Development of a Pneumatic Stowing and Chocking System for Packages Containing Radioactive Waste

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INTRODUCTION

Since that goods are transported, their chocking and stowing is very often done by improvisation, successfully or disastrously. When the disaster appears in comics it is always a source of an enormous amusement, when it appears in road or maritime accidents it is most of the time a source of death or severe damages.
The loss of a container loaded with drums filled with lindane some months ago in the Atlantic sufficiently showed that stowing and chocking cannot be subject of improvisation.

Even if transport of radioactive materials could be considered as the exception where chains and tie-down systems are used abundantly, their strength relies always on the weakness of their components. Special attention has been paid to the transport of type A or type B packages, but obviously there was a lack of interest for the transport of low level radioactive waste, even knowing that the quantities of this waste are a hunderdfold or a thousandfold of the first ones.

On the subject of stowing and chocking systems for radioactive waste packages, TRANSNUBEL together with the CEA-France performed under the sponsorship of the Commission of the European Communities between 1980 and 1985 a study (ref. EUR 8057EN), 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 package of about 30 g at a speed of about 50 km/h. This energy of course decreases at the same time as the speed.

These conclusions served as basic principles for the development by TRANSNUBEL of a pneumatic stowing and chocking system for packagings containing radioactive waste.

Basic considerations

In 1981, a national Agency in charge of the management of radioactive waste and fissile materials was established, called NIRAS-ONDRAF. In 1982 sea dumping of low level conditioned waste was stopped. At that time NIRAS-ONDRAF set up a new radioactive waste management program. This consists of reducing the volume of the conditioned waste as far as possible and of standardizing the waste packages, in order to ease their transport and storage. The "standard drum" is a 400 liter reinforced steel drum with lid.

The basic safety standards for radiation protection (IAEA, Safety Standards n° 9) deals in section IV with optimization of radiation protection. It recommends that all exposures should be kept as low as reasonably achievable, economic and social factors being taken into account. This requirement may be met both in qualitative way in operational practice and in a more quantitative way in chosing design criteria.

According to the IAEA Safety Standards n° 6, the conditioned waste is classified as Low Level Solid material (LLS) following edition 1973 or as Low Specific Activity III material (LSA III) following edition 1985.

Development

The design of the transport container TNB 0178, where the pneumatic stowing and chocking system was applied for the first time, was set up in close cooperation between NIRAS-ONDRAF and TRANSNUBEL.

Since 1986 a container (TNB 0167) has been put in operation for the transport of standard 400 l drums with a maximum surface radiation level up to 300 mSv/h. Due to its heavy shielding and the consequent mass, the speed of the road train is limited and its capacity is limited to maximum 14 drums.

For standard drums with low surface radiation level there was a need to develop a lighter system with a higher capacity.
Before use of the TNB 0178, drums or packages containing conditioned waste were transported loaded horizontally on flat trailers or on standard ISO containers. Chocking and stowing were reduced to a minimum using wooden wedges under the last row of drums, which were loaded with a crane.
Lifting hooks had to be installed and removed manually.

This resulted more of less in a mountaineering exercise on radioactive drums, with annual doses to the workers of 10 to 20 mSv.

An improvement to this primitive chocking technique was the use of a trailer equiped with a rack in which 20 drums could be transported vertically. A cover equiped with chains was placed above the drums to ensure the stowing. Even if this was an improvement of the latter, this technique still had the draw-back of high doses to the workers since manipulation of the drums, and lashing were still done manually.

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. It was also decided to apply any reliable technique which, being still economical, could reduce the doses to the workers as much as possible.

Description

TRANSNUBEL selected the principle of a pneumatic stowing and chocking system. Basic design and pilot tests led to the system shown in fig. 1 for which a patent is pending in Europe and in the USA. It consists basically in a honeycomb rack equiped 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 equiped with guides in order to facilitate loading and unloading of the drums. The whole system is mounted in an open top 40 feet steel 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.

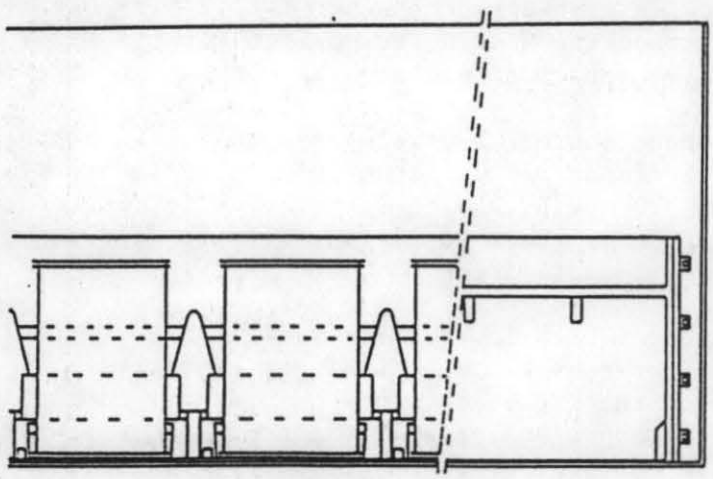

Fig. 1
Pneumatic stowing and chocking system for packages containing radioactive waste - Container TNB 0178

As well at the producers site or at the storage site, loading and unloading are performed by means of a remote 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.

Overall dimensions of the 40 feet ISO container are :
- length : 12,2 m
  width : 2,4 m
  height : 2,5 m
- mass of the empty container : 15,5 tonnes
  mass of the container loaded with 20 standard 400 l drums : 33,5 tonnes

Results

This table gives a comparison between the actual and the former way of transporting.

	Former situation	TNB 0178
- Maximum surface radiation level of the drums	2 mSv/h	5 mSv/h
- Number of drums transported (400 l Niras/Ondraf type)	24	20
- Loading - unloading time	2 hours	1 hour
- Manpower	2 workers	no manual intervention
- Absorbed annual doses	1 driver + 2 workers 30 to 50 m Sv	1 driver 0.9 to 1.5 m Sv
- Investment	22,500 USD 40 feet + tie-down system	115,000 USD 40 feet container + pneumatic system

Up to now approximatively 400 m^3 of conditioned waste have been transported with the TNB 0178 container between the Belgian power plants and the interim storage facility of Belgoprocess.
One annular cushion had to be replaced due to a leak at the inlet valve. No other incidents occurred during these transports.

Conclusions

NIRAS-ONDRAF, introducing a waste management program including the standardization of the packages for the radioactive waste, together with Transnubel, introducing an innovative stowing and chocking system, contributed to the reduction of the average dose levels to the workers during the transport operations of conditioned radioactive waste.
The new system has been proven to be reliable and safe. It fully satisfies to the international regulations and to the stowing and chocking rules set up by the research of TRANSNUBEL and CEA/France.

This unique concept of pneumatic stowing and chocking could be applied to the transport of other kinds of radioactive or toxic goods provided that the packages have standard dimensions.

References

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- IAEA Safety Standards n° 6 : Regulations for the Safe Transport of Radioactive Material.

- IAEA Safety Standards n° 9 : Basic Safety Standards for Radiation Protection.