the northern area by a strip foundation (in area 2, see Figure 5-2).

The hall consists of a fire-retardant coated steel structure with walls made of horizontal aerated concrete wall panels as well as aerated concrete masonry. The roof consists of aerated concrete roof panels with a non-combustible heat insulation and a sealing.

There is a reinforced concrete firewall on the north gable of the hall.

The hall's floor has a decontamination coating to protect its surface from the penetration of contamination. Moreover, the base plate is designed as a tank for the retention of extinguishing water.

The TBH has a conventional independent ventilation system with supply air filtration. The exhaust air is discharges via the roof.

The TBH is equipped with a lightning protection system following the applicable provisions.

All containers and drums can be moved within the hall, also without the use of a forklift using the built-in double-girder bridge crane with a lifting load of approx. 22 Mg.

The interiors of the TBH as well as the surrounding site are electrically illuminated according to the general traffic safety requirements.

The TBH is sub-divided into three main areas:

- Area 1 (supply of barrel drums, containers and empty waste containers)
- Area 2 (supply of containers, concrete and cast iron containers or packages)
- Handling area / transfer area

Bumper buffer devices (ram protection) are installed at the handling and transfer area as well as at transfer area to the Connecting Hall. This ram protection prevents damages to stored drums and the steel structure from improper manoeuvring of forklift vehicles or panel trolleys at the transfer points.

The building has an entrance and exit for transport vehicles for container transport on the eastern and western sides in the handling areas.

In the southern part of the east wall, the engineering room (ventilation equipment, crane control etc.) is connected to the TBH. It is accessible from the outside.

Adjoined to the north side of the TBH, the Connecting Hall is connected to the Old Experimental Hall. It is used as a lock and access to the TBH. Here one can also find a clearance measurement system, an aerosol sampler, a wipe test measurement station and a hand/foot monitor.

The floor plan of the hall with adjacent engineering room and Connecting Hall to the Old Experimental Hall is shown in Figure.

