Development of a Large Shielded Packaging for the Transport of Conditioned Radioactive Waste

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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 standardise the radioactive waste packages in order to facilitate and optimise the shipment to and the storage at a central storage facility awaiting final disposal.

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 Level Solid (LLS) material, according to the 1973 edition of the IAEA regulations for the Safe transport of radioactive material, or as Low Specific Activity-III (LSA-III) material according to the 1985 edition of these regulations, 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 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.
Furthermore, the overall dimensions of the packaging 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 developped. 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 heighth 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.

As such the container was designed for the shipment of :

- either two rows of seven standard drums with a maxium 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 tonnes 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 tonnes for the first configuration and amounts to 35 tonnes 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.

REGULATORY CONSIDERATIONS.

The packaging, according to the IAEA-regulations for the safe transport of radioactive material, is the ensemble formed by the outer reinforced ISO 20' container, the internal shielding, the spacing structure (rack) and handling equipment, together with 7 or 14 empty drums according to the type of rack.

The package, according to the IAEA-regulations, is the ensemble formed by the outer container, its internal structure, shielding and handling equipment, together with 7 or 14 drums filled with solidified radioactive waste.

The solidified radioactive waste classifies as LLS-material (IAEA 1973) or as LSA-III material (IAEA-1985).

The shipment is carried out as full load (IAEA 1973)/exclusive use (IAEA 1985) from the nuclear power plants of Doel and Tihange and the Nuclear Research Center of Mol to the central storage facilities of Belgoprocess at Dessel.

It can easily be shown by calculation that the package qualifies as an industrial package, as required for the shipment of this kind of radioactive material.

EXPERIENCE.

The 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.

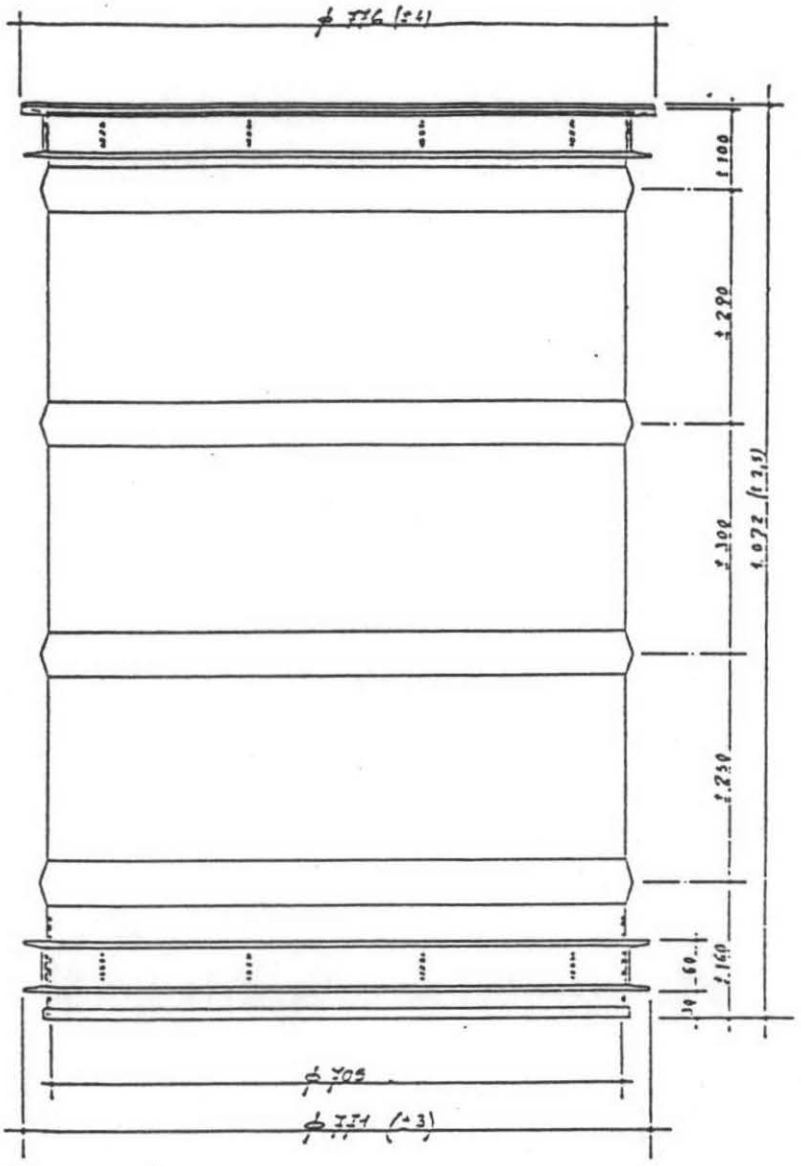
Fig. 4 shows the results of radiation monitoring for a typical 14 drums configuration.

