DEVELOPMENT OF PACKAGING FOR TRU MATERIALS

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INTRODUCTION

Japan Atomic Energy Research Institute (JAERI) performs studies using TRU materials which are transported from United States and other countries to Japan. Previously, FCC-80Y-170K transport packaging has been used for this transportation. However, for the purposes to expand the capacity and to meet new transport regulations corresponding to IAEA '85, JAERI started the development of new packaging (ACC-90Y-180K) in 1988 and obtained the certificate of design approval in 1991.

The main feature of the packaging and demonstration test results are discussed in this paper.

CIRCUMSTANCES OF DEVELOPMENT

The outline of FCC-80Y-170K packaging is shown in Fig 1., which has been previously used for TRU transportation.

However, on the occasion of new Japanese transport regulations incorporating IAEA'85, JAERI determined to develop new design of packaging for TRU.

Basic requirements for new design were as follows.

① Requirements for operations

— easy decontamination

— light weight

— easy handling by remote control

② Requirements for contents

— large capacity up to 100g of fissile materials (in case of FCC-80Y-170K packaging, it is less than 15g)

③ Requirements for safety

— to meet new Japanese regulations and IAEA'85, especially

- ductility and soundness under −40℃
- mechanical test including drop test Ⅲ

The schedule for development of this packaging was as follows.

1988 : preliminary design

1989 : detail design / fabrication of 4 full scale model for demonstration test

1990 : demonstration test / preparation of safety analysis report

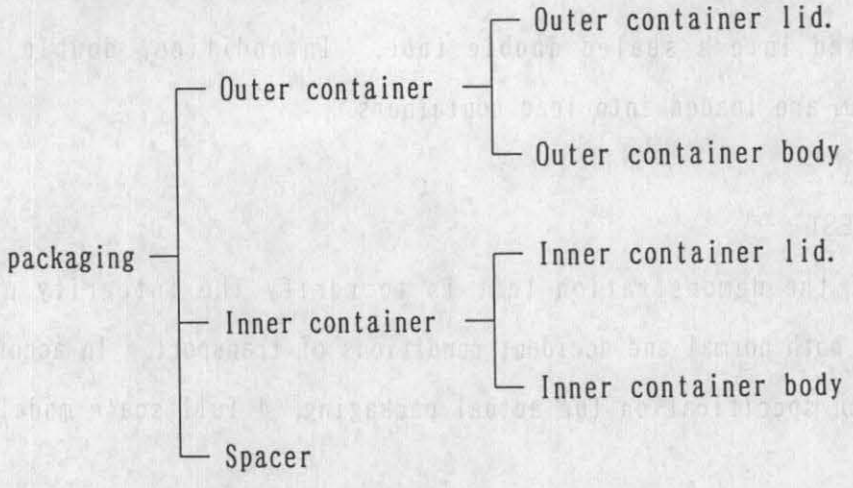
1991 : application of licence / issue of certificate of design approval.

OUTLINE OF ACC-90Y-180K PACKAGING

The outline of ACC-90Y-180K packaging is shown in Fig 2.

Total weight of the package is 180kg and outer dimension is φ560mm×715mm.

The packaging is consisted of the following parts.



The main material of the outer container is bulkfiber block and its surface are covered by 3mm thickness of stainless steel plate. The main function of the outer container is protection of inner container under both normal and accident conditions of transport. The bulkfiber block acts as a shock absorber during drop test and as a thermal insulator during the fire test.

The material of inner container is stainless steel. The inner container is containment vessel of the package, therefore, leaktightness of the packaging is assured by the inner container. The material of the gasket of inner container is sillicone rubber which can be used under -40 ℃～200℃ for long duration.

The spacer, which contains a double tube for TRU specimens, is contained in the inner container. There are two types of spacers, which can be used depending on kinds of TRU materials. Spacer can be divided into two parts in the axial direction in order to contain the double tube for TRU specimens.

Contents of this package is shown in Table 1.

Standard specification of TRU materials is as follows;

Weight : Up to 110g

Activity : Up to 72.1TBq

Decay heat : Up to 14.7w

Outer dimension of double tube : ϕ 13.7mm × 128.4mm

Contents of the packaging are actinoid-dioxide or actinoid-Aluminum alloy which are encapsulated into a sealed double tube. In addition, double tubes containing ^{243}Am are loaded into lead containers.

DEMONSTRATION TEST

The purpose of the demonstration test is to verify the integrity of the packaging under both normal and accident conditions of transport. In accordance with fabrication specification for actual packaging, 4 full scale model were fabricated.

Dummy contents simulating sealed double tubes were loaded into each specimen to evaluate integrity of welding joints of the double tube during the tests.

