MTR TRANSPORT EXPERIENCES OF TRANSNUCLEAIRE IN SOUTH AMERICA AND STATUS ON THE NEW TN-MTR PACKAGING

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Presented at:
The 1998 International
Reduced Enrichment for Test Reactor Conference
Sao Paulo, Brazil
October 18-23, 1998

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The present paper describes the last MTR transport operations performed in September 1998 by TRANSNUCLEAIRE and especially from SOUTH AMERICA (URUGUAY and VENEZUELA) from where MTR spent fuels from Research Reactors were taken in charge within a DOE contract for the storage of such material at SAVANNAH RIVER Site in the U.S.A.

TRANSNUCLEAIRE supplied, for EDLOW which was in charge of the whole transport. three IU04 casks and the technical assistance for the preparation and the loading operations.

Each transport is specific and must be very well prepared because the MTR fuels are generally very specific to the Research Reactor. Their characteristics (type, dimensions. irradiation ...) have to be carefully identified because, for example, sometimes they are not well-known due to their period of storage. The URUGUAY and VENEZUELA are good examples of two different approaches in order to perform the transport in good, safe and economical conditions.

1. TRANSPORT FROM URUGUAY

The Centro de Investigaciones Nucleares (CIN) at the University de la Republica had been operating the RU I Reactor, located in MONTEVIDEO, for the years between 1978 and 1986.

On the site of the reactor, there were only 19 fuel elements remaining, with low level of radiation. The purpose of the operation was to transport these 19 elements from the reactor to SAVANNAH RIVER Site in the USA.

All the transport organization has been completed within only two months including the procedures to obtain the transport licenses in the different countries for these specific fuel elements.

1.1 Main characteristics of the fuel elements

The fuel elements are composed of plates of enriched uranium (less than 20 %) and aluminium. The main dimensions are: 70 mm x 70 mm x 600 mm.

These elements had a very low level of radiation (about 130 m Ren-1/h on contact) which allow to be manually handled.

The fuels elements were stored in five containers located in a storage building separated from the reactor.

1.2 The IU04 cask

The IU04 cask was designed by COGEMA mainly for the transport of spent fuels used in Research Reactors. It is composed of a body with a basket inside. a closure system and a shock absorber.

The body is made of an internal steel shell surrounded by lead for gamma shielding and compound for thermal protection against fire. Externally, fins are welded on a steel shell and allow the evacuation of the heat power of the radioactive material.

Inside the cavity of the cask, different baskets may be used in order to optimize the quantity of transported material and to take into account the real characteristics of this material. For the fuels issued from the CIN laboratory. an aluminium basket was placed in FRANCE before shipping the cask to URUGUAY.

The closure system is composed of a lid and a ring flange. The lid is made of steel with lead inside for additional gamma shielding. The ring flange, made of steel. is bolted on the body in order to fix the lid, to compress an elastomer gasket located in the lid and to obtain the right level of leaktightness. Two orifices allow to control the cavity and to empty or fill the cavity with water during loading and unloading operation.

The shock absorber is bolted on the body and protect the cask during accidental conditions (drops and fire tests).

The main characteristics of the IU04 cask are :

A sketch of the IU04 cask is enclosed (figure 1).

- Overall height 2,239 mm
- Height without shock absorber 1,760 mrn
- Overall diameter 1,875 mm
- External diameter without shock absorber 1,510 mm
- Diameter of the cavity 800 mm
- Height of the cavity 1,040 mm
- Total weight (transport configuration) 2,2300 kg

A Sketch of the IU04 cask is enclosed (figure 1)

The internal equipment used in URUGUAY was a AA-50 basket with 36 lodgements.

The French IU04 packaging license with this basket and the Uruguayan fuel elements was extended on the 29th of May 1998 and validated in URUGUAY in the 2 91h of June 1998 and on the 17'hof July 1998 in the U.S.A.

1.3 Loading operations

The IU04 cask was prepared in FRANCE and shipped by sea in a 20 feet ISO container.

At the Reactor site, it was not possible to load the cask inside the storage building due to limited dimensions of the entrance of the building. Therefore. it was decided to load the cask outside.

Before loading the fuel elements in the cask, each fuel had been equipped with a clamping system in order to be in accordance with the transport license. Then. the elements were directly loaded in the cask in dry condition.

The conformance of the fuels was checked by a AIEA inspector.

The complete preparation and loading operation has been performed by two TRANSNUCLEAIRE technicians within one week at the beginning of September 1998.

