Packaging for Transport of the ILW-LL of EDF First Generation Power Plant Dismantling – 16517

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ABSTRACT

EDF has a first generation decommissioning plan involving different types of reactors: Heavy Water Reactor, Natural Uranium and Gas Cooled Reactor, Fast Neutron Reactor and Chooz-A the first Pressurized Water Reactor (PWR) of the French decommissioning plan. The dismantling of these first generation reactors produces various types of radioactive waste, the most radioactive of them being the intermediate-level long-lived waste (ILW LL). After cutting and/or extraction from the reactors, these ILW LLs have to be transported to the EDF Conditioning and Storage Facility for Activated Waste ICEDA where they will be temporarily stored until a final depository solution is built. To transport these irradiated and contaminated metallic wastes, EDF decided to give ROBATEL Industries the responsibility of designing a new B- type package and obtaining the associated approval from the French Nuclear Safety Authority (ASN). A lot of issues had to be overcome to comply with the nuclear transport regulations and answer the ASN and its technical support IRSN's questions. Among them, was the difficulty to have a single type of package to transport unblocked waste coming from reactors of different technologies, sites in different stages of decommissioning and using different methods of waste production, conditioning and control. In the end, EDF had to apply for a specific approval for each dismantling site. These difficulties, some other technical issues encountered, and the decision to get first an approval for the transport of Chooz A's ILW LLs, are described here.

INTRODUCTION

France's nuclear fleet consists of 58 Pressurized Water Reactors. EDF is the only operator of the French nuclear power plants. EDF also has a first generation decommissioning plan involving different types of reactors: Heavy Water Reactor, Natural Uranium and Gas Cooled Reactor and Fast Neutron Reactor. Chooz-A is the first Pressurized Water Reactor (PWR) of the French decommissioning plan.

In France, a single public body is in charge of the long-term management of all radioactive waste, under the supervision of the Ministry of Ecology, Energy, Sustainable Development and the Sea, and the Ministry of Research: The National Radioactive Waste Management Agency or ANDRA. ANDRA has defined different classes of nuclear waste in order to assess their radiological risk.

The decommissioning of this first generation of reactors produces various types of radioactive waste, the most radioactive of them being the intermediate-level long-lived waste (ILW LL) from the reactors' cores. Those wastes are destined to be stored in the final repository solution CIGEO when it is built. In the meanwhile, they will be stored in the EDF Conditioning and Storage Facility for Activated Waste, ICEDA. The dismantling of the reactors' cores also generates intermediate and low level short-lived wastes (ILLW SL), for which the dedicated repository is the ANDRA Low Level Waste repository. Some of these short-lived wastes will be directly shipped there from the waste production site with IP2 packaging, whereas some of them exceeding the IP2 dose rate criteria will have to be transported in a B-Type packaging to ICEDA where they will be conditioned and wait for the IP2 transport criteria to be reached.

The initial objective of EDF was to develop a unique model of B-type package to transport these irradiated and contaminated wastes coming from all the first generation reactors. This was a difficult aim given the diversity of technologies, the different stages in decommissioning, and the sites' variety of methods of waste production, conditioning and control.

EDF decided to give ROBATEL Industries the responsibility of designing this new B-type packaging and obtaining an approval from the French Nuclear Safety Authority ASN. A fleet of R73 packaging was built to answer the decommissioning planning needs.

DESCRIPTION

R73 physical description

The R73 cask is a Type B(U) package [1] et [2] specifically designed to evacuate the metallic ILL waste from the EDF First Generation nuclear dismantling sites to the centralized repository installation (ICEDA, located near Bugey, 69-France). With a gross weight close to 24 tons, it can carry up to 2 tons of radioactive waste either by road or by rail.

The wastes are loaded in a cylindrical metallic basket itself placed into the cylindrical cavity of the cask. This cavity (dimensions are about 1 m in diameter and 1 m high) is then blocked by an intermediate shielded plug and finally sealed by a closure lid fixed by bolts (cf. Fig. 1).
For the transports, the package's body is protected by two shock absorbers fixed to its lower and upper extremities. They aim at limiting the impacts in case of accident (especially for the regulatory 9 m drop tests on a rigid target) and also ensure thermal protection in case of a fire.
The overall design of the R73 packaging is shown in Fig. 1: its overall dimensions are approximately 2.2 m in diameter and 2.4 m high (its main features are detailed in Table I). The R73 package is transported in the vertical position thanks to a specific and dedicated transport frame (as shown in Fig. 2).

