TRANSPORT SYSTEMS FOR CONDITIONED RADIOACTIVE WASTE IN BELGIUM.

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ABSTRACT.

In implementing the waste management program set up by NIRAS/ONDRAF, conditioned waste packages have been standardized in order to facilitate and optimize their shipment and storage. Two transport systems have been developed for the carriage of these standardized packages. The paper gives a description of and reviews the experience with the two systems.

INTRODUCTION

In 1981, a national Agency in charge of the management of radioactive waste and fissile materials called NIRAS/ONDRAF has been established in Belgium. Since sea dumping of low level radioactive waste has been abandoned in 1982, NIRAS/ONDRAF has set up a new radioactive waste management program. This program mainly consists of reducing the volume as far as possible and to standardize the radioactive waste packages in order to facilitate and optimize the shipment to and the storage at a central storage facility awaiting final disposal.

Two transport systems have been developed by Transnubel and were successfully put into service. In 1988, NIRAS/ONDRAF became co-owner of these systems.

BASIC CONSIDERATIONS

A consequence of the reduction of the volume is the increase of the specific activity of the conditioned radioactive waste and the increase of the radiation level produced by that waste. If one is supposed to use the standardized reinforced steel drums [see Fig. 1] containing about 400-l of conditioned waste as primary packages for transport and for storage, even if the content may still be classified as Low Specific Activity-III (LSA-III) material according to the 1985 edition of the IAEA-regulations for the safe transport of radioactive material (1), the radiation dose rate at the outer surface of that package may amount to more than 10 mSv/h. As such, these industrial packages are to be carried under special arrangement, according to the IAEA-transport regulations.

If one wants to avoid that kind of special arrangement, one has to add some shielding: either inside the drum or outside the drum. Adding shielding inside the drum limits the useful content (if one uses concrete for instance) or is a waste of useful material (if one uses lead for instance).

The alternative is to add at the outside of the drum some shielding which is an integral part of a conveyance or a larger packaging. The 400-l drums are therefore regarded as inner receptacles of a larger packaging, designed in such a way as to limit the radiation level to less than 10 mSv/h at its outer surface. Taking into account that this larger packaging, when mounted on a trailer may also be considered as a conveyance, the radiation level must be further reduced

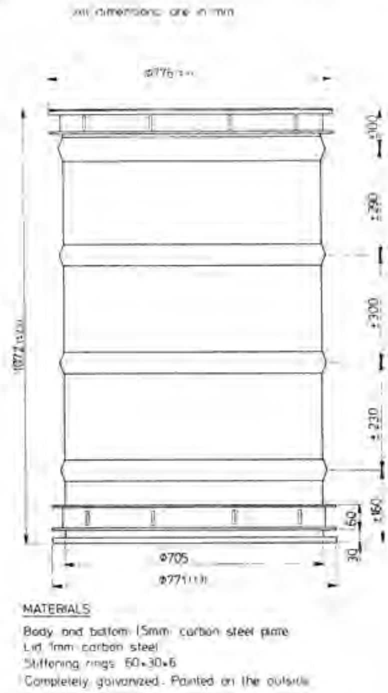

Fig. 1. Standard 400L. Drum.

to less than 2 mSv/h at its outer surface, to 0.1 mSv/h at a distance of 2 m and to 0.02 mSv/h in the driver's cabin.

Given the rather high radiation output of the 400-l waste packages, all handling of these drums must be conducted from a safe distance and/or with sufficient biological shielding.

Special attention has to be paid to the stowing of the packages. On that subject, TRANSNUBEL together with the CEA-France performed under the sponsorship of the Commission of the European Communities between 1980 and 1985 a study (2) which clearly showed that during a road accident, in case of a front end impact, the stowing system must be able to absorb entirely the kinetic energy generated by the package deceleration, which is proportional to the package mass. This means that a tie-down system according to the 2g - 1g - 1g standard is convenient, provided that the package is chocked in the direction of the traffic.