Test sequence of the demonstration test is shown in Fig. 3, and that was determined so as to maximize damage of the specimen.

As the activity of the contents possibly exceeds $1000A_2$ and the weight of the package is less than 500kg, the drop test Ⅲ (crush test from 9m height with 500kg of solid mild steel $1m^{W} \times 1m^{L}$) was also performed.

After the sequence of mechanical tests, the model was put into the fire (800℃, 30min) in the furnace.

Summary of the test results are shown in Table 2.

According to the test results, the followings were confirmed.

- Stainless steel covering outer container was not ruptured.
- The inner container and the double tube were not deformed.
- Maximum temperature of inner container lid gasket was less than the maximum allowable temperature.
- It was confirmed by leak test after the demonstration that integrity of containment of the inner container and the double tube was maintained.

Therefore, we can conclude that the demonstration test was successful. Based upon the test results, necessary calculations were carried out and safety analyses were completed.

CONCLUSION

JAERI has succeeded in the development of the new packaging for TRU materials which satisfy the operational requirements such as easy decontamination, light weight, easy handling by remote control, and meet requirements of Japanese regulations and IAEA'85.

Table 1 Specification of contents

No.	TRU material	Maximum Weight of TRU (g)	Maximum Activity (TBq)	Use of Lead container
1	Pu-238, Am-243	38.5	51.6	Yes (Am-243)
2	Pu-240, Np-237, Am-241	61.0	10.7	No
3	Pu-238, Cm-244	12.3	12.6	No
4	U-235, U-238, Pu-239 Pu-242, Th-232	103	7.72	No
5	Any combination of U-235, U-238 Pu-239, Pu-242, Th-232	110	35.0	No
6	Pa-231, U-236, Pu-241	67.1	72.1	Yes (Pa-231)
7	Mixture of Pu-239, Np-237 Am-241, Am-243	20.4	1.21	Yes (Mixture)
8	Mixture of Pu-239, Am-241 Am-243	20.5	1.96	Yes (Mixture)

Table 2 Summary of Test Results.

	DROP TEST I (9m)			DROP TEST III (Crush)	
	Oblique	Vertical	Horizontal	Horizontal	Vertical
Deformation of Outer Container (mm)	64	9	33	76	53
Deformation of Inner Container and Double Tube	None	None	None	None	None
Maximum Temperature of gasket during Fire Test (℃)	less than 167℃ (Allowable Temp. is 200℃)				
Leak Rate after the Test (mm) — Inner Container — Double Tube	less than 1×10^{-2} atm・cc/sec less than 1×10^{-8} atm・cc/sec				