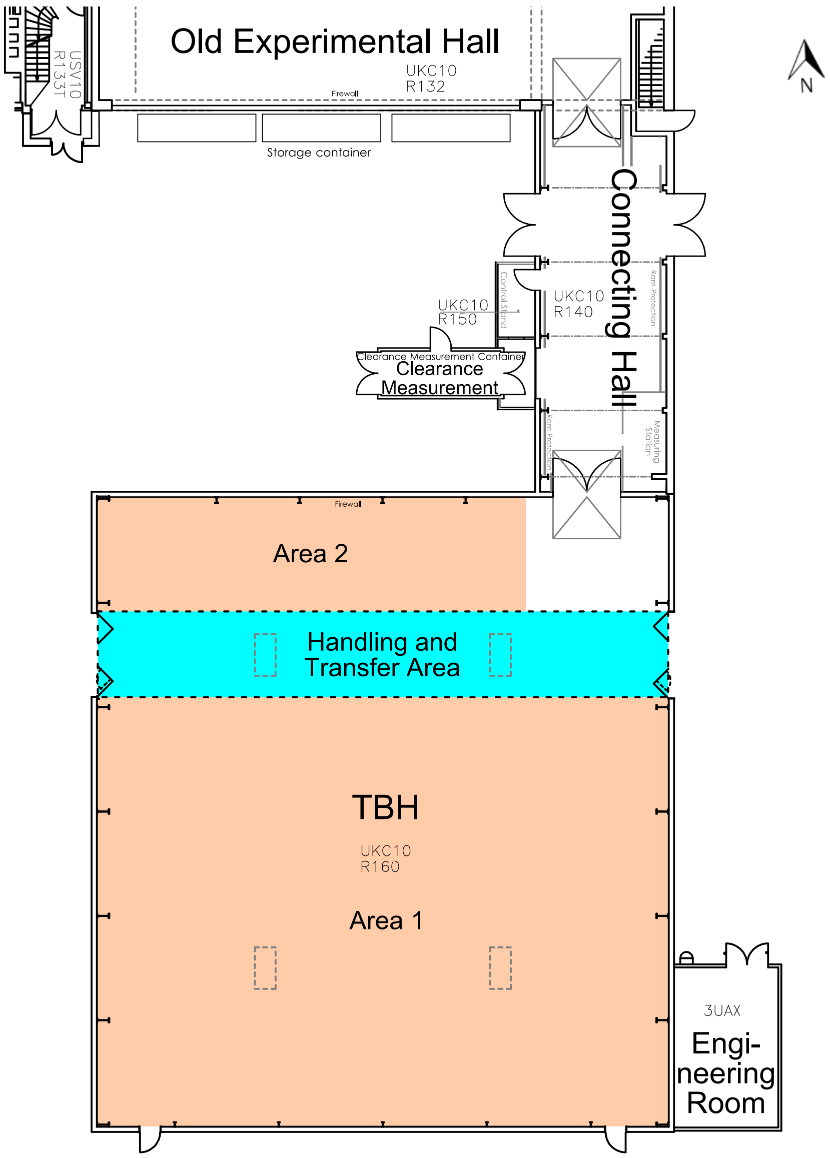

Figure 5-2: Floor plan of the TBH with adjacent engineering room and Connecting Hall to the Old Experimental Hall

5.3 Supply Capacity

With an area of 825 m² and double stacking, up to approx. 700 m^3 of low radioactive waste can be stored in the TBH. For this barrel drums or final disposal-capable containers and 36 shielding cast iron containers can be used. They are filled with non-heat-generating low and intermediate radioactive waste, cf. the floor plan and exemplary load configuration in Figure 5-3.

