A New Type B ISO Container for Transportation of Alpha Waste

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1. INTRODUCTION

The French Atomic Energy Commission (CEA) operates several facilities which produce various transuranic wastes. These wastes are generally stored in metallic drums.

There is a need for transportation of more than 1000 drums per year to intermediate storage sites and in the future to final storage sites which will be managed by ANDRA the French nuclear waste Agency.

To answer this need, TRANSNUCLEAIRE has developed the TN-GEMINI II, a large dimension "type B" container for use in France and in Europe.

This packaging fits on ISO 20 ft standard truck trailers using conventional tractors, and is also compatible with french railcar dimensions.

The main improvements brought by this design are:

- high payload: 40 drums, 200 liter type,
- versatility for transport of large size contaminated parts
- simple operational features.

An important part of the calculation studies were performed by TRANSNUCLEAR Inc., NEW YORK, taking advantage of the experience gained in the previous design of the TN GEMINI I in the United States.

2. SPECIFICATION OF CONTENTS OF THE PACKAGING

This packaging can accommodate forty 200 liter drums or sixty 100 liter drums and also 400 or 500 liter drums filled with transuranic waste. 5 m^3 and 10 m^3 containers, of concrete cylinders from ANDRA, may also be accomodated.

The TN GEMINI II can also be used as large size back-up packaging to transport defective or damaged containers, or contaminated items.

The maximum plutonium content assumed in the cavity is 400 g. The maximum thermal power generated by the total amount of radioactive waste in the drums is: Pmax = 10 watts

This thermal power and Pu content apply to waste stored in drums, but can be increased for different types of contents such as glove boxes, etc.

In the contents, the following materials are prohibited: pyrophoric, explosive, highly flammable or corrosive materials, items containing pressurized or flammable gases, and reactive chemicals. Good chemical compatibility among the wastes is required.

3. DESIGN FEATURES

The packaging is "type B" fissile and complies with IAEA 85 Regulations.

Its design relies upon the single containment concept accepted by various national Regulations in Europe. The internal design pressure is 2.0 bar gauge in normal conditions and 3 bar gauge in accident conditions. TRANSNUCLEAIRE has performed a detailed investigation concerning gas generation and flammable gas control (hydrogen) under the assumptions given in paragraph 2 and using data from Molecke (1978).

Based on G factor values for radiolytic generated gases of worst case materials (cellulose), we estimated that for the duration of 1 year, pressure increase is 1.2 bar and total pressure is kept within the criterion given. For a transport duration limited to 45 days, hydrogen content is 3.1%, therefore less than 4% which is the limit of burnable or explosive mixture in the cavity.

Further studies are presently being carried out with the French Competent Authority to assure that there is no accumulation of hydrogen in the drums before transport.

4. DESCRIPTION OF THE CONTAINER

4.1 Dimensions and weight

Overall dimensions are the following, in millimeters :

- length: 6058
- width: 2500
- height: 2800

BREAKDOWN OF WEIGHT	METRIC TONS
Internal arrangement	2
Containment	7
Wood	2
Puncture resistant panel	4
Framework	2
Shock absorbing cover	2
Empty weight	19
Contents	8
TOTAL loaded weight	27

Loaded with forty 200 l drums (8 tons) the total gross weight of the packaging is 27 metric tons, which leads to 40 tons for the whole transport system, complying with French road regulations. For other European countries, new internal arrangements can be adapted to optimize the payload to maximum authorized weight in transport.

4.2 Containment vessel

As shown in Figure 1, the container consists of a parallelepipedic stainless steel containment vessel whose useful dimensions are 2050 mm high, 1800 mm wide and 4610 mm long closed by a bolted door with a sealing flange.

Sealing is provided by two concentric elastomer "O" rings, which allow leaktightness testing when required and at least during a yearly maintenance.

4.3 Outer protective structure

The containment vessel is surrounded by a protective structure made up of several layers of materials ; balsa wood, fire insulation, puncture resistant panel and stainless steel outer envelope.

These layers are maintained by a steel framework including ISO standard corners for tie-down on trailer.

At each end, the packaging is protected by 40 cm thick shock absorbing covers. At the rear side of the trailer, it is removable to allow opening of the door, while at front side it consists of a fixed structure.

5. OPERATIONAL CHARACTERISTICS

The TN GEMINI II is designed for transport by truck trailer and train. The tie-down devices are in accordance with ISO standard. Only conventional trailers and transport equipment are needed, with the advantage of a low center of gravity.

It allows easy horizontal loading and unloading operations at rear side of the trailer without the need for hoisting the loads.

Figure 2 shows the sequence of operations for loading the container.

