Experience of Maintenance of the HZ-75T Cask in Japan

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SUMMARY

The HZ-75T spent fuel shipping cask has been used in domestic transportation of LWR spent fuel and ATR spent fuel from 10(ten) nuclear power plants to the Tokai Reprocessing Plant of Power Reactor and Nuclear Fuel Development Corporation. The details of design, fabrication and experience of operation were presented at previous meetings of the PATRAM (Onodera et al 1978, Niomura et al 1980 and Ozaki et al 1983).

As of March 1992, 104 shipments in total(number of casks:208, about 600 MTU) have been made.

The HZ-75T casks are strictly controlled in accordance with the proper quality assurance program for long term use. By application of the appropriate periodic inspections and maintenances, the soundness of casks have been kept perfectly at any time.

The periodic inspections and maintenances of HZ-75T cask are specified as 4(four) categories in the essential maintenance program. They are each shipment, annually, 5(five) yearly and 10(ten) yearly.

By continuing these activities, it is planned to use HZ-75T Casks for the domestic transportation of spent fuel for a long time.

1. DESIGN SPECIFICATION OF THE HZ-75T CASK

The HZ-75T cask weighs approximately 82 tons as package, and it is able to carry 7 PWR or 17 BWR(ATR) fuel assemblies.
The cask is designed as wet type and consists of 3(three) stainless steel barriers including lead as gamma shield and ethylene glycol solution as neutron shield.

Details of design specifications are listed in Table-1 and a rough sketch of the cask is shown in Fig. 1.

2. EXPERIENCES OF TRANSPORTATION

Four units of the HZ-75T casks that were fabricated in 1979 (PWR:2 units, BWR:2 units), have been exclusively used for domestic transportation of LWR and ATR spent fuels to the Tokai Reprocessing Plant of Power Reactor and

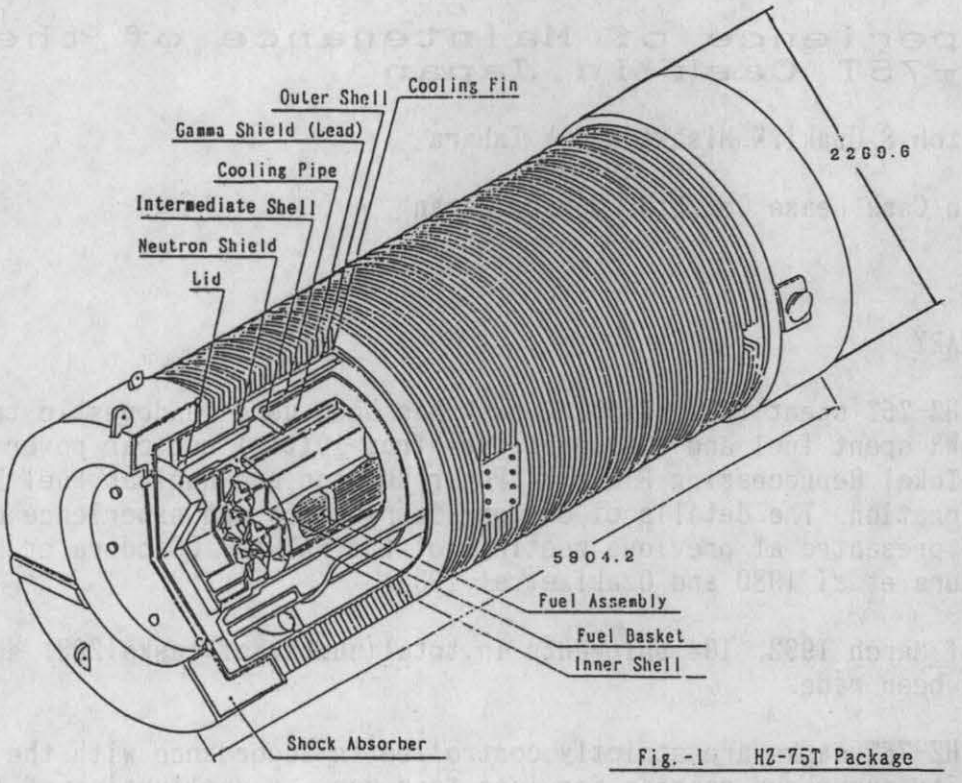

Fig.-1 HZ-75T Package

Table-1 Design Specification of the HZ-75 Cask

Classification	Type B (M)
Dimension	
Length (including Impact Limiter)	5.91 m
Outside Diameter	2.27 m
Cavity Diameter	0.95 m
Cavity Length	4.54 m
Weight	
Lifting Weight in reactor building	approx. 79 ton
Cask on Transporter	approx. 82 ton
Capacity	
PWR Fuel	7 assemblies
BWR Fuel	17 assemblies

