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M-36

SEP 20 1985

MEMORANDUM FOR: Leland C. Rouse, Chief
Advanced Fuel and Spent Fuel Licensing Branch
Division of Fuel Cycle and Material Safety

FROM: John P. Roberts
Advanced Fuel and Spent Fuel Licensing Branch
Division of Fuel Cycle and Material Safety

SUBJECT: MEETING WITH MITSUBISHI HEAVY INDUSTRIES, LTD. (MHI)

DATE AND TIME: September 5-6, 1985; 8:30 a.m.

LOCATION: Lawrence Livermore National Laboratory
Livermore, California

ATTENDEES: See Enclosure 1

PURPOSE: To discuss MHI's submittal of a revised topical safety analysis report for the design of its MSF IV dry spent fuel storage cask (formally the REA 2023 cask) for the storage of spent pressurized water reactor (PWR) fuel in an at reactor site independent spent fuel storage installation (ISFSI) (See Enclosure 2, agenda).

DISCUSSION: In general, the discussion followed the agenda. After introduction of MHI (see Enclosure 3 and 4), quality assurance was briefly discussed. It was discussed in detail in a subsequent meeting with the Quality Assurance Branch on September 10, 1985. Design changes have been made to the REA 2023 PWR original design which will be incorporated in the MSF IV. Previous NRC staff comments (letter to Ridihalgh, Eggers and Associates dated November 4, 1983) on the original REA 2023 PWR cask design were reviewed. MHI is preparing a revised topical report in response to NRC staff comments for submittal in early 1986.

John P. Roberts
Advanced Fuel and Spent Fuel
Licensing Branch

Enclosures:
1. Attendance List
2. Agenda
3. Organizational Chart
4. MHI Capabilities

OFFICE				FCAF	FCAF		
SURNAME				JPRoberts/cj	LCRouse		
DATE				9/20/85	9/20/85		

Enclosure 1

ATTENDEES
(6 Sept. 1985)

JOHN R. GENSER	NUCLEAR STRUCTURES, INC.
DWAINE A. GODFREY	NUCLEAR STRUCTURES, INC
GORDON EPSTEIN	MITSUBISHI INT'L CORP.
Masao Ohashi	Mitsubishi Heavy Industries
H. NAKAMOTO	MHI head quater Nuclear Waste Management Eng. Sec.
Homer Lowenberg	Lowenberg Associates, Inc.
John P. Roberts	NRC/NMSS
Jim Schneider	"
MARTIN W. SCHWARTZ	LLNL
Mark Mount	LLNL
Monika Witte	LLNL
Larry Fischer	LLNL
Kazuo Asada	Mitsubishi Heavy Industries
Saburo Ashida	Mitsubishi Atomic Power Industries Inc.
Mitsuhiro Irino	Mitsubishi Heavy Industries Inc. TAKASAGO
Masaharu Kudoh	MHI Kobe Nuclear Plant QA Sect
Katsunori Ohsono	MHI head quater Nuclear Waste Manag. Eng. Sec.

Agenda for Meeting Between
MITSUBISHI HEAVY INDUSTRIES, LTD.
and NRC on September 5 and 6, 1985

September 5, 1985

1. Opening remarks and presentation of MHI organization and communications chart - H. Lowenberg (5 minutes)

2. Introduction of MHI-NSI technical team and MHI interest in NRC approval of MSF-IV for storage - H. Nakamoto (15 minutes)

3. Presentation of MHI capabilities and resources
   - Video tape and movie - (45 minutes)
   - Documents - (5 minutes)

4. Brief presentation of MHI QA Program/Plan for MSF-IV - M. Kudoh (10 minutes)

5. Discussion of principal design criteria - H. Lowenberg and MHI-NSI technical team - (30 minutes)

6. Discussions on design conditions, i.e. radiation protection, site conditions, installation, etc. - H. Lowenberg and MHI-NSI technical team - (1 - 2 hours)

7. Lunch Break - (1 hour)

8. Discussion of key NRC questions and MHI approach to providing responses for accident analyses - H. Lowenberg and MHI-NSI technical team - (2 - 4 hours)