Fig 5 shows similar results for a typical 7 drums configuration.

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 TNB0167 according to its design parameters.

To avoid radiation exposure to workers, the individual drums are not labelled but are marked with the trefoil symbol of radioactivity, an identification number and a coloured band indicating the radiation level. The colour code is the one which was used at the time when packages were prepared for sea dumping.

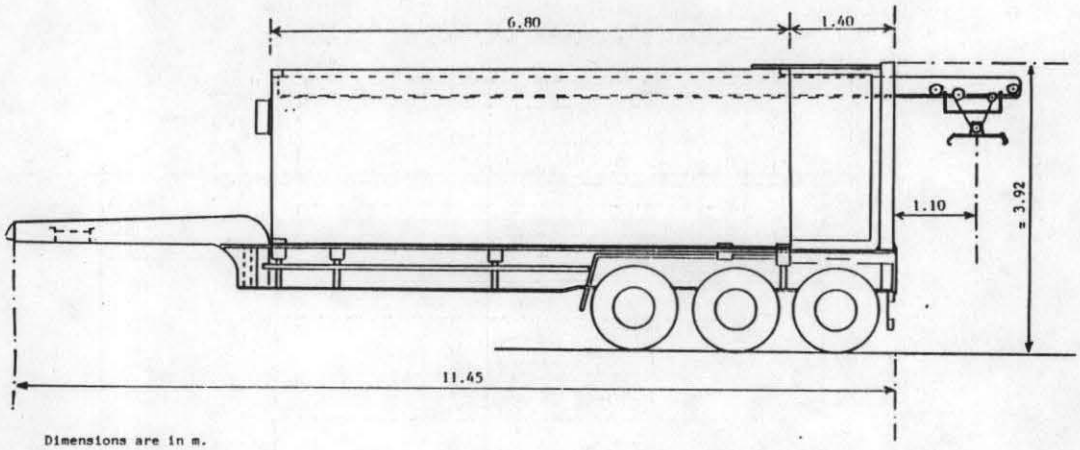


MATERIALS

Body and bottom : 1,5 mm carbon steel plate
Lid : 1 mm carbon steel
Stiffening rings : 60 x 30 x 6
Completely galvanized - Painted on the outside

All dimensions are in mm.

Fig. 1 - Standard 400-L drum



Dimensions are in m.