Design Parameter of Fuel

	PWR	BWR	ATR
Fuel	UO_2	UO_2	UO_2/UO_2+Pu_2
Cladding	Zircaloy	Zircaloy	Zircaloy
Enrichment, U235	3.5 %	3.3 %	2.45 %
Average burn-up (max.)	35,000 MWD/MTU	34,000 MWD/MTU	35,000 MWD/MTU
Cooling Time (min.)	360 days	300 days	720 days

Nuclear Fuel Developement Corporation.

As of March 1992, 104 shipments in total(number of casks:208, about 600 MTU) have been made as shown in Table-2.

Additional 2(two) BWR type casks will be ready by the fall of 1993 for increasing the transportation capacity.

3. QUALITY ASSURANCE PROGRAM

Domestic transportation in Japan is short distantance transportation and is carried out by cooperative use among ten utility companies, so the frequency of transportation is very high.
It is necessary and important to ensure that the casks are in good condition and in compliance with the regulation and approved conditions required by the competent authority.
The quality assurance program of the HZ-75T cask has been prepared for cooperative use by OCL and has been employed.
In the QA program, the principles of maintenance are given and the details are provided in the "HZ-75T cask maintenance manual".
The quality assurance program flow chart as to maintenance is shown in Fig.2.
All QA records and/or information is compiled and managed by the QA group of OCL so that QA engineers can understand the actual conditions of a cask and take them into consideration for the proper maintenance activities in a timely manner.