The chocks must be able to absorb a deceleration energy generated by the packages of about 30 g at a speed of about 50 km/h. This energy of course decreases at the same time as the speed.

Furthermore, the overall dimensions of the packaging/conveyance must be in accordance with the general transport regulations.

Design of the TNB 0167 container

Taking account of these basic considerations, the container TNB0167 has been developed. The general design parameters were determined in agreement with/after consultation of/ the waste producers and conditioners.

In order to respect the general transport regulations, the overall width and height were chosen as those of a standard ISO container : 2.44 m and 2.59 m respectively. The length of 6.80 m was determined as an optimum between the number of drums to be carried and the total mass of the loaded shielded container, taking account of the maximum allowable radiation level of 2 mSv/h at the outer surface and of 0.1 mSv/h at a distance of 2 m from the container/conveyance.

A such the container was designed for the shipment of :

- either two rows of seven standard drums with a maximum surface radiation level of 50 mSv/h.
- or one row of seven standard drums with a maximum surface radiation level of 300 mSv/h, stowed in a different rack with additional lead shielding.

To reduce doses to workers during loading and unloading, the container is equipped with an internal gantry crane with a capacity of 2.5 tons to take over the drums positioned outside of the container and to place them in their position in the rack. The gantry crane is fully remotely operated and controlled by TV cameras ; the control panel is located in the driver's cabin. After loading and positioning in the rack, the drums are covered with shielded lids which are positioned on the top of the rack and are automatically blocked when the inner doors of the container are closed, so as to ensure adequate stowing during shipment.

An overall view of the container, mounted on a trailer, is given in Fig. 2. Its mass is 28 tons for the first configuration and amounts to 35 tons for the second configuration.

The structure of the package is visualized as follows (see Fig. 3) :

- enforced ISO-type steel container as basic structure with a thickness of about 15 cm and enclosing rockwool as thermal isolation ;
- lead and steel shielding at the bottom and the walls ; the two sets of doors at the back provide for the same shielding and are equipped with elastomere gaskets ;
- shielded covers to provide for stowing ;
- remotely operated handling equipment ;
- either a rack with 2 x 7 positions, or a rack with 7 positions provided with additional lead shielding sandwiched between steel plates ; these racks are bolted on the bottom frame ;
- either 14 or 7 drums containing solidified radioactive waste.

Design of the TNB 0178 container.

For standard drums with lower surface radiation level there was a need to develop a lighter system with a higher capacity.

In 1987 it was decided between NIRAS-ONDRAF and TRANSNUBEL to develop a road transport system able to move 20 standard drums with an average mass of 1000 kg and a maximum surface radiation level of 5 mSv/h.

TRANSNUBEL selected the principle of a pneumatic stowing and chocking system. Basic design and pilot tests led to the system shown in fig. 4 for which a patent is pending in Europe and in the USA. It consists basically of a honeycomb rack equipped with inflatable annular cushions with a rectangular cross-section. The diameter of the cell is designed as to provide close contact between cushion and drum when the system is pressurized. The cells are equipped with guides in order to facilitate loading and unloading of the drums. The whole system is mounted in an open top 40 feet ISO container.

In order to comply with the IAEA transport regulations, additional lead and steel shielding is foreseen on the floor and up to over the height of the drums on the sides of the 40 feet container.

Loading and unloading are performed by means of a remotely operated crane, which pulls down or up the drum vertically without any manual intervention.

During transport a flexible roof skirt covers the top of the 40 feet container. This skirt is operated remotely from beside the container in a few minutes operation.

Compressed air for the cushions is supplied to the system by a compressor on the truck. Pressure indicators and alarms warn the driver for a pressure drop in the system. In that case the faulty cell can be isolated from air supply.