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September 6, 1985

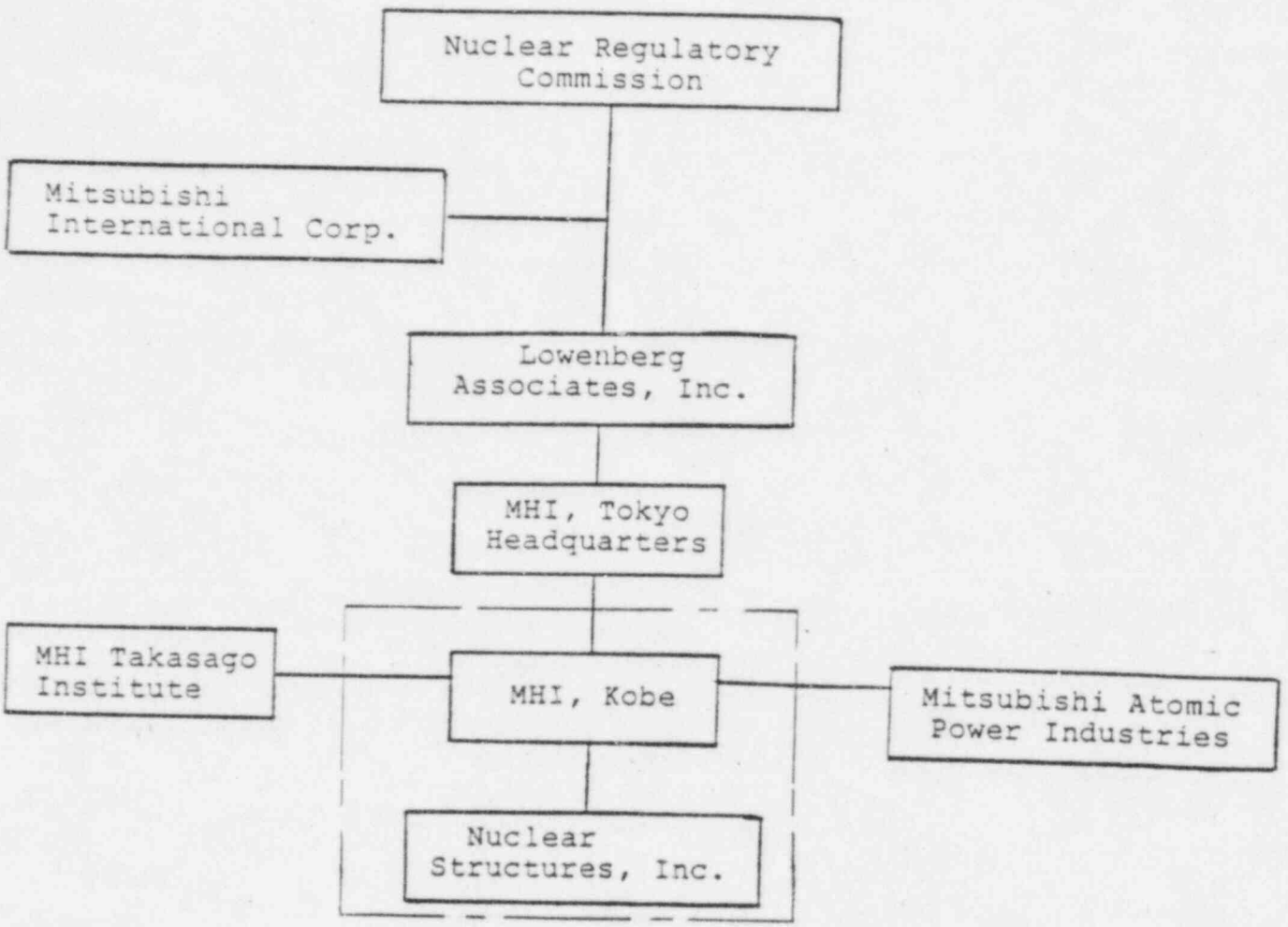
9. Review of discussion on September 5, 1985 - further clarification H. Lowenberg and MHI-NSI technical team - (½ to 1 hour)

10. Review of docket M-36 project - H. Lowenberg (1 hour)
    - MHI's schedule for submittal of revised TSAR
    - NRC projection for review and approval
    - Availability of data from DOE demonstration and tests
    - NRC comments

11. Plans for next meeting with NRC (15 minutes)
    - Quality Assurance
    - TSAR

12. Closing remarks from MHI - H. Nakamoto (5 minutes)
    - Video tape - (20 minutes)

Organizational Structure and Communication Chart for Mitsubishi Heavy Industries, Ltd. (MHI) Docket Files M-36 and M-33



Organization	Function
MIC-Washington	Liaison
LA (Lowenberg Associates)	Agent
MHI head office (Nuclear Waste Management Eng. Sec.)	Official Capacity for application
MHI Kobe (Kobe Shipyard & Engine Works) Nuclear Plant Equipment Designing Sec. Nuclear Plant QA sec.	Overall responsibility for MSF-IV Cask Engineering Quality Assurance
MHI Takasago Institute MAPI (Mitsubishi Atomic Power Ind.)	Technical Advisor
Vendor NSI (Nuclear Structures Inc.)	Analysis

Enclosure 4

CAPABILITIES OF

DESIGNING AND MANUFACTURING OF SHIPPING CASK

IN MITSUBISHI HEAVY INDUSTRIES (MHI)

MITSUBISHI HEAVY INDUSTRIES, LTD.