Fig. 2 - Container TNB 0167 mounted on trailer

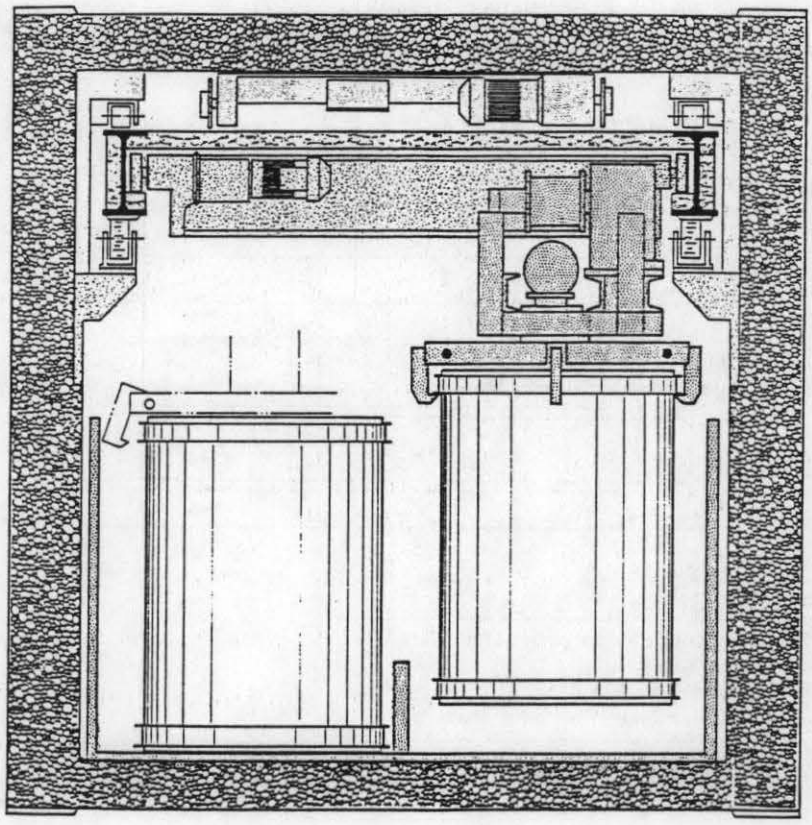


Fig. 3 - Schematic view of the TNB 0167

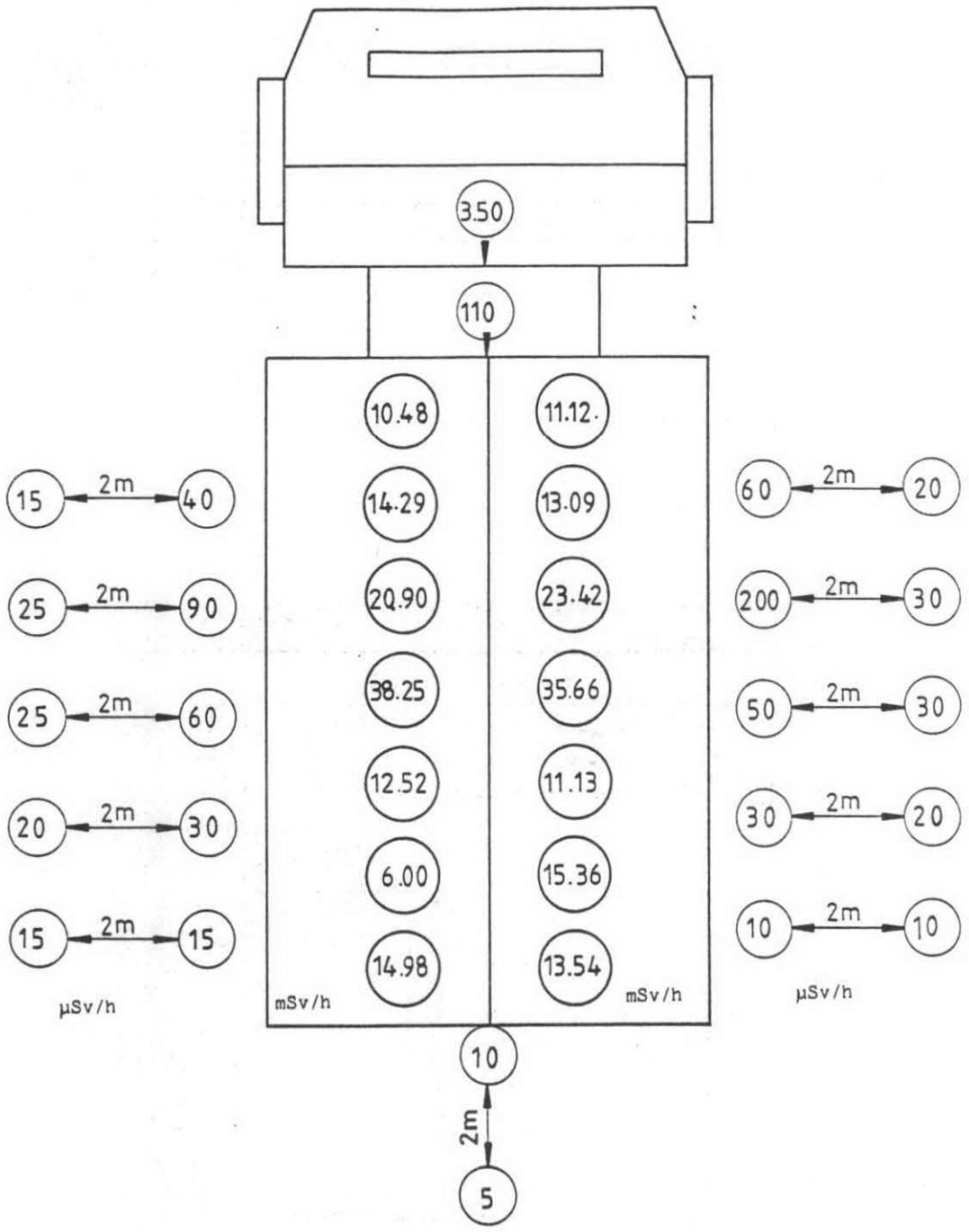


Fig. 4 - Results of radiation measurements
(14 drums configuration)