After all the controls required before shipping (leaktightness. dose rate. contamination rate ...). the transport was performed first by road from the reactor until MONTEVIDEO harbour where the cask had been transferred on a ship to CHARLESTON harbour and then to SAVANNAH RIVER Site by rail. The cask arrived on the 6th of October 1998.

2. TRANSPORT FROM VENEZUELA

The Instituto Venezolano de Investigaciones Cientifics (IVIC) had been operating the RV1 Reactor, located in CARACAS, for the years between 1958 and 199 1.

Among the spent fuels which were used in the reactor, there were 56 irradiated fuel elements still remaining. The purpose of the operation was to transport 54 elements from the reactor to SAVANAH RIVER Site in the U.S.A. Two failed elements are still stored at the RV1 Reactor Building.

Due to the necessity to use specific equipments for the loading operation, all the organization for the transport has been completed within 6 months (design and manufacturing of equipments, transport licenses ...).

2.1 Main characteristics of the fuel elements

The fuel elements are composed of plates of aluminium and enriched uranium (less than 20 %). The main dimensions are 77 mm x 77 mm x 1000 mm and the average bum-up is 20 %.

They were stored in storage racks located in a transfer canal placed close to the reactor inside the building.

2.2 IU04 casks

Two IU04 casks were used for this transport. They were similar to the one used in URUGUAY and described in the paragraph 1.2.

The internal equipments were different. Two baskets were used :

- the AA-267 with 40 lodgements,

- the TN 9083 with 36 lodgements.

For the Venezuelan fuel elements, the IU04 packaging equipped with these two baskets was licensed in FRANCE on the 29th of May 1998 and validated in VENEZUELA on the 23rd of July 1998 and on the 17th of July 1998 in the U.S.A.

2.3 Transfer system

Due to a limited capacity of the crane over the transfer canal and limited dimensions of this canal, it was not possible to load the fuel elements directly in the IU04 cask.

Therefore, TRANSNUCLEAIRE designed and manufactured a specific transfer system in order to handle the fuel elements from the storage rack and to load them into the IU04 cask. This transfer system is composed of two main equipments :

- a shielded bell,
- a cask loading equipment.

The shielded bell is used to handle each fuel element. It is composed of an external shielding protection, made of steel and lead, and of a handle device to catch the top of the fuel element. Each fuel element was transferred under water from the storage rack placed in the transfer canal until a well (5 meters deep) where the fuel element was placed on a support. The shielded bell is handled in the water over the support and placed on it. Then, the handle device is operated manually, catches the fuel element and lifts it inside the shielded bell. The bottom of the latter is closed and then the fuel element can be safely transferred to the loading area.

The cask loading equipment is used to load the fuel elements in the cask and to protect the operators against the radiation. It is composed mainly of a thick stainless steel shell, surrounded by lead, placed and bolted over the top of the cask. On the bottom part, there is an elastomer gasket to prevent from water leak. Then, the cavity and the cask loading equipment is filled with water. The cask is placed in a configuration, for loading, similar to a loading configuration in a large pool. Inside this equipment, a transfer device allow to support the fuel element.

Then, the loading operation can start and the shielded bell is handled in the cask loading equipment, full of water, over the transfer device. The door of the shielded bell is opened and the fuel element is placed on the transfer element. After taking out the shielded bell, the fuel element is manually handled from the transfer device into the compartment of the IU04 cask.

These equipments were successfully tested and operated for the loading of the two IU04 casks used in VENEZUELA. They are belonging to TRANSNUCLEAIRE and can be operated each time it appears to be necessary, and especially with the new TN-MTR cask (see paragraph 3).

2.4 Loading operation

Based on the procedure explained in the previous paragraph, 28 fuel elements have been loaded in the first IU04 cask which was introduced directly with its 20 feet ISO container equipped with a removable roof inside the reactor building.

A general view of the inside of the Reactor is enclosed (figure 2).

Then, the second IU04 cask was loaded with the 26 remaining fuel elements.

The loading operation needed two weeks between the 14th and the 25th of September 1998. Four TRANSNUCLEAIRE technicians participated to this operation.

After all the controls required before shipping, the casks were transported to CARACAS harbour where they joined the ship already containing the IU04 from URUGUAY.

3. STATUS ON THE TN-MTR PACKAGING

3. 1. The TN-MTR design

The TN-MTR packaging has been designed by TRANSNUCLEAIRE for the transport of the MTR fuels in accordance with the AIEA regulation and especially as a B(U)F packaging. It will take into account the new AIEA 1996 specification for the packagings (ST-1) and the ICPR specification especially for the dose rate.