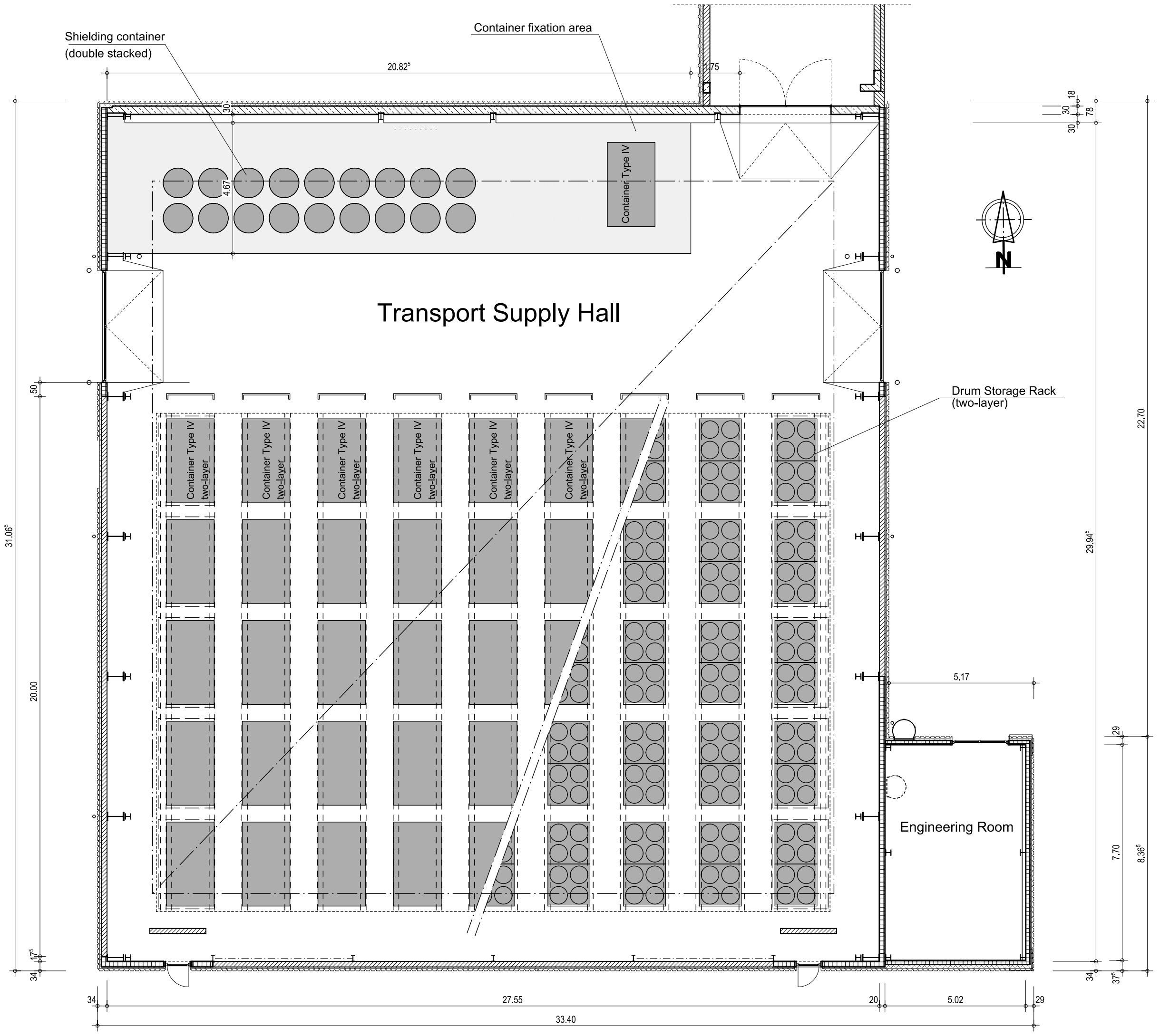

Figure 5-3: Floor plan of TBH with sample load

In an exemplary load configuration in the TBH can be stored by double stacking, 720 pieces of 200-ℓ-drums or 90 pieces of the Konrad containers of type III or IV.

Depending on the activity inventory of the radioactive waste, it is packed into cast iron containers type II or Konrad containers. Currently, 18 positions (double stacking) are assigned for the storage of cast iron containers type II within the TBH. If this area is not sufficient for cast iron containers, the storage area can be expanded by still unused storage area.

As long as storage areas are not used for the storage of waste packages in area 1, this area can be flexibly used for the storage of empty waste containers.

6 Operation of the Transport Supply Hall

6.1 Description of the Infrastructure

The operation of a TBH includes all required systems and equipment as well as all supporting activities which are required to maintain the remaining safety objectives and storage.

The following systems and equipment are required primarily for the operation of the TBH:

- Power supply
- Instrumentation and control equipment
- Fire protection
- Site protection
- Lighting
- Lifting gear / transport devices
- Communication equipment
- Ventilation systems
- Lightning protection
- Media supply and disposal
- Radiation protection instrumentation

6.2 Handling of Waste Containers for Storage and Disposal

Only packages with conditioned radioactive waste and empty waste containers are stored in the TBH. There is no handling of open radioactivity.

The waste packages are usually delivered individually through the Connecting Hall with fork-lifts or low platform trailers. They are transported with the corresponding lifting tackle and the double-girder bridge crane to the intended storage area.

Waste packages are moved with the double-girder bridge crane for their transport to the Federal Final Disposal or for reprocessing. For this the crane moves the packages to the loading and handling area for loading a low platform trailer or to the handling area nearby the gate to the Connecting Hall.

The transport of waste packages in the TBH with the double-girder bridge crane is always performed with a closed gate to the Connecting Hall and closed external gates and doors.

6.3 Loading and Fixation of Containers

A portion of the stored waste packages does not fully meet the requirements for final disposal (mainly barrel drums). They are transferred to final disposal-capable packages before their transport to the Federal Final Disposal.

The loading of empty, final disposal-capable containers within TBH is always performed with drums only. This is done at the container’s storage area, to the north of the hall passageway.

Cementing equipment optionally can be installed to load and fix the drums in the container.

6.4 Inspection of Waste Drums

The dose rate and surface contamination of the waste packages are determined and documented as part of the activity monitoring.

A check of the waste drums for potential damages is performed and documented at regular intervals.

The waste packages are checked again for their dose rate and surface contamination before their transport by road according to the requirement of the GGVSEB.

7 Radiation Protection

The radiation protection ensures the protection of the population, the environment and the personnel, who carry out the operation, from ionising radiation. The radiation protection principles “limitation of doses” as well as “avoidance of unnecessary radiation exposure and dose reduction for man and the environment” will be maintained.

The significant tasks of radiation protection are:

- Definition and monitoring of the radiation protection areas
- Radiation protection monitoring including the completion of the clearance procedure
- Radiation protection planning including dose assessment and residual material management
- Radiation and activity monitoring

7.1 Radiation Protection Areas

The radiation protection areas of the TBH are separated in accordance with StrlSchV into supervised and controlled area as well as temporary, changing controlled areas.

The entire FRG, HL and TBH complex is surrounded by a security fence. This fence represents the border of the supervised area. Structural and administrative radiation protection measures, such as shielding, filtering of the exhaust air or measures to prevent inadvertent dispersion of radioactive substances ensure the compliance with the radiation limits.

