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ENSA EXPERIENCE ON THE DUAL PURPOSE CASK-DPT

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SUMMARY

This article explains ENSA performance and experiences on cask design, licensing and manufacturing. It mainly describes the activities on the Trillo Dual Purpose Cask for 21 fuel element assemblies. This cask will be the first dual purpose cask to be certified by the US NRC and an European Country.

INTRODUCTION

Over the past several years, Equipos Nucleares, S.A. (ENSA), under contract with ENRESA (company responsible for the management of all kind of radioactive waste in Spain), has been involved in the design and development of the NAC-STC, a transport and storage cask for light water reactor (LWR) fuel, which has been licensed at the end of September 1994 by the US Nuclear Regulatory Commission (US-NRC) for transporting fuel assemblies from a store facility to repository or, conceivably, to a reprocessing facility. License application for storage is under evaluation by the USNRC and the award of storage license is expected during 1994.

The participation of ENSA in the NAC-STC project has increased ENSA capabilities, improving experience and knowledge in design, licensing and manufacturing of storage and transport casks.

Nowadays ENSA, under contract with ENRESA, is leading the design and licensing of a dual purpose cask for the spent fuel of the Trillo nuclear power plant, known as the DPT cask. The DPT will be the first cask to be used in Spain as part of the ENRESA plan to dry store spent fuel assemblies from nuclear power plants in Spain. The objective of the DPT cask is to store spent fuel for an extended period of time - up to 40 years - and then transport the fuel sometime in the future to the repository or reprocessing facility without having to place the cask back into the reactor spent fuel pool and removing the fuel. The year 1995 has been established as an objective to accomplish the following goals: design, testing, storage and transport licensing as well as to begin the manufacturing of the first set of casks.

T I
DPT design criteria

Fuel Assembly Type	KWU 16x16 - 20
Enrichment, w/o U-235	4.0
Burnup MWd/tU	40,000
Cooling Time, yr	5.0
Decay Heat, kW/assembly	1.16
Total Design Heat, kW	24.36
Payload (Fuel assembly)	21
Maximum Weight (t)	120

T II

DPT Main Characteristics

CASK BODY	
Cask Cavity i.d.	1679 mm
Cask length	5024 mm
Outer Diameter	2359 mm
Inner Shell	40 mm
Lead Gamma Shield	104 mm
Outer Shell	70 mm
Neutron Shield (NS 4FR)	120 mm
Thermal fins	
- cooper	6 mm
- SS	8 mm
Outer Skin	6 mm
Bottom End - inner	158 mm
- NS4FR	50 mm
- outer	138 mm
Lift Trunnions	bolted
Rotational Trunnions	welded
CLOSURE LIDS	
Inner Lid (Double metal Seals)	200 mm
Outer Lid (Double metal Seals)	141 mm
Shielding Cover (Only for storage)	
- NS4FR	25 mm
- SS shells	13 mm
Impact Limiters	**redwood balsa**
TOTAL WEIGHT	**115 (t)**

TRILLO DUAL PURPOSE (DPT) DESIGN EXPERIENCES

ENSA set up a group of experts to perform the design of dual purpose casks, taking as a basic reference the already designed NAC-STC cask which was under licensing process by the USNRC.

The ENSA-DPT will be qualified for use in two types of scenarios. One is for storage of spent fuel at a licensed reactor site for an extended period of years, followed by transport to any other licensed site, where it may again be stored for an extended period. This versatility results in unique operational features to meet all the requirements for storage and transport.

Demonstration of containment integrity is the key in this regard. The design features and operational requirements that allow such use of the DPT cask involve the performance of:

- Thermal and Structural analyses
- Containment analysis
- Nuclear Criticality analysis
- Nuclear Shielding analysis
- Drop and Puncture Testing
- Storage and Transport Licensing documents preparation to demonstrate compliance with regulations requirements.