The main characteristics of the TN-MTR packaging are**:**

- Overall height : 2,008mm
- Overall diameter : 2,080mm
- Height without shock absorber : 1,610 mm
- Diameter without shock absorber : 1,600 mm
- Diameter of the cavity : 960 mm
- Height of the cavity : 1,080 mm
- Current total weight in transport (loaded) : 22,000 kg
- Total weight without shock absorber (full of water) : 21,000 kg

For heavy fuels, the total weight in transport can be 23,400 kg.

The TN-MTR is mainly composed of a body with a thick shell of lead as a gamma shielding and with resin for thermal protection and as a neutron shielding. Externally, the cask is covered by fins in order to allow the heat transfer of the radioactive material during the transport. Two trunnions, bolted on the body, allow to handle easily the cask in vertical position (without tilting) inside the facilities. The cavity is made of stainless steel.

The closure system is composed of a lid with gamma (lead) shielding. Two orifices are placed in the lid for the control of the cavity during the loading and unloading operation (water filling and draining, air injection and vacuum. control the atmosphere of the cavity). The leaktightness is obtained with elastomer gaskets which can be separately controlled.

TRANSNUCLEAIRE is presently working on a new design of the closure system in order to limit the total weight of the cask to 20 tons (instead of 22 tons).

There are different designs of baskets which can be used according to the characteristics of the fuel elements (geometrical dimensions, enrichment, burnup, cooling time ...) :

- MTR-68 with 68 compartments
- MTR-52 with 52 compartments
- MTR-44 with 44 compartments
- MTR-4 with 4 compartments
- MTR-RFH with 3 compartments

They are mainly made of aluminium with boron in order to optimize the capacity the sub-criticality and the heat transfer. The maximum allowable heat power is 8 KW.

The design procedure of the TN-MTR packaging allow to add easily. if necessary, baskets type for specific fuel elements.

The shock absorber, mainly made of wood covered by stainless steel plates. protects the cask during the accidental conditions (drop tests and fire tests).

A sketch of the TN-MTR cask is enclosed (figure 3).

The TN-MTR packaging is transported in vertical position and can be placed in a 20 feet ISO container. The cask is compatible with most of the existing facilities and need only few equipments (handling beam, orifice tool ...) for the loading operations. These equipments can be transported with the cask in the ISO container.

3.2 Licensing procedure

The regulatory drop test have been performed in spring 1997 and TRANSNUCLEAIRE applied in summer 1998 for the TN-MTR packaging equipped with a MTR-68 basket. We expect a French transport license for the next weeks.

The design with the MTR-52 and MTR-RHF has been recently applied.

As soon as the French license will be issued, TRANSNUCLEAIRE will apply for many countries all over the world and especially in EUROPE and in U.S.A in order to operate it during next year.

3.3 Manufacturing of TN-MTR casks

Three casks are presently under manufacturing in FRANCE and they must be delivered in the very beginning of next year.

Simultaneously, five baskets are manufactured: MTR-RHF. two MTR-68 and two MTR-52. They will be also ready for beginning of next year.

