ON-SITE TRANSFER AND STORAGE OF SPENT FUEL IN CASTOR® CASKS IN GERMANY

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ABSTRACT

On-site transfer and storage of spent fuel in CASTOR® casks will become more and more important in Germany because storage facilities will go into operation at each NPP site by 2005. Up to now, there have been on-site transfers of spent fuel casks to an external wet storage facility, transfers between pools to optimize pool storage capacities at sites with 2 reactors, and transfers to dry storage facilities at some NPP sites. Some special safety features, that differ from regulations for transport on public roads have to be considered in these cases, e. g. drop accidents without shock absorbers, radiolyses during wet transfer, tightness control during storage. No relevant safety problems appeared during the transfers and the storage carried out up to now.

INTRODUCTION

Up to now, reprocessing and direct disposal have been accepted as equal options for spent fuel management in Germany. But, according to the consensus agreed upon by the red/green government and the utilities, reprocessing will be terminated and spent fuel shall be transported under the existing reprocessing contracts until 2005, at the latest. After fulfillment of the contractual obligations with COGEMA and BNFL, it is the intention of the government to minimize transports on public roads/railroads. Therefore, storage facilities will be erected at all NPP sites by 2005.

Besides an external wet storage facility operated since 1999 at the Obrigheim NPP (KWO), at all other NPP sites dry storage facilities for transport and storage casks will be used. In preparation of this, medium-term-storage garages are operated at some NPP sites and other sites have applied for licenses to operate them, too.

In the following the different spent fuel strategies directed to on-site storage are introduced. Facilities and casks in operation are described and experiences with respect to on-site transfer of spent fuel in transfer or in transport and storage casks of CASTOR® types are presented.

ON-SITE SPENT FUEL STORAGE IN GERMANY

According to the consensus agreement between the red/green government and the NPP operating utilities transports of spent fuel to the reprocessing facilities in France und England will be finished in 2005. The same applies for the centralized storage facilities Ahaus and Gorleben.

The spent fuel management policy will be to store spent fuel assemblies on-site. Therefore, all NPP operators, except Obrigheim NPP, where a wet storage facility is in operation, applied for storage licenses for dry storage facilities using transport and storage casks. As usual in mid and western Europe the casks will be kept in storage buildings (see Figure 1). At the

Neckarwestheim NPP there is not enough space for a storage building. Therefore, a tunnel into the adjacent precipitous rock will be used.

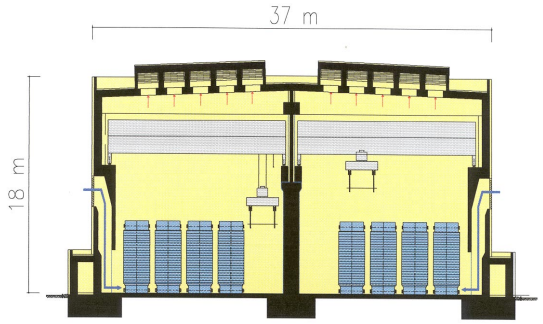

Figure 1, Cross Section of a Typical Storage Facility for Transport and Storage Cask

These storage facilities have to be erected up to mid 2005. To cover the urgent need up to this date some operators applied for short term storage facilities consisting of a concrete pad and casks lying on a storage frame which are shielded by movable concrete garages (see Figure 2).

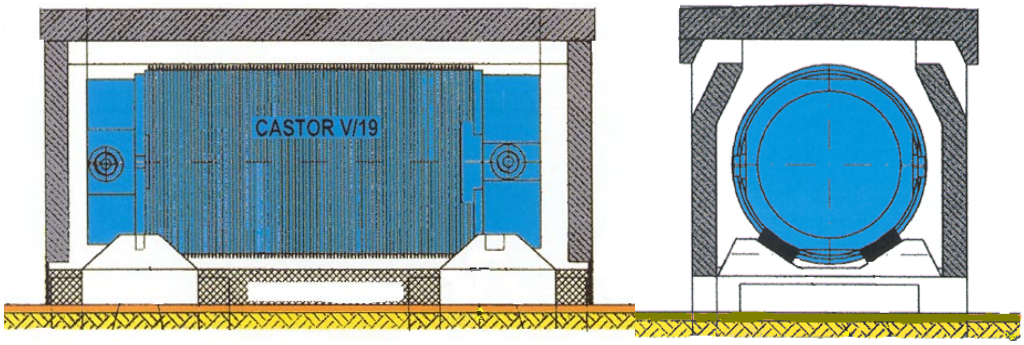

Figure 2, Cross Section of a Concrete Garage around a Transport and Storage Cask

The status of all the license procedures is listed in Table 1.