CONTENT

SPENT FUEL SHIPPING CASK

OUR EXPERIENCE IN THE SHIPPING CASK FIELD

From the first half of 1960's, we, Mitsubishi Heavy Industries, Ltd., have been involved in the development of designing and manufacturing in the cask, together with the safety licensing application service.

Up to the present, we have manufactured and constructed numerous nuclear facilities including nuclear power plants and the nuclear fuels, and with this accumulated technology as a basis, we are now aiming to design and manufacture the shipping cask that coordinates nuclear power plant and nuclear fuel.

SAFETY ANALYSIS

As for safety analysis of the shipping cask, overall correspondence in broad fields is required, such as structural, thermal, sealing, shielding and critical analysis together with its manufacturing and inspection.

Safety analysis is now carried out based on abundant, high-level technology that was experienced in the designing of nuclear power plants.

TESTING AND RESEARCH

To evaluate the safety of the shipping cask, it is necessary to carry out its analysis and various demonstration tests, model tests and basic researches in material and welding, etc.

At our company, these tests are carried out at Takasago Technical Institute which is our main laboratory for research relating to nuclear energy.

MANUFACTURE

As the shipping cask contains spent fuels or radioactive materials, it is necessary that the technology of manufacturing and quality control should be highly reliable.

For years, we have been manufacturing not only heavy components for nuclear power plants, but also numerous vessels and core internals for reactors at our factory exclusively for nuclear energy.

Also, our broad experiences based on technology acquired from manufacturing and quality control is applied to the manufacturing of these shipping casks.

SUPPLY LIST

No.	Place of Delivery	Year Delivered	Designation of Work	Type
1.	Japan Atomic Energy Research Institute	1963, 1964	Designing & Manufacturing of Spent Fuel Shipping Cask for JRR2	–
2.	Central Research Institute of Electric Power Industry	1978	Concept Design of 100 Ton & 50 Ton Class LWR Spent Fuel Shipping Cask for Demonstration Test.	B(M)
3.	Mitsubishi Heavy Industries, Ltd. (in-house use)	1979	Demonstration Test of Shipping Cask for Demonstration Transporting Surveillance Capsule for Nuclear Reactor	B(M)
4.	Mitsubishi Heavy Industries, Ltd. (in-house use)	〃	Designing and Manufacturing of Shipping Cask for Transporting Steam Generator Extraction Tubes.	A
5.	Mitsubishi Heavy Industries, Ltd. (in-house use)	1980	Designing and Manufacturing of Shipping Cask for Transporting Surveillance Capasule for Nuclear Reactor.	B(M)
6.	Power Reactor & Nuclear Fuel Development Corporation	〃	Demonstration Test of TN9121 Type Shipping Cask for Transporting Fresh Fuel of Jyoyo.	B(U)
7.	Central Research Institute of Electric Power Industry	〃	Demonstration Test of 50-Ton Class Shipping Cask for Transporting LWR Spent Fuel (Fire Test)	B(M)
8.	Central Research Institute of Electric Power Industry	〃	Manufacture of 50-Ton Class Shipping Cask for Demonstration Test.	B(M)
9.	Central Research Institute of Electric Power Industry	〃	Designing of 100-Ton Class Cask for Demonstration Test for Transporting LWR Spent Fuel.	B(M)
10.	Central Research Institute of Electric Power Industry	〃	Demonstration Test of 50-Ton Class Shipping Cask (Pressure Resistance Test: 300kg/cm^2)	B(M)
11.	Kansai Electric Power Company, Inc. (Licensee)	1982	License Application for Approval of Designing MS-1 Type Shipping Cask.	B(M)
12.	Power Reactor & Nuclear Fuel Development Corporation (Licensee)	〃	License Application for Approval of Designing of TN9121 Type Shipping Cask	B(U)
13.	Central Research Institute of Electric Power Industry	〃	Concept Design of Shipping Cask for Transporting High Level Returned Disposals.	B(M)
14.	Power Reactor & Nuclear Fuel Development Corporation	〃	Reconstruction Work of TN9121 Type Shipping Cask	B(U)
15.	Central Research Institute of Electric Power Industry	〃	Manufacturing of 100-Ton Class Shipping Cask for Demonstration Test.	B(M)
16.	Mitsubishi Heavy Industries, Ltd. (in-house use)	〃	Concept Design of MSF-1 Type Shipping Cask for Transporting LWR