The overall dimensions of *the 40 feet ISO container* are :

- length : 12,2 m

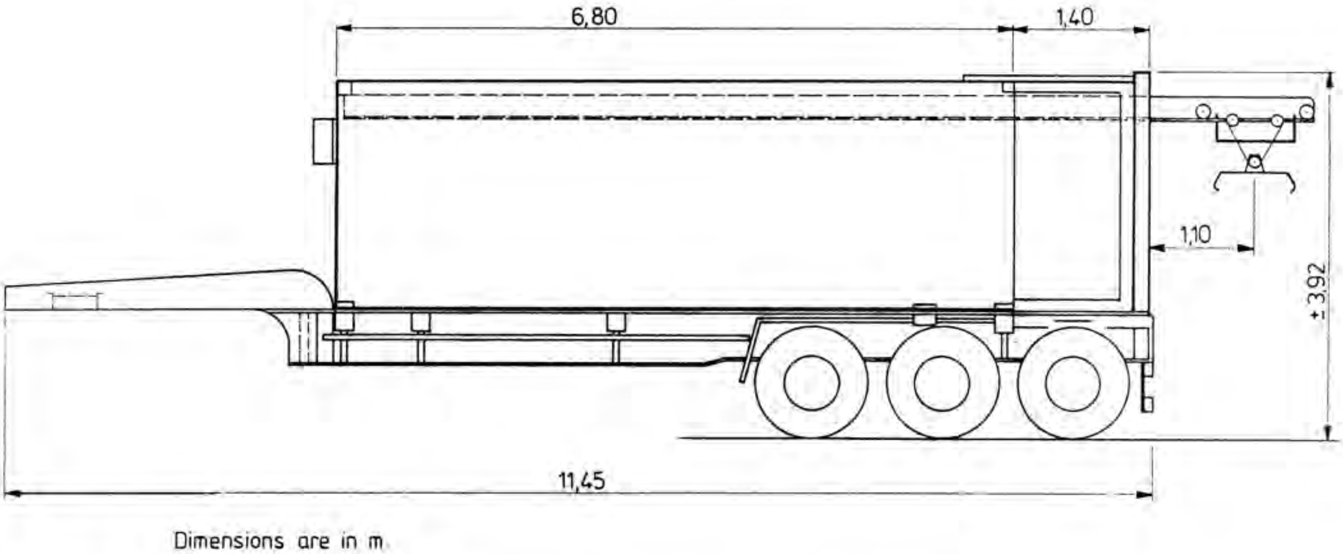

Fig. 2. Container TNB 0167 Mounted on Trailer.

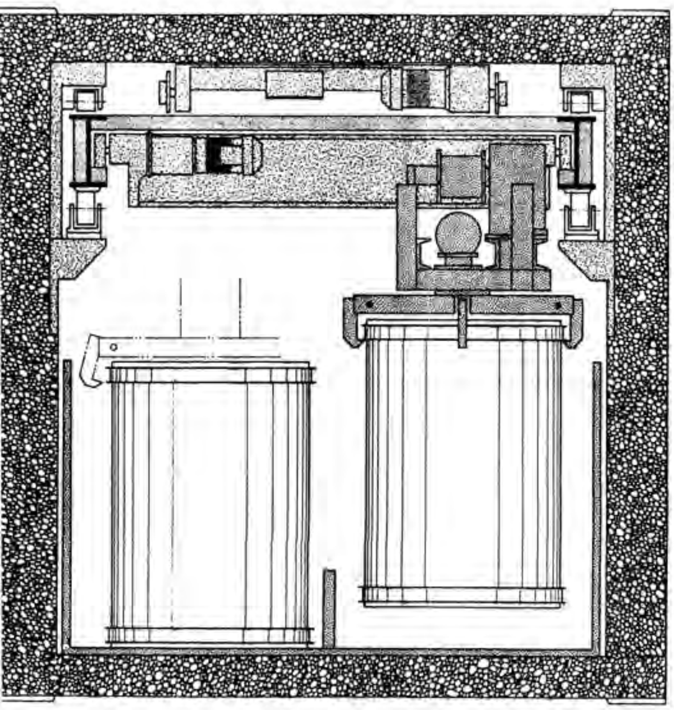

Fig. 3. Schematic View of the TNB 0167.