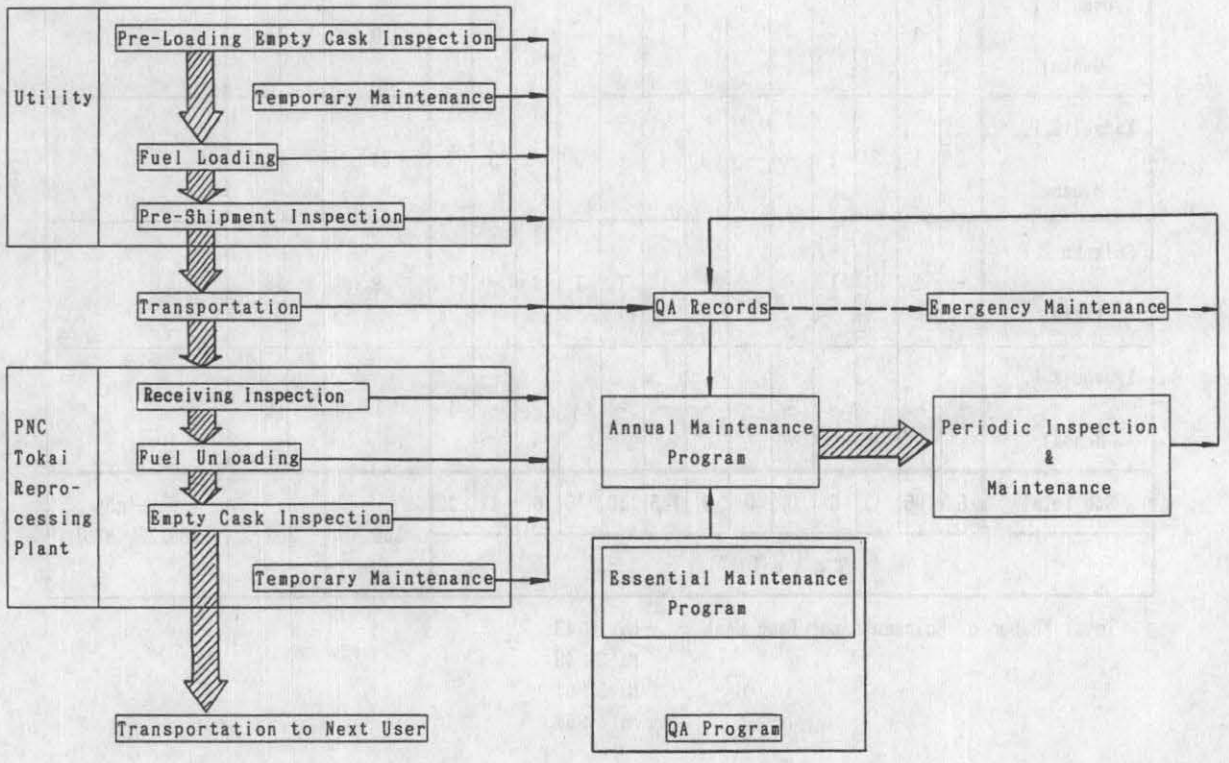

FIG 2. Quality Assurance Flow Chart

Table-2 Transportation Record of Utilities

Utility / Power Site	Number of Shipment/The Year(Fiscal) Transported '79	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91	Total Number of Shipments	Total Number of Casks	Remarks
Chugoku E.P. Shimane	2	2	2	1	-	-	-	1	1	-	-	1	1	11	22	
Chubu E.P. Hamaoka	1	2	1	1	-	-	1	1	-	1	1	-	1	10	20	
Japan Atomic P. Tokai	-	1.5	1	1	-	-	-	3.5	2	2	-	3	2	16	32	
Tokyo E.P. Fukushima 1	-	-	1	1	-	-	3	2	3	2	1	1	1	15	30	
P N C. Fugen	-	-	-	-	-	-	1	1	-	1	1	2	1	7	14	
Tohoku E.P. Onagawa	-	-	-	-	-	-	-	-	-	-	1	1	(1)	2	2	
Kyushu E.P. Genkai	1	3	2	-	-	-	-	1	1	-	1	-	-	9	18	
Kansai E.P. Mihama	2	1	3	1	-	-	3	4	2	3	-	3	2	24	48	
Shikoku E.P. Ikata	-	1	1	1	-	-	1	1	1	1	1	-	1	9	18	
Kyushu E.P. Sendai	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	
Sub Total	6	10.5	11	6	0	0	9	14.5	10	10	6	11	10	104	208	U-Weight 598.29 (MTU)
Total																

Total Number of Shipments per Each Cask
No. 1 : 43
No. 2 : 43
No. 3 : 61
No. 4 : 61

4. MAINTENANCE PROGRAM

The essential maintenance program has been prepared for the HZ-75T casks to ensure that all inservice operations are carried out under safe conditions at any time.
The annual maintenance program which specifies the details to be carried out during 1(one) year is arranged reflecting the latest data and information.

The essential maintenance program for the cask body consists of 4(four) categories of inspection and maintenance group as shown in Table-3.

"Each Shipment" is carried out at pre-loading stage of each shipment to ensure the soundness of cask during every turnround operation.
For the damages that affect normal operation and/or approved condition of the package the temporary maintenance is to be applied.

"Annually" is carried out periodically every year to ensure and keep the soundness of cask for use several times.
"5 Yearly" and "10 Yearly" are carried out periodically every 5(five) years and 10(ten) years to refurbish the cask and ensure its soundness for long term use.
These maintenances include major inspection, test and repair, and systematic replacement of parts for refurbishing.

The HZ-75T cask consists of stainless steel structure so that all the material of the exposed surface is made of stainless steel that has high resistance against corrosion and other damages.
The essential maintenance program is prepared and improved periodically by taking these characters, transport cycle and the experiences of maintenance activities into consideration.

5. EXPERIENCES OF MAINTENANCE

Periodic maintenance activities of HZ-75T cask are carried out at the facility of the utility and/or the reprocessing plant, because we have no independent maintenance facility for a cask in Japan at this point.
In the case of this condition, it takes 3(three) days per cask by 5(five) workers for annual maintenance and we need additional control staff and a period for preparation depending on each different site requirement.

As to HZ-75T cask which is a wet type cask and has an open basket, the contamination of the cask interior has not been increased, so the exposure dose for personnel has not offered a serious problem.
The total exposure dose for personnel(man·mSv) of each maintenance category carried out at reactor site is shown in Table-4.
It is possible to reduce the number of workers, the period and exposed dose by preparing the exclusive maintenance facility in the future.