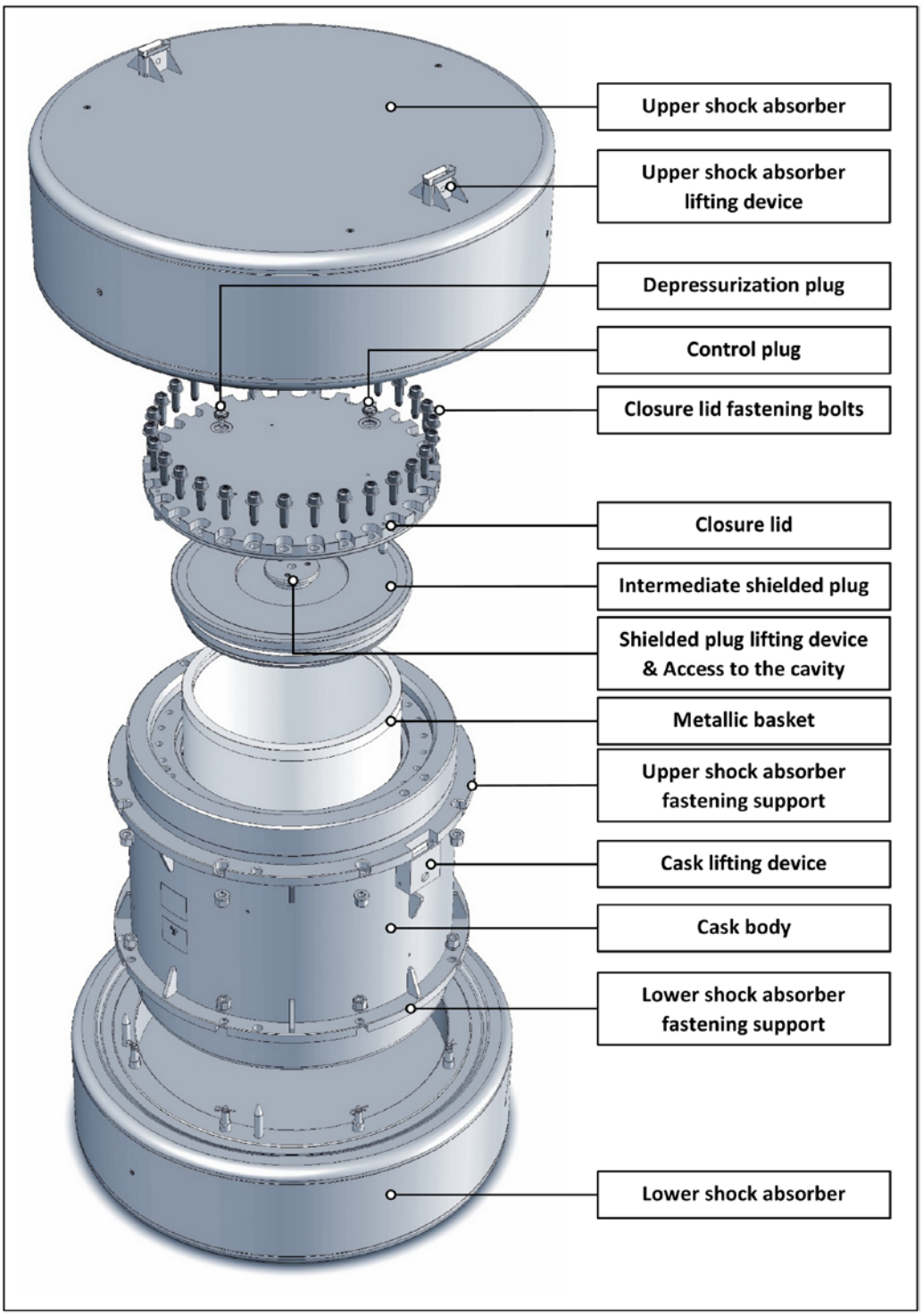

Fig. 1. R73 packaging – Overall view.

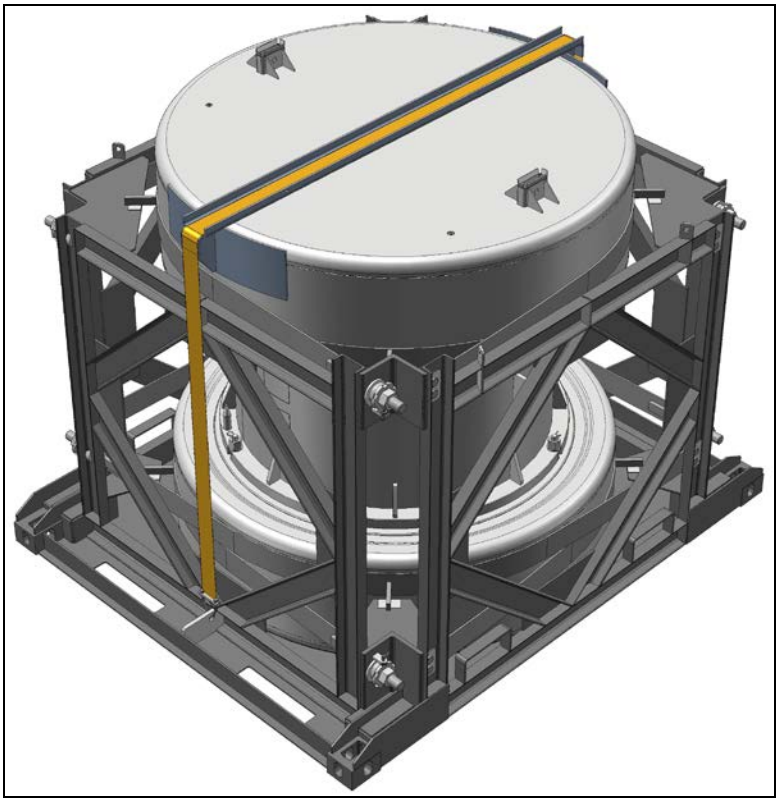

Fig. 2. R73 package within its transport frame.