Figure 1
IU04 PACKAGING

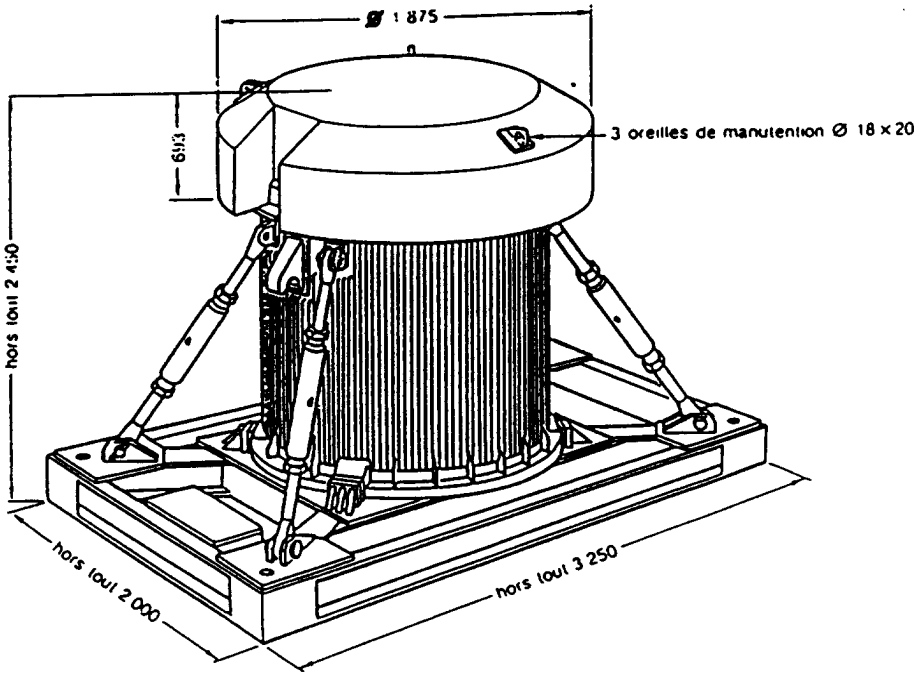

Figure 2
RV1 REACTOR BUILDING

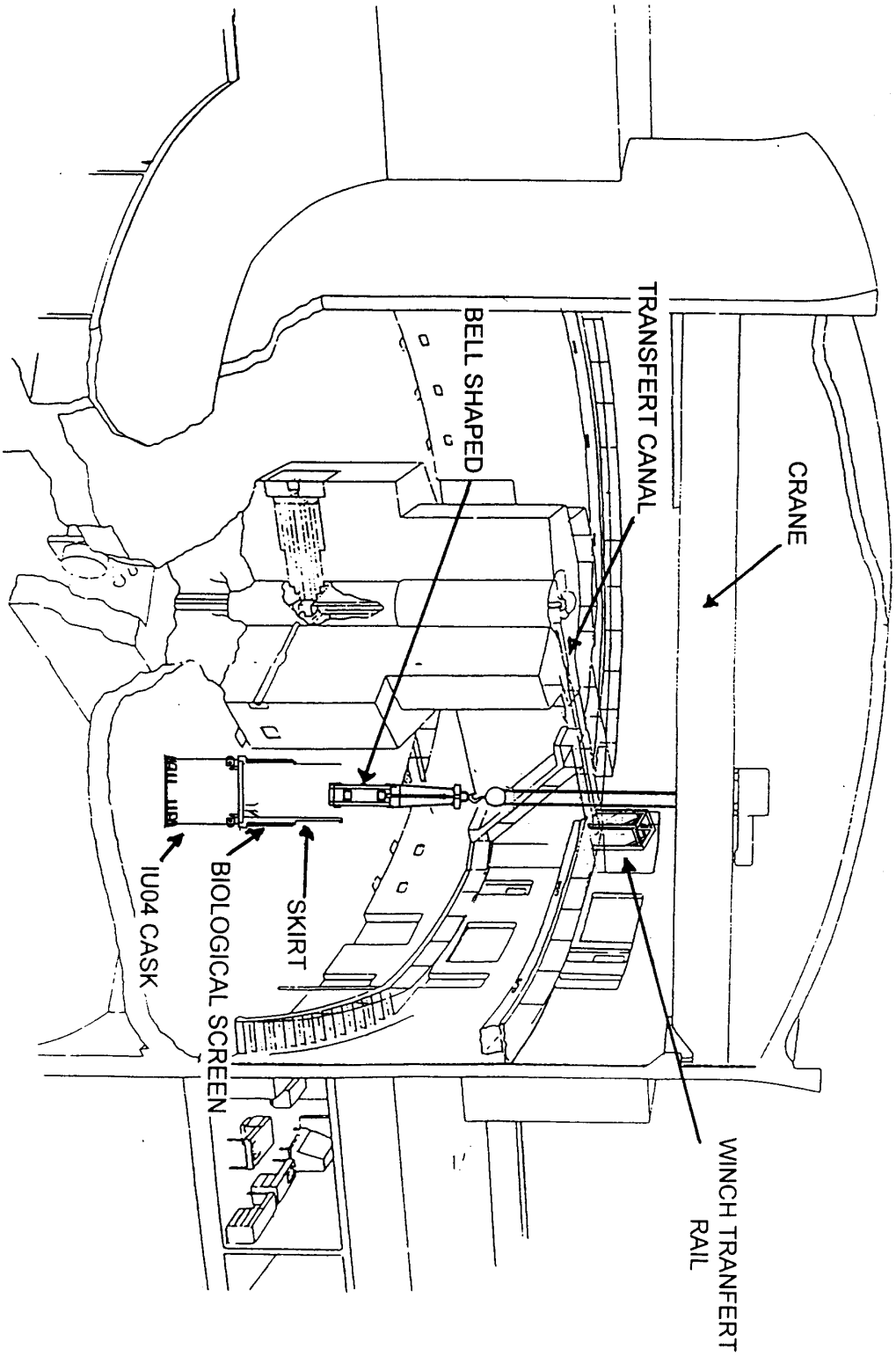

Figure 3
TN-MTR PACKAGING