Table-3 Essential Maintenance Program of Cask Body

Category	Items	Method
Each Shipment	1. Visual inspection	Visual check of surface of all components.
	2. Leak tightness test	Pressure drop test for lid and valves.
	3. Soundness check of lifting devices	Visual check of surface of lifting devices.
	4. Cask inside inspection	Visual check of cask inside and deformation of fuel basket.
	5. Operational inspection	Operational check of valves and other accessories.
	6. Temporary maintenance	Replacement of damaged parts and carrying out other minor maintenance.
Annually	1. Visual inspection	Visual check of surface of all components and parts.
	2. Leak tightness test	Pressure drop test or helium leak test for lid and valves with special acceptance criteria. (Normal A.C. $\times$1/10)
	3. Soundness check of lifting devices	Visual check and dye penetrant inspection for all lifting devices.
	4. Cask inside inspection	Visual check of cask inside and deformation of fuel basket.
	5. Operational inspection	Removal of all accessories and visual check of all parts.
	6. Contamination check	Measurement of contamination level of cask inside.
	7. Periodic replacement of parts	Replacement of all elastomer O-ring and damaged parts.
	8. Periodic repair	Repair of hurtful damage and polish of cask surface. (Partial)
5 Yearly	1~8 : Same as annually	
	9. Sampling check of neutron shield	Measurement of specific gravity and freezing temperature of ethylene glycol solution.
	10. Bolt hole maintenance	Replacement of all helicoils and cleaning holes.
10 Yearly	1~10 : Same as 5 Yearly	
	11. Dimensional inspection of fuel basket	Through gauge check for fuel basket.
	12. Pressure test	Hydrostatic test for pressure barrier.
	13. Dye penetrant inspection for weld seam	Dye penetrant inspection of typical weld seam of inner and outer cask surface.
	14. Evaluation of thermal conductivity and shielding	Analyzing evaluation in comparison with measured detail data of typical package.
	15. Periodic replacement of parts	Replacement of all bolts used for pressure barrier.
	16. Periodic repair	Repair of all damages and polish of full surface.

Table-4 Total Exposure Dose for Personnel (man·mSv)

Category	PWR	BWR
Each Shipment	< 0.01	< 0.01
Annually	< 0.5	< 2
5 Yearly	< 1	< 5
10 Yearly	< 1	< 5

6. FUTURE APPLICATION

The maximum dose rate of the package for typical high burnup fuel is shown in Table-5.
The life of a cask is to be dominated by future design parameters and the damaged condition of hardware.

From the viewpoint of the future design requirements, the HZ-75T cask can be applied for long term use.

As of 1992 the prior 4 units of the HZ-75T casks have been used for 14 years, and the casks have been kept in good condition by carrying out the suitable maintenance as mentioned above.

To continue these activities, it is planned to use the HZ-75T casks for the domestic transportation of spent fuels for a long time, and the experiences of maintenance activities of the HZ-75T casks are to be reflected in the design of later casks.

Table—5 Maximum Dose Rate of HZ-75T Cask for Typical High Burnup Fuel

Item			Current Specification	Specification of Typical High Burnup Fuel
PWR	Parameter of Fuel	Burnup ($\frac{MWD}{MTU}$)	35000	44000
		Enrichment (%)	3.5	4.0
		Cooling Time (days)	360	630
	Maximum Dose Rate	At Normal Transport (At 1m from Surface) (μSv/h)	32 (Top of Lid)	51 (Top of Lid)
		Normal Test Condition (At Surface) (μSv/h)	1092 (Lateral of Lid)	1660 (Lateral of Lid)
BWR	Parameter of Fuel	Burnup ($\frac{MWD}{MTU}$)	34000	40000
		Enrichment (%)	3.3	3.4
		Cooling Time (days)	300	1050
	Maximum Dose Rate	At Normal Transport (At 1m from Surface) (μSv/h)	81 (Lateral of Lid)	75 (Lateral of Lid)
		Normal Test Condition (At Surface) (μSv/h)	838 (Lateral of Lid)	788 (Lateral of Lid)

REFERENCE

N. Niomura et al. 1980 (PATRAM '80) " FABRICATION EXPERIENCE OF THE HZ-75T SPENT FUEL SHIPPING CASK "

A. Onodera et al. 1978 (PATRAM '78) " THE HZ-75T SPENT FUEL SHIPPING CASK "

S. Ozaki et al. 1983 (PATRAM '83) " OPERATIONAL EXPERIENCE WITH THE HZ-75T SPENT FUEL SHIPPING CASK "

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