Controlled areas are areas surrounded by the supervised area, where persons can receive in accordance with the provisions of StrlSchV an effective dose of more than 6 mSv in a calendar year or an organ dose of more than that the values defined there. In case of need, temporary controlled areas will be established by the radiation protection officer. All controlled areas are delimited and marked with a radiation warning sign "CONTROLLED AREA", so an accidental entry cannot happen.

7.2 Radiation Protection Monitoring

Mobile radiation monitoring devices are available inside the TBH which can be used for everyday use. In addition, an aerosol sampler is used for the measurement of suspended radioactive particles in the air.

There are sufficient α-, β-and γ-measuring stations available for the evaluation of aerosol samples and wipe tests.

According to a fixed schedule, the rooms and packages will be monitored regularly through measurements.

A hand-foot contamination monitor will be used in order to recognise contamination carryover. It is located in the Connection Hall. Alternatively, a people screening is possible, by means of mobile radiation monitoring devices.

There are two independent dosimeters for monitoring occupationally exposed persons:

- Electronic dosimeter with a display for a daily monitoring
- Dosimeter of an official measurement department which will be evaluated regularly

7.3 Discharges of Radioactive Materials

7.3.1 Discharge of Gaseous Radioactive Materials

There is no handling of open radioactivity.

The maximum permissible activity concentrations are not exceeded for the discharge of radioactive materials with air from radiation protection areas in accordance with Annex VII part D StrlSchV on an annual average.

Therefore, it is possible to pass on the definition of activity quantities and activity concentrations for the dispersion of radioactive materials with air.

7.3.2 Discharges of Liquid Radioactive Materials

A technical application of water is not planned with the storage of waste packages or packing of containers. Therefore, it is not expected that wastewater will be discharged from the controlled area during normal operations.

7.4 Radiation Exposure

The potential radioactive exposure in the area surrounding the TBH comprises of the potential radiation exposure through the dispersion of radioactive materials with the exhaust air and by direct radiation originating from the plant.

Through the use of appropriate measures (shielding), an annual dose value of < 1 mSv can be maintained due to the direct radiation in the area accessible to the public.

In accordance with § 47 para. 4 it can be considered, that the discharge of radioactive materials complies to the limit values of Annex VII part D StrlSchV, if the activity concentrations for the discharge of radioactive materials by air or water from radiation protection areas are not exceeded as an annual average. It was shown that the values of Annex VII part D StrlSchV are not exceeded (cf. Chapter 7.3.1) and thus the potential radiation exposure is below of the limit value of 0.3 mSv per calendar year for the effective dose in the calendar year.

For the calculation of the potential radiation exposure, the resulting value for the effective dose per calendar year is approx. 3.2 E-02 mSv. This value applies to the most exposed age group infants (> 1 – ≤ 2 years) with the assumption of a complete exhaustion of the licensing values for the discharge of radioactive materials with the exhaust air. This value results almost exclusively from the radiological initial loading (cf. Chapter 3.9). The amount of the exposure which is caused by discharges from TBH, is considerably below < 1 E-03 mSv/a.

The most unfavourable receiving point is located at a distance of 1 100 m in sector 11 at the fence of KKK (for exposure path, external exposure and inhalation) or sector 12 northeast of the outdoor switchyard of KKK (Ingestion), see Figure 3-2.

The limit value of 0.3 mSv for the calendar year is also not exceeded taking the initial loading into account.

Operational measures ensure that the sum of the external exposure from the direct radiation and the exposure from discharges is safely below the limit for the effective dose according to § 46 StrlSchV of 1 mSv in the calendar year for individuals of the population at the border of the supervised areas.

8 Residual Materials and Waste

If radioactive residual materials occur upon cleaning / decontamination, they will be collected in containers and immediately removed from the TBH. The residual materials will preferably be measured for clearance in accordance with § 29 StrlSchV or treated at HZG, if possible. Therefore, the residual materials will be transferred to the appropriate areas of FRG or HL. Other waste than indicated above is not expected to accumulate.

The treatment and storage of radioactive residual materials may performed at external facilities, if possible and reasonable or if the FRG and the HL is not available any more. The residual materials will be packed according to the terms of delivery of the external service provider. For the transportation of radioactive residual material and radioactive waste on public traffic routes, in addition, the requirements of the GGVSEB (or GGVSee, if required) will be met.