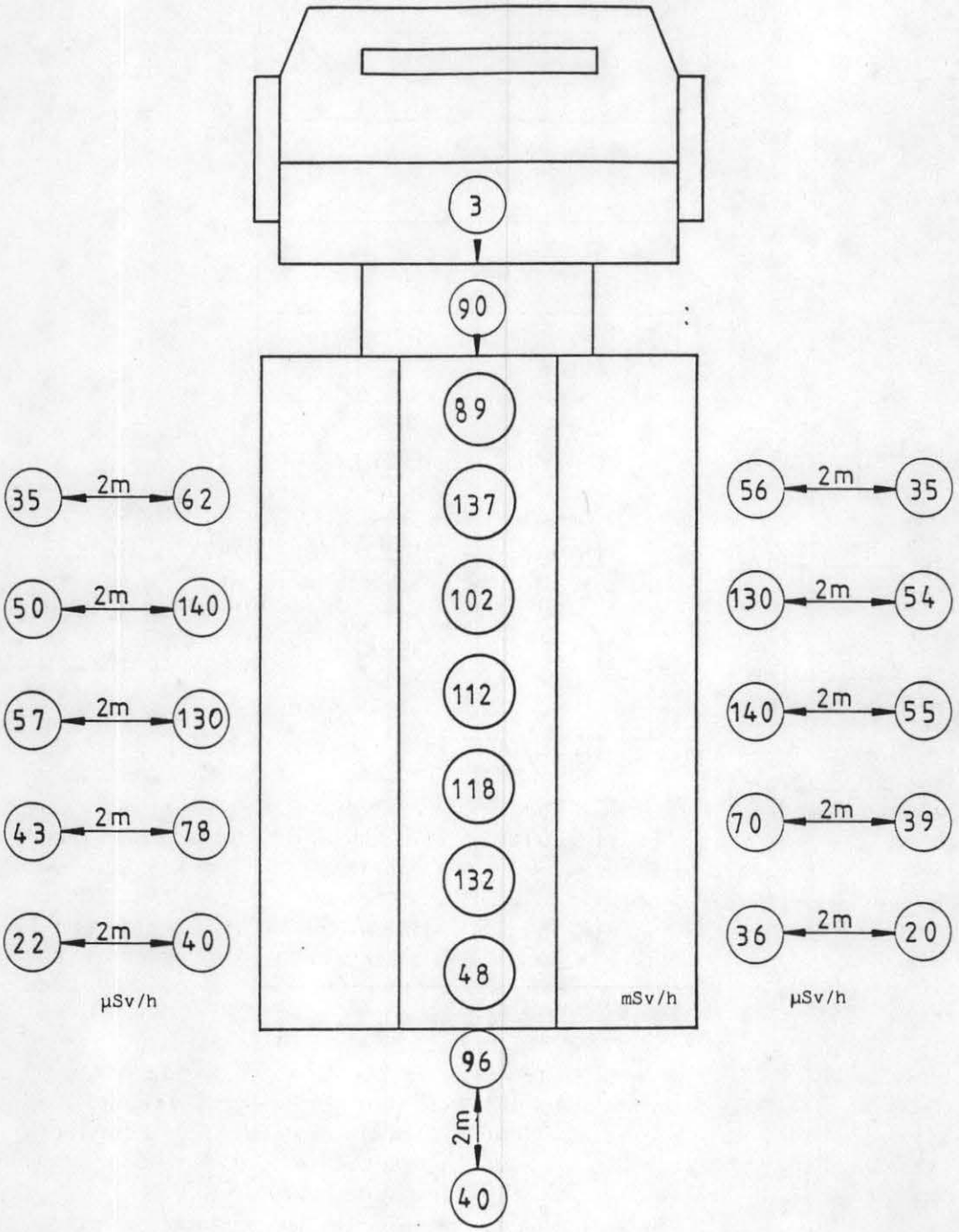


Fig. 5 - Results of radiation measurements
(7 drums configuration)