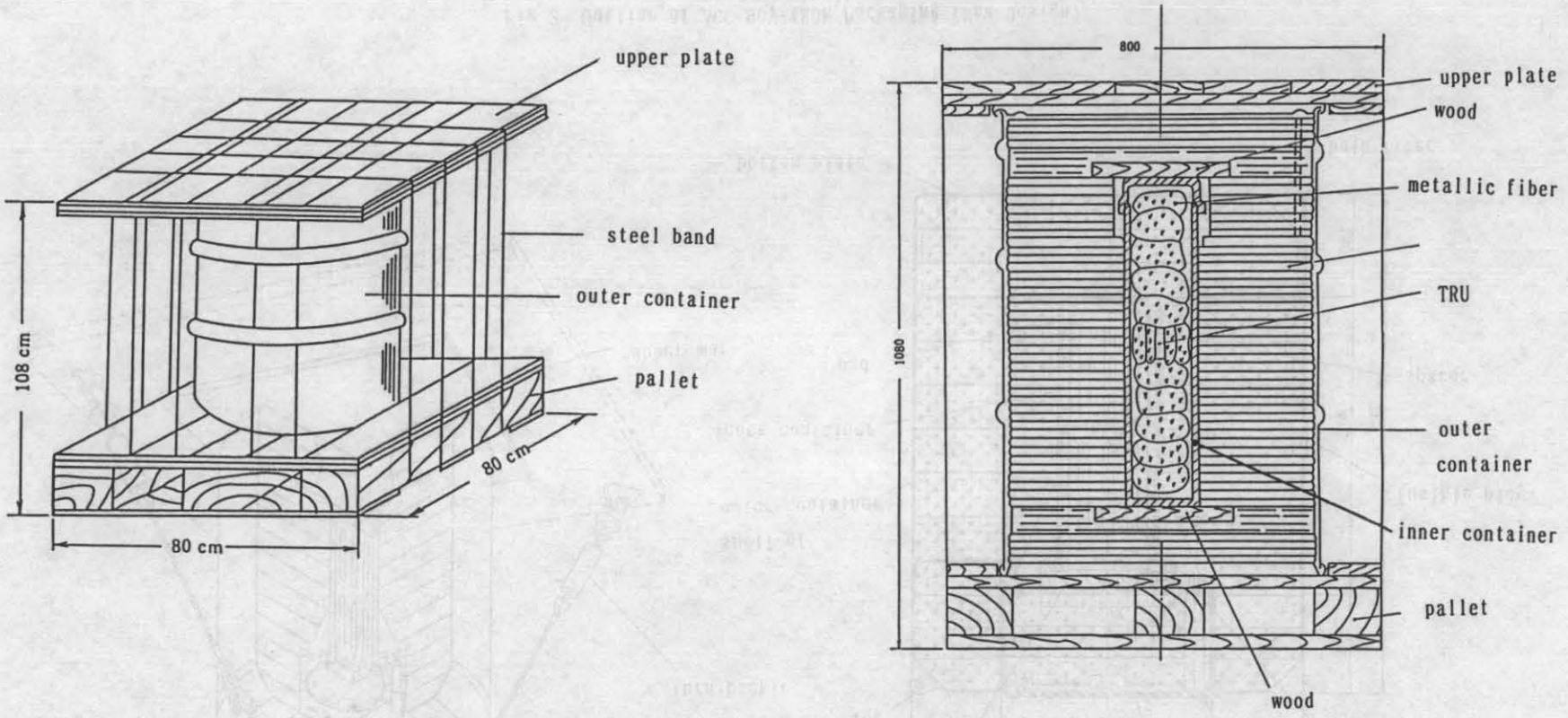


Fig 1 Outline of FCC-80Y-170K Packaging (Previous Design)