The radioactive residual materials will be packed in suitable transportation packages. The packaging is performed in 200-ℓ-drums, if radiologically possible. Typical treatment processes are:

- Combustion
- High pressure compactation
- Dehydratisation
- Evaporation
- Solidification (e.g. cementation)

The treatment of radioactive waste is performed in accordance to the regulatory guideline on the control of residual radioactive material and radioactive waste as well as § 74 StrlSchV. Conditioned waste which is generated due to the treatment of residual materials during the operation of the TBH will be stored in the TBH until its transportation to the Federal Final Disposal.

During operation, the following measures are applied for the avoidance of additional radioactive residual materials:

- Avoidance of contamination carry-over
- Use of best practices, equipment and installations
- Objects and materials that are not required in the controlled area must not be taken in

The complete residual material and waste flow will be documented..

9 Accident Analysis

For planning, in accordance with StrlSchV, structural or technical protective measures shall be undertaken under consideration of the potential damage extent, in order to limit radiation exposure in the event of design basis accidents through the release of radioactive substances into the environment. The effective dose caused by the release of radioactive substances into the environment thereby must not exceed the so-called incident planning value of 50 mSv.

The estimation of the total activity inventory of the TBH including the operational waste resulted in a value of approx. 5.0 E15 Bq. The activity inventory is thereby almost completely trapped in the activated plant structures of the reactor pool installations, the reactor pool and operational waste and thus not directly releasable. Significantly less than 1 % of the total activity inventory is present as contamination.

The protection measures to be taken for the operation of a TBH are determined by the hazard potential which is still present in the plant and the probability of occurrence of an accident. The potential danger primarily results from the still existing unfixed activity inventory (essentially as a part of the contamination present in the plant), which can be released partially into the environment during accidents, e.g. during transport and when handling radioactive residual materials and waste.

For the following event sequences to be considered within the accident analysis for the TBH, the release of radioactive substances into the environment cannot be ruled out. These events are divided into two groups:

- Internal events:
  - Fire
  - Load drop
  - Leakages
  - Failure of radiation protection or supply equipment

- External events:
  - High water / flood, storm, heavy rain, ice and snow
  - Penetration of gases
  - Explosion due to chemical reactions
  - External fire
  - Earthquake
  - Aircraft crash (beyond design-basis)

The considered safety-relevant event sequences and their corresponding potential radiation exposures in the environment, result in values for the most unfavourable reference person in all cases, which is clearly below the incident planning value.

An earthquake which results in the destruction of the TBH constitutes a highly unlikely but comprehensive event with a resulting potential radiation exposure of 5.1 mSv. This corresponds to an exhaustion of the incident planning value of approx. 10 %. Thus, it has been shown that sufficient precaution has been taken against possible events.

Furthermore, an aircraft crash into the TBH is assumed as a very rare, beyond-design-basis event. The consequences of an aircraft crash are treated and evaluated as a beyond-design-basis event according to the provisions of the "Basic Recommendations for disaster control in the vicinity of nuclear installations". It was show that no drastic measures for the disaster control are necessary.

10 Impact on the Environment

Two environmental impact assessments (UVP) will be performed within the scope of the approval procedure of the “Decommissioning of the Research Reactor FRG-1 and Dismantling of the Research Reactor Plant and of the Hot Laboratory and the Disassembling of Reactor Pressure Vessel of Nuclear Ship Otto Hahn” and for the “Operation of a Transport Supply Hall (TBH)”. An environmental impact study (UVU) was performed as the basis for both environmental impact assessments. The UVU (environmental impact study) comprises the description and assessment of the effects of projects on the affected objects of protection:

- Humans, including human health
- Animals, plants and biological diversity
- Soil
- Water
- Air
- Climate
- Landscape
- Cultural heritage and other material goods

Possible significant or considerable negative effects through the project “Operation of a Transport Supply Hall (TBH)” on the objects of protection through the effect factors of conventional air pollutants, noise, vibrations, light and heat emissions, the utilization of land and sealing, the construction of structures, water extraction, drainage of conventional waste waters and the accumulation of radioactive and conventional wastes can be excluded. This is because the predominant part of the tasks is performed within buildings and the insignificant emissions are not able to cause any relevant additional effects.

Direct radiation at the plant fence is continuously monitored. Through operational measures it is ensured that the total radiation exposure from discharges with exhaust air and waste water as well as through direct radiation safely does not exceed the limit value of the effective dose of 1 mSv/a for an individual in the population.

In summary, it can be stated that significant or considerable negative effects of the project on objects of protection, especially for the people and the environment, are not expected.