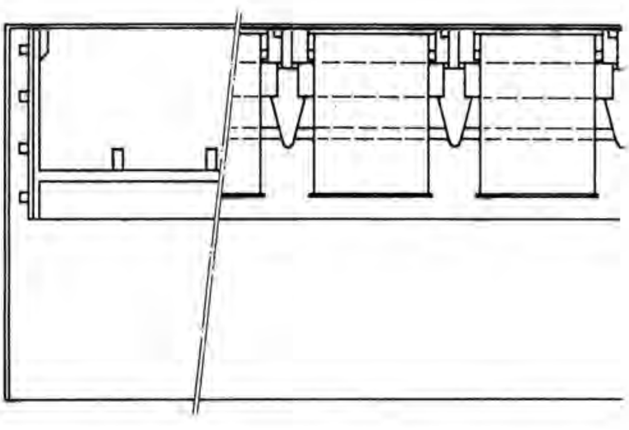

Fig. 4. Pneumatic Stowing and Chocking System for Packages Containing Radioactive Waste _Container TNB 0178.

width : 2,4

height : 2,5 m

mass of the empty container : 15,5 tons

- mass of the container loaded with 20 standard 400 l drums : 33,5 tons.

EXPERIENCE

The TNB 0167 container has been put into service at the end of 1986. A few hundreds of shipments have been performed since then.

Radiation monitoring has shown that the design criteria, set on the basis of pessimistic assumptions (the radioactive content being all Co60), allow for a sufficient margin of safety. This means that the radiation level at the outer surface and at a distance of 2 m are well below the regulatory limits.

Fig. 5 shows the results of radiation monitoring for a typical 14 drums configuration.

Fig. 6 shows similar results for a typical 7 drums configuration.

The TNB 0178 container was put into service in 1988. Table I gives a comparison between the actual and the former way of transporting.

Fig. 7 shows the results of radiation monitoring for a typical 20 drums configuration in the TNB 0178 container.

Up to now approximately 2000 drums of conditioned waste have been transported with the TNB 0178 container and 1150 drums with the TNB 0167 container.

One annular cushion had to be replaced due to a leak at the inlet valve. No other incidents occurred during these transports.

CONCLUDING REMARKS

According to the 1985 edition of the IAEA regulations, a restriction is added, namely that the radioactive waste to classify as LSA-III material should not produce a radiation level of more than 10 mSv/h at a distance of 3 m from the unshielded material. This means that the radiation level at a distance of 3 m of an individual drum should not exceed 10 mSv/h.

This requirement will not constitute any constraint to the use of the TNB 0167 according to its design parameters.

To limit radiation exposure to workers, the individual drums are not labelled but are marked with the trefoil symbol of radioactivity, an identification number and a colored band indicating the radiation level. The color code

TABLE I
Advantages of the TNB 178 container

	Former situation	TNB 0178
- Maximum surface radiation level of the drums	2 mSv/h	5 mSv/h
- Number of drums transported (400 1 NIRAS/ONDRAF type)	24	20
- Loading - unloading time	2 hours	1 hour
-Annual doses	1 driver + 2 workers 30 to 50 mSv	1 driver 0.9 to 1.5 mSv
- Investment	22,500 USD 40 feet container + tie-down system	115,000 USD 40 feet container + pneumatic system