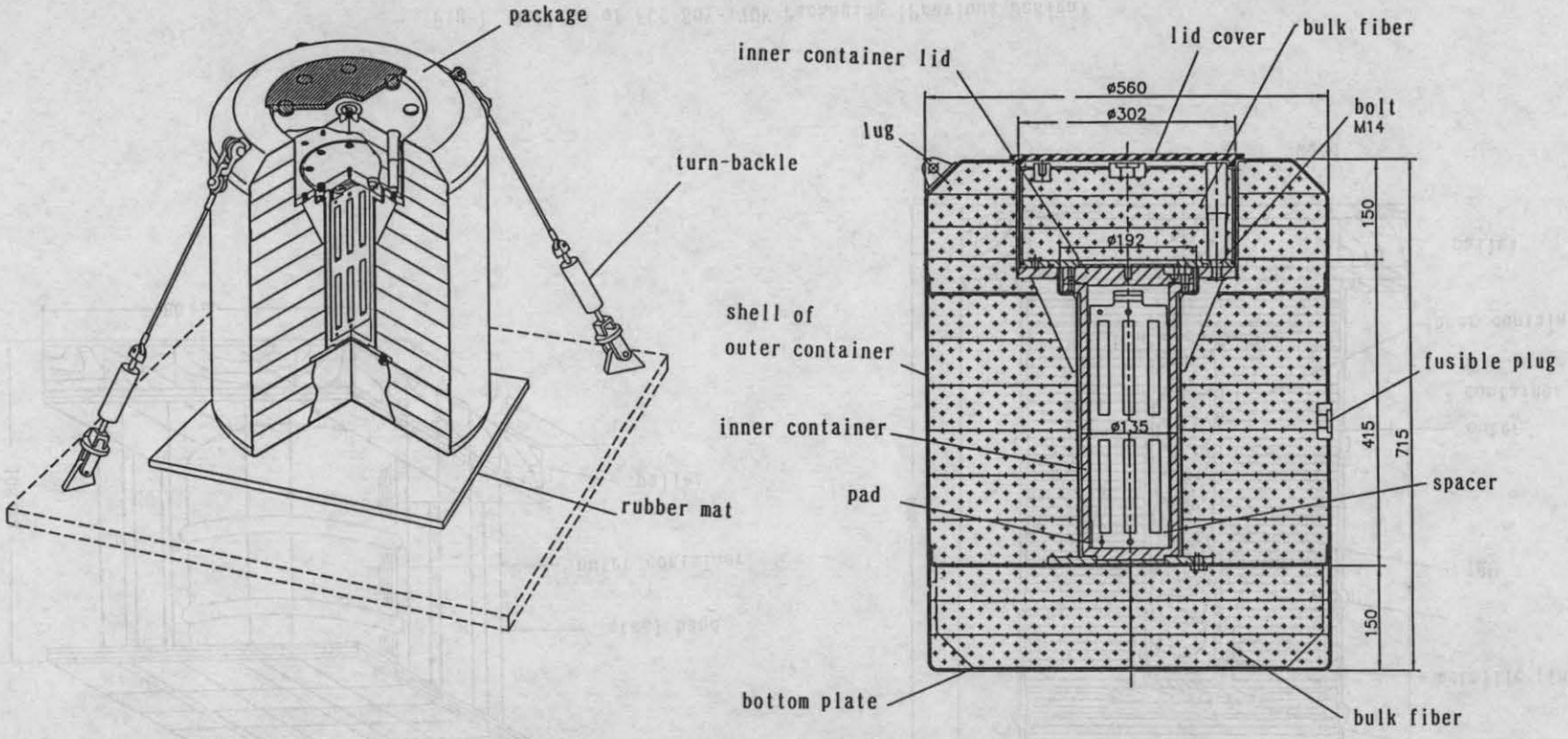


Fig 2 Outline of ACC-90Y-180K Packaging (New Design)

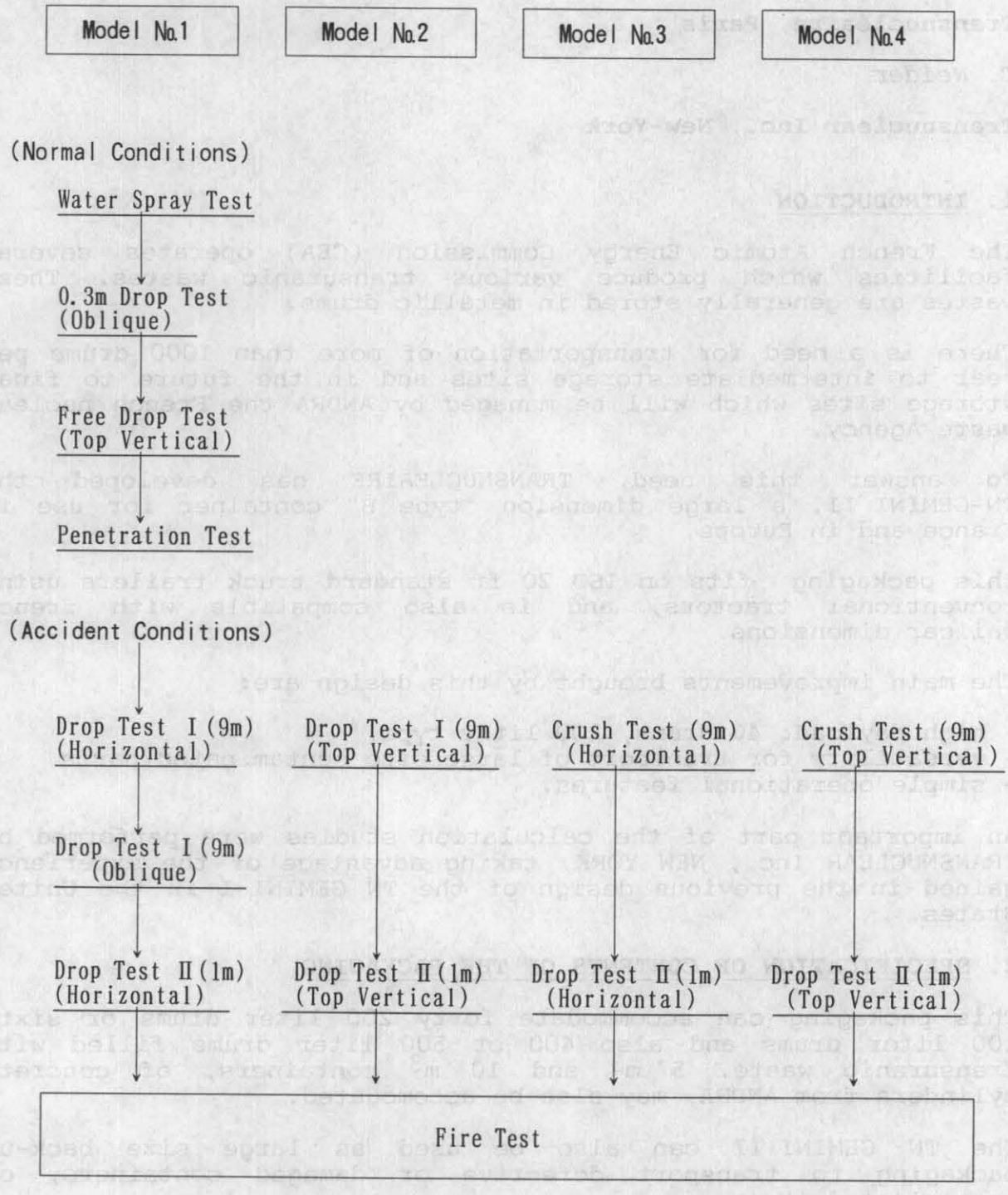


Fig. 3 Demonstration Test Sequence