TABLE I. Main data related to the R73 packaging.

Characteristics	Unit	Values
Main dimensions:		
Overall height	mm	2 370
Overall diameter	mm	2 210
Gross weight	kg	24 100
Loading capacities:		
Cavity height	mm	935
Cavity diameter	mm	1 040
Cavity volume	L	790
Maximum payload	kg	2 000
Main protections:		
Radiological shielding: *(lead equivalent)*		
– Side	mm	> 220
– Upper side	mm	> 270
– Lower side	mm	> 185
Thermal protection *(PNT7™)*	mm	30

R73 main specificities

The R73 package is dedicated to the transport of decommissioning waste. This has led to specific needs in terms of operation and safety functions.

First of all, because the evacuated waste would likely be very mixed (in terms of geometries as well as in terms of activity levels), one of the specificities of the R73 packaging is its large containment enclosure surrounded by a high radiological shielding (cf. Table I). This feature enables the cask to carry large loadings without specific constraint on either the packing plans, the wastes positions or their geometries. They may be thus loaded “in bulk” inside the packaging’s cavity. Even if the operator always tries to optimize the package loading in order to minimize the number of packages and transports that are necessary to evacuate all the waste, the way to achieve this goal can be chosen freely.

Secondly, in order to minimize the operator’s exposure during the loading/unloading steps, the packaging has been equipped with an intermediate sealed and shielded plug in addition to its closure lid. This design thus enables the opening of the cask’s cover while maintaining a significant level of shielding and containment during for instance either operations that would require access to the inner cavity, or the wait before the cask is connected to cells for loading or unloading.

DISCUSSION

The fleet of casks was produced in 2008. Given the difficulty of the licensing, the initial approval was obtained in 2015. Until then, several demonstrations had to be made and technical difficulties overcome. Those were dealing both with the content and with the whole package.

Difficulties to be overcome during the package approval

Several technical challenges had to be overcome to comply with the transport regulatory requirements. They mainly dealt with the nature of radioactive material involved. As the wastes were to come from the dismantling (current and/or future) of various facilities (and/or equipment), their description could not be as detailed and extensive as generally expected. This led to 2 main difficulties.

The first one had to do with defining the allowable contents limitations within the Package Design Safety Report (so called PDSR) given the waste’s properties, control possibilities and safety assessment needs.

Because of the different origins of the wastes, some specific demonstrations had to be made for certain types of waste. For example, when the dismantling is performed underwater, the waste has to be dried and the radiolysis issue has to be dealt with, which is not the case for waste coming from air-dismantling sites. Another example is that, different reactor technologies implies different materials to

transport. In the case of Natural Uranium and Gas Cooled Reactors for example, the non explosiveness of graphite dust particles present on the waste has to be demonstrated to the Safety Authorities.

The second difficulty had to do with EDF's wish to minimize the constraints on the waste packing plans. For instance, the will to allow bulk loading implies that the waste could not be blocked, which led to issues related to the wastes' possible movements inside the cavity. Especially, their ability to potentially damage the containment's enclosure or the package's closure system had to be studied. The bulk loading also led to difficulties in the demonstration of compliance with the radioprotection criteria.

Having said that, the challenge was then to justify the compliance of the package with regulatory requirements whatever the conditions and uncertainties related to its content.

Positioning set up to get the approval

Given the difficulties defining a generic allowable content and dealing with the specificities of each site's waste, the decision was made to dissociate the sites and to apply for a separate authorization for each of them. Chooz A PWR was the first to get approval in 2015 for the transport of the long-lived and short-lived (non transportable in IP2 packaging) core reactor wastes to ICEDA.

In order to obtain this authorization, the existing lids had to be modified to demonstrate the package's continuing licktightness in case of delayed impact of its contents on the closure lid in accident conditions.

In addition: highly conservative hypothesis had to be taken on released gas and aerosols, a radiological criteria based on the sum of the dose-equivalent rate of the loaded wastes was defined in the approval, and radiolysis calculation were made to define an allowable water content inside the package.

CONCLUSIONS

Experience shows that the getting of a B-type approval requires a perfect definition of the radioactive objects to be transported and a good knowledge of the control methods set up to insure the respect of the allowable contents limitations. This explains why getting a regulatory approval is a difficult project in the decommissioning field where the nature of the waste is becoming more and more precisely known only as the decommissioning progresses.

In our case it was necessary to dissociate the sites and to apply for a separate approval for each of them.

More generally, the delay to get an approval of a new B-type package, generally between 3 and 6 years, and sometimes more for the complex files, is an important parameter to take into account for each nuclear project.

REFERENCES

1. AIEA – TS-R-1, Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2009).
2. ADR – Accord européen Relatif au Transport International des Marchandises Dangereuses par Route (2013).