NPP Site	NPP	Storage Facility	License Status
Biblis	PWR/PWR	Garages (short term) Building (40 a)	Public hearing finished Public hearing finished
Brokdorf	PWR	Building (40 a)	Public hearing finished
Brunsbüttel	BWR	Garages (short term) Building (40 a)	Public hearing finished Public hearing finished
Grafenrheinfeld	PWR	Building (40 a)	Applied for
Grohnde	PWR	Building (40 a)	Public hearing finished
Gundremmingen	BWR/BWR	Building (40 a)	Public Hearing in October
Isar	BWR/PWR	Building (40 a)	Applied for
Krümmel	BWR	Garages (short term) Building (40 a)	Public hearing finished Public hearing finished
Lingen	PWR	Building (40 a)	Public hearing finished
Neckarwestheim	PWR/PWR	Garages (short term) Tunnel (40 a)	Licensed Applied for
Obrigheim	PWR	External wet pool	Licensed
Philippsburg	BWR/PWR	Garages (short term) Building (40 a)	Licensed Public hearing finished
Stade	PWR	Building (40 a)	Applied for
Unterweser	PWR	Building (40 a)	Public hearing finished

Table 1, License Status of On-site Storage Facilities (as of August 1, 2001)

Up to now, on-site transfers of spent fuel assemblies in CASTOR® casks have been carried out at Biblis, Neckarwestheim, Obrigheim and Philippsburg. The details of the different types of on-site transfers and storage are described as follows:

FUEL TRANSFER INTO THE EXTERNAL WET STORAGE FACILITY AT OBRIGHEIM NPP

The Obrigheim NPP is the oldest operating commercial NPP in Germany. The internal NPP pool has 230 positions of fuel assemblies. Since 1999 an external pool with 980 positions is licensed.

Because of the limited load capacity of the material lock in the NPP only casks with maximum weight of 80 MT can be handled. Therefore, a CASTOR® Ib with the capacity of only 4 fuel assemblies is being used.

To date, 29 transfers have been carried out, thus 116 fuel assemblies (incl. 24 MOX-FA) are stored in the external pool. Figure 3 shows a view into the pool. The pool with the fuel assembly racks in the upper and the cask position on the lower left hand side and the CASTOR® Ib on the right hand side can be seen.

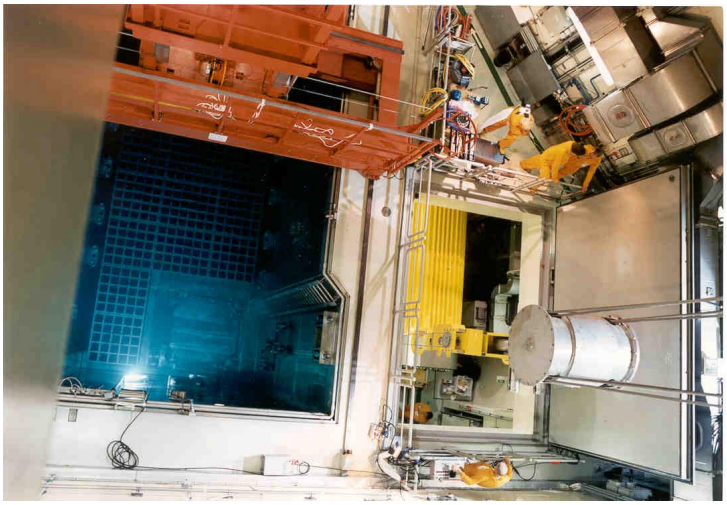

Figure 3, External Pool at Obrigheim

POOL-TO-POOL FUEL TRANSFERS AT NECKARWESTHEIM AND PHILIPPSBURG NPP

There are two sites with an older NPP with a small pool and a low crane capacity and a newer one with a higher pool and crane capacity (see Table 2). At both sites fuel assemblies are transferred from the older NPP to the other NPP in order to compensate a lack of positions, to extend the necessary cooling time prior to loading and storage and, finally, to use storage casks of higher payloads.