The removable shock absorbing cover is tilted to the horizontal position by hydraulic jacks. After opening the doors, the drum pallets can be loaded easily with rolling plates to their precise position in the cavity, and then tied-down. At facilities, a fork lift is the only necessary equipment for loading/unloading operations.

6. DESIGN CALCULATION AND TESTING

In order to comply with French and European regulations, this packaging is designed to withstand testing prescribed for "type B" packagings by IAEA Regulations.

6.1 9 m drop tests

Based on available crush distances and various impact orientations, the crush resistance of energy absorbing material has been determined. Design acceleration for corner drops is 85 g.

Stresses of the containment wall have been calculated by finite element analysis.

6.2 1 m drop test on punch bar

Calculations and scale testing of the panel have been performed for the case of punch bar which is obviously a severe test for parallelepipedic containers.

Kukuchek et al. (1983) show that the initiation energy during a 30-45° angle impact is only a fourth of the initiation energy of a perpendicular impact. Our test confirms that the angle impact condition causes far more damage than 90° impact.

First, static tests on structure specimens have been carried out to select panel designs which withstand the drop on the punch bar. Several combinations of steel plates, steel wire mesh, aluminium profiles, glass reinforced epoxy resin and wood have been tested. Various boundary conditions have also been tested: clamped, welded or free standing panels. A combination of steel and wood layers has finally been chosen.

After completing these tests, the most severe orientation of the packaging has been determined. The deepest penetration of the bar during a static test is obtained at 30°. At higher angles, the puncture bar tends to slide along the puncture resistant panel.

Subsequently, dynamic tests have been carried out on half scale panels in order to check the behaviour of the structure in actual drop. These tests show that there is no penetration for the worst drop orientation (30°) with the center of gravity over punch bar.

The TN GEMINI II is currently undergoing testing and analysis for licensing.

7. CONCLUSION

The TN GEMINI II is a new "type B" packaging which allows transport of transuranic waste in a variety of conditionings. It meets all type B testing requirements including punch impact in the orientation of maximum damage.

The TN GEMINI II is well adapted to the equipment of various nuclear sites thanks to its horizontal loading. Because of the large volume available, it is versatile and provides an answer to future development of transports of alpha waste to interim storage sites and final deep repositories.

8. REFERENCES

IAEA safety series n° 6. ed. 1985 amended 1990.

KUKUCHEK, P.E, KING, H.H, CHERRESH, M.C. "Trupact puncture resistant wall evaluation" GRC Adv. tech. div. CR-83-1222 (1983)

MOLECKE, M "Gas generation from Transuranic Waste degradation: data summary and interpretation". SAND. 79-1245 Sandia National Laboratories, 1978