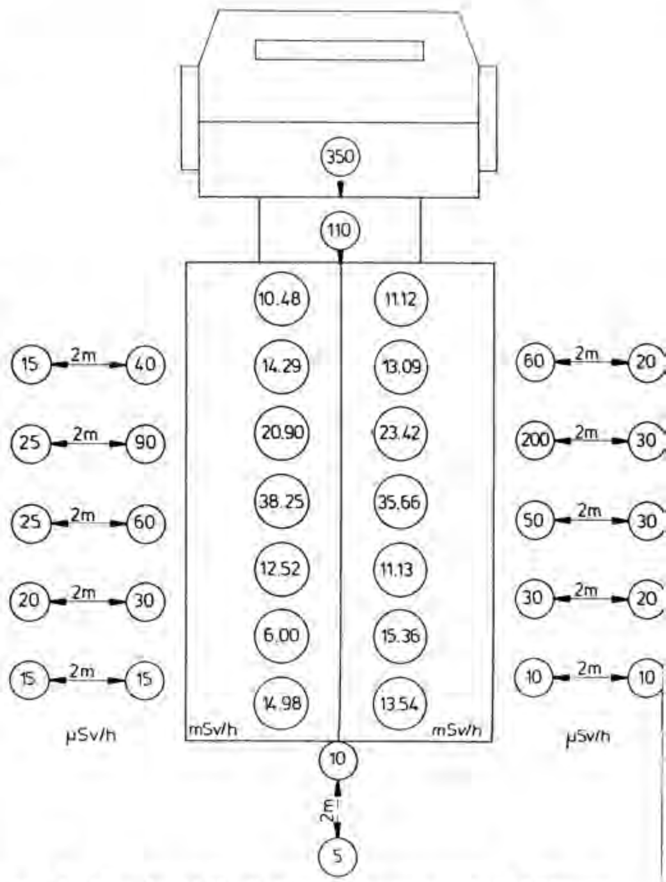

Fig. 5. Results of Radiation Measurements (14 Drums Configuration).

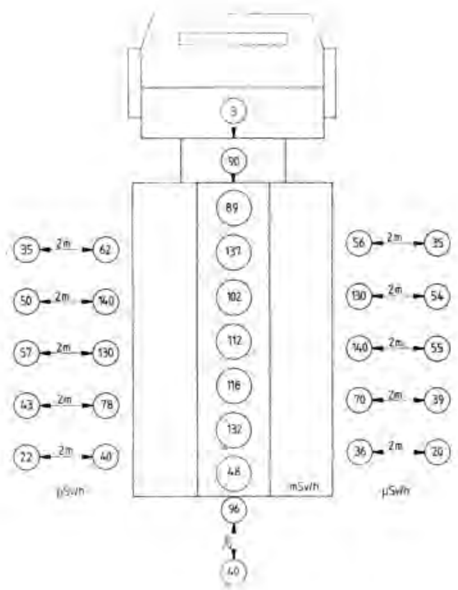

Fig. 6. Results of Radiation Measurements (7 Drums Configuration).

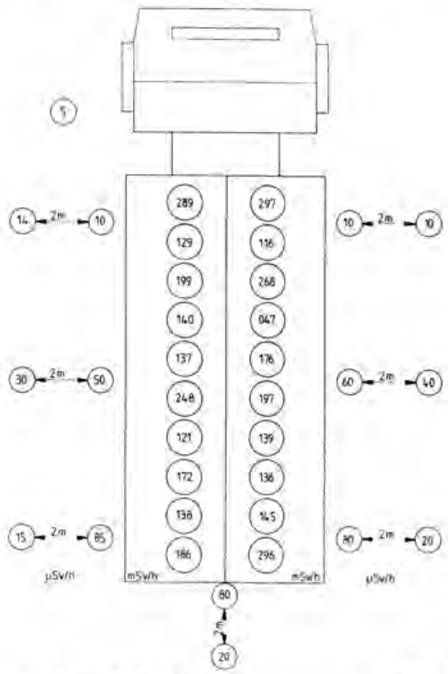

Fig. 7. Results of Radiation Measurements (20 Drums Configuration).

is the one which was used at the time when packages were prepared for sea dumping.

The introduction of an innovative pneumatic stowing and choking system also contributed to the dose reduction to transport workers. This system could also be applied to the transport of other radioactive of dangerous materials, provided the packages have been standardized.

REFERENCES

1. Regulations for the safe transport of radioactive material, International Atomic Energy Agency, Safety Series 6 (1985).
2. P. GILLES, G. CHEVALIER, M. POUARD, J.C. JOLYS, J. DRAULANS and I. LAFONTAINE, "Stowing of packages containing radioactive materials during their road transportation with trucks for loads up to 38 tons", Commission of the European Communities, EUR 10731 EN (1986).