Site	**Neckarwestheim**		**Philippsburg**	
NPP-Type	**I: PWR**	**II: PWR**	**1: BWR**	**2: PWR**
Start of Operation	1976	1989	1980	1985
Pool Capacity [FA]	310	786	948	897
Crane Capacity [MT]	80 *	127,5	80	140
Transfer Cask	CASTOR® IIb		CASTOR® Ic	
Cask Capacity	8 PWR-FA		16 BWR-FA	
Transports carried out up to July 31, 2001	20		11	

* Now upgraded to 120 MT

Table 2, Pool-to-Pool Transfer at Neckarwestheim and Philippsburg NPP

A speciality is the storage of BWR-FA of KKP 1 in the PWR-pool of KKP 2. Today, there is one rack with 169 positions for BWR-FA installed. This allows an additional cooling time of about 1.5 years of the BWR-FA.

FUEL TRANSFERS TO DRY STORAGE FACILITIES

As mentioned above, at some sites it is planned to store transport and storage casks in concrete garages until the long-term storage facilities go into operation by 2005. To date, the Neckarwestheim and Philippsburg NPP have received such a license for 24 resp. 12 casks of the type CASTOR® V/19. Six of these casks have been loaded and are stored (see Figure 4) at the Neckarwestheim NPP, whereas one cask is loaded and stored at Philippsburg NPP.

Figure 4, Six Concrete Garages for Storage of CASTOR®V/19 Casks at Neckarwestheim NPP

At the Biblis NPP a license is granted for a short term storage period. At present 6 casks of the type CASTOR®V/19 are loaded according to the criteria of the transport approval and the storage license of the centralized storage facility Ahaus or Gorleben. All 6 places in Biblis are used (see Figure 5).

Figure 5, Concrete Garages for Storage of CASTOR®V/19 Casks at Biblis NPP

SAFETY FEATURES

The transfer of casks with spent fuel assemblies at the NPP site requires the consideration of some special safety issues which do not arise during transport on public roads/railroads of these casks.

- *Radiolyses*
  During the pool-to-pool transfer the casks cavity remains partially filled with water. Due to the radiation a hydrogen formation by radiolyses has to be considered. Detailed evaluations of this effect have shown that a large amount of hydrogen will be recombined to water. This means, for the conditions of the transfer that a pressure build-up can be limited to values below 0.1 MPa, and the risk of an explosive gaseous mixture with hydrogen can be excluded.

- *Accidents scenarios: Drop from greater heights without shock absorbers*
  Due to the handling conditions at the NPP the cask has to be elevated to heights up to 25 m without shock absorbers. In some cases a drop of the cask due to a failure of the crane or the handling equipment can not be excluded.
  For the drop scenario of a cask at the NPP several evaluations were performed, which take either the real characteristics of the impact area or additional impact limiter on ground into account. It could be shown that the loads at the cask components during a drop from up to 25 m onto realistic (yielding) impact areas are lower than during drops from 9 m height onto an unyielding target according to IAEA requirements for transport.

- *Dose rates*
  During on-site cask transfers it is not necessary to fulfill the dose rate requirements of IAEA regulations. Therefore, with corresponding safety measures, fuel assemblies with significantly shorter cooling times than allowed by the transport approval can be loaded into the cask

- *Temperatures*
  Similar to dose rate, the cask and inventory temperatures have not to be considered under IAEA conditions (e. g. 38 °C ambient temperature). Instead of that, the ambient temperatures can be limited to reasonable side-specific values and the short transfer time can be taken into account. Thus, the maximum heat load can be increased compared to the transport approval.

- *Tightness control*
  As usual, for storage casks of CASTOR® type the tightness control is performed by controlling the pressure between the primary and the secondary lid, which is increased compared to ambient and cask cavity pressure. But, because this pressure will change only very slowly and because the double barrier system will prevent any activity release, the control measurements for the short term storage facilities will be performed in a four week period, only.

SUMMARY

Up to now, on site transfers of spent fuel assemblies at sites with operating NPP in Germany have been carried out at 4 NPP sites. These transfers have been carried out successfully under operational and economic aspects. The safety requirements have been met during the handling and measures with the on-site transfers of CASTOR® casks and storage of spent fuel assemblies.