FIGURE 1

DESIGN FEATURES OF HIGH CAPACITY ALPHA WASTE CONTAINER

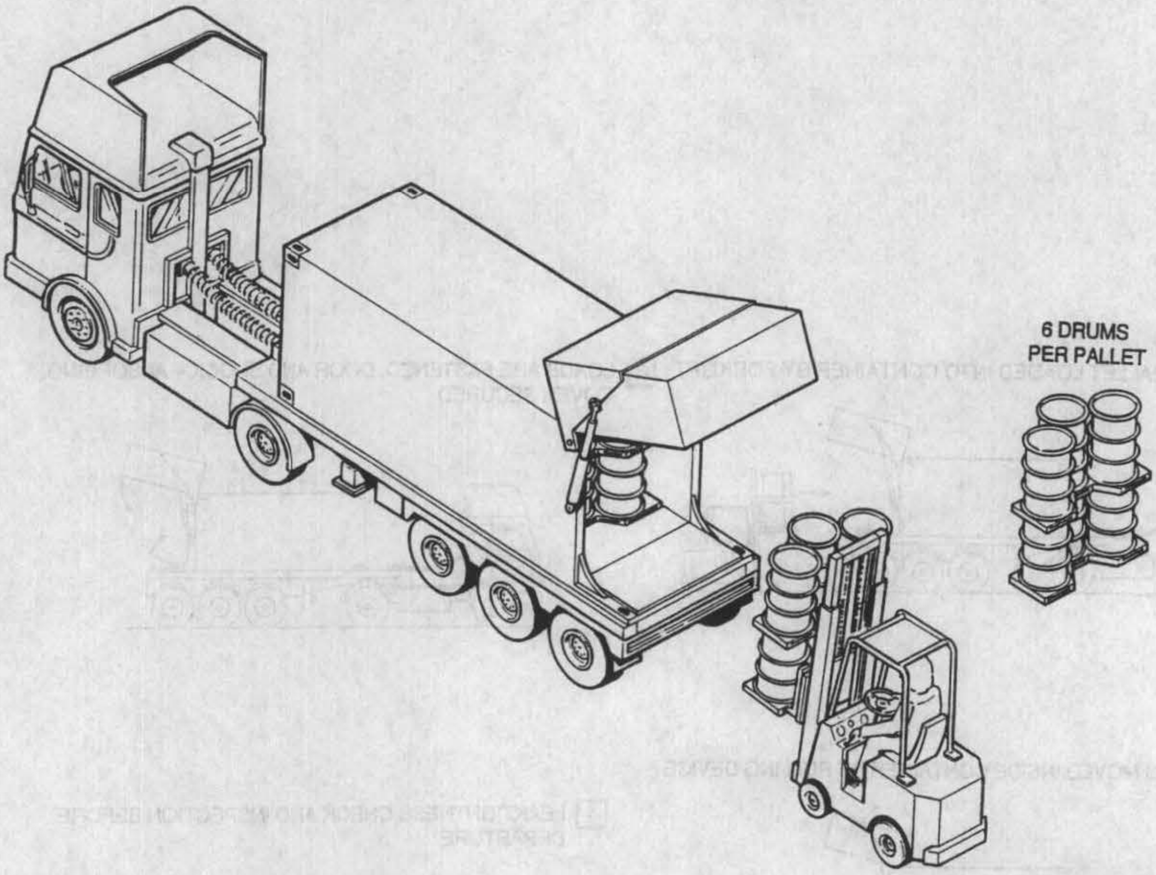
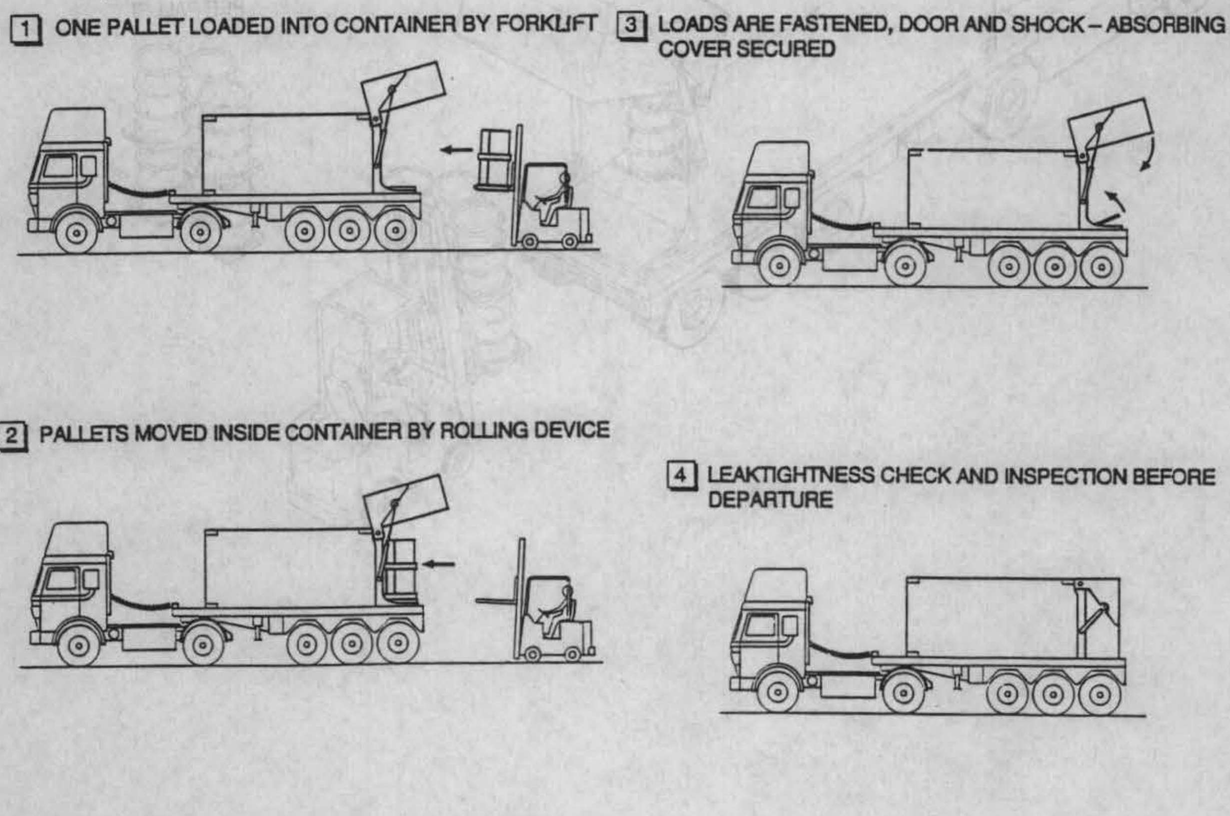


FIGURE 2

UNLOADING SEQUENCE OF THE ALPHA WASTE CONTAINER



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