ENSA has performed the thermal, structural and containment analyses. NAC has performed, under contract with ENSA, the nuclear analyses: fuel source terms definition, criticality and shielding. ENSA let a contract to AEA Transport Technology at Winfrith (UK) in February 1993 for testing a quarter scale model of the DPT, designed and manufactured by ENSA, together with several pairs of end impact limiters.

Empresarios Agrupados (a Spanish engineering company) has acted as support engineering to ENRESA.

The DPT cask has been designed to comply with IAEA (Safety Series Nº 6) and US (10 CFR 71) transport regulations and US (10 CFR 72) storage regulations and ENRESA Technical Specification.

Both sets of transport regulations require tests to demonstrate survival in a variety of impact accidents without leakage of the radioactive contents, enhanced external radiation or a risk of criticality.

Table I summarizes the design criteria of the DPT cask. Table II and Figure I show the main characteristics of the DPT cask.

The design criteria are the result of considering the limiting parameters associated with the plant layout, maximum crane load capacity and fuel characteristics of the Trillo power plant.

Several computer codes have been used during the analysis of the DPT cask, as shown on Table III.

Results from the analyses performed demonstrate that the transport requirements envelop those for storage. Complying with transport regulations has been the goal to be met.

TRILLO DUAL PURPOSE (DPT) LICENSING EXPERIENCES

The Spanish regulations require to homologate with the Spanish authorities any container to be used on nuclear activities.

The authorization is provided by the Industry Ministry, with the binding advise of the Consejo de Seguridad Nuclear (CSN).

ENRESA is seeking the Authority approval of the Trillo Dual Purpose and has agreed to get such approval in two steps: storage and transport.

ENSA and NAC are acting as technical supporters and the first round of comments with the authorities is already over. We do have the hope to get the storage release within the present year and we also expect to get the transport release by the middle of 1995.

The Trillo Dual Purpose Cask will then be the first European Dual Purpose Cask released by an European Country. This achievement should be added to the fact that the "STC reference cask" will also be the first Dual Purpose Cask to be certified by the NRC for the USA market. (Transport Certificate already issued).

The licensing system followed with the Spanish and American authorities may become a reference for future homologations, and locate ENSA/NAC team as an experienced one in dealing with international licensing systems.

MANUFACTURING EXPERIENCES

ENSA has been involved in dry storage containers manufacturing activities since 1986. The first manufacturing activities were carried out during the construction of the first set of 3 instrumented canisters supplied to Carolina Power and Light in the US. These three canisters were the model demonstration to monitor the achievement of design hypothesis.

T III

Computer Codes used in the DPT Analysis

TYPE OF ANALYSIS	COMPUTER CODES
Thermal & Structural	ANSYS (2D and 3D models) DYNA 3D SCOPE SCANS (for preliminary design)
Sources Terms	SAS 2 (H) sequence of SCALE
Criticality	CSAS (including KENO Va Monte Carlo of the SCALE calculational sequence)
Shielding	- SAS 1 sequence (including XSDRNPM/XSDOSE) - SAS 2 (H) sequence (including ORIGEN II) - SAS 4 sequence (including XSDRNPM/MORSE Monte Carlo)
Impact Limiters (Shock Absorbers)	RBCUBED (a NAC computer code to predict cask acceleration and loads)

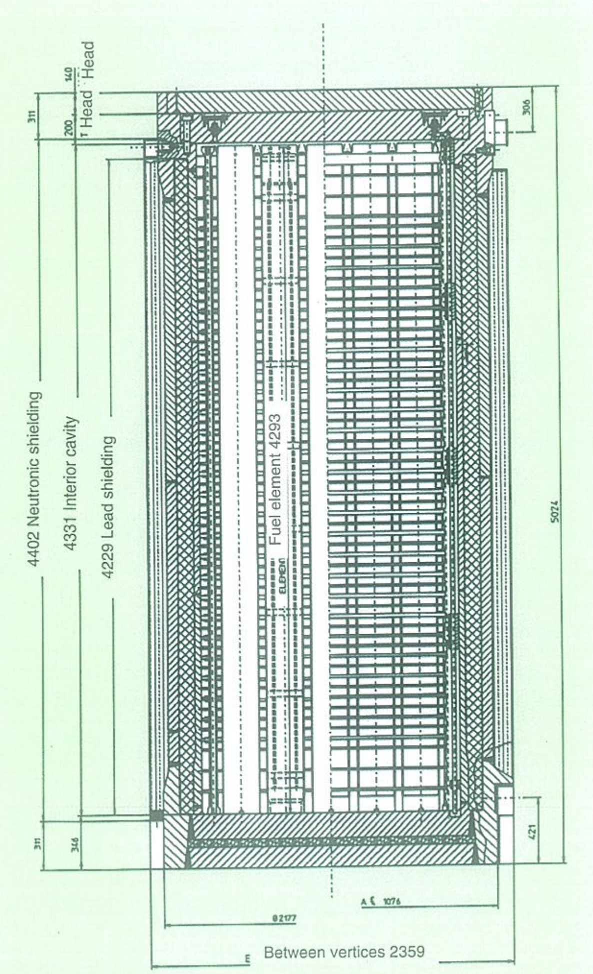
These initial activities were followed by additional orders to manufacture up to 18 additional canisters, transport and transfer casks, and storage casks under different designs and requirements.

As part of ENRESA program to guarantee cask feasibility, ENSA has recently manufactured a 26-PWR element storage cask which basically has similar manufacturing requirements and difficulties as the DPT design.

It has to be noted that cask manufacturing activities have to be performed under the requirements of a nuclear component manufacture and therefore it has to comply with a Product Assurance Program, to meet ASME code requirements Section III - NB and to comply with 10CFR50 and 10CFR21 requirements.

The cask manufacturing has two clearly different approaches: body and basket constructions. In both cases ENSA is mainly using stainless steel materials type 304 but thickness and processes are quite different: the body involves activities of longitudinal and circumferential automatic welding, machining of medium sized forgings, sophisticated neutron absorber and, lead pouring processes, radiographic and gamma testing skills, knowledge on small thickness plate welding, handling and deformation controls and meeting strict welding and dimensional requirements.

F I *ENSA - DPT Cask*



The most critical manufacturing steps are the following:

Regarding the cask, due to the high dimension restrictions, the most critical point is to maintain the component within tolerances.

This is specially difficult with the inner cask cavity, since its diameter must be very precise and continuous along its 4 meters depth, as it affects the very accurate gap necessary between

Cask and basket, and the shells concentricity, as it defines lead thickness and has direct impact on gamma absorption capacity and cask final weight, which is extremely important. In this connection, there are three main characteristics to control: actual gap between shells, actual lead thickness and lead pouring quality.

These operations are handicapped by the need of important outside/inside welded metallic stiffeners to reduce deformations and narrow heating/cooling temperature rates during lead pouring.

Regarding the basket, it is required to perform a very precise machining of the multiple disks, in order to obtain a perfect assembly of the whole basket structure, which permits the subsequent incorporation of the fuel guide tubes through the multiple disk assembly.

The main manufacturing techniques and facilities are:

- automatic welding processes with narrow weld edges preparation
- high precision boring machines
- radiographic and gamma facilities
- ultrasonic new technology equipment
- specific lead and neutron absorber pouring installations
- lifting capacities over 150 t
- clean area for final assembly and inspections
- thermal test equipment
- hydrotest installation
- sophisticated dimensional control system

All these facilities, techniques and human resources have been used at ENSA to manufacture several dry containers, the last being a STC-26 storage cask and a 1/4 scale model cask, under ENRESA order to:

- demonstrate ENSA availability
- perform the drop tests required by the Spanish authorities and - be in the adequate position to offer to the Spanish utility industry the guarantee of meeting their needs.

As the result of the design and manufacture efforts ENSA has proven that it is now prepared to offer ENRESA and the international market its ability to design, licence and produce casks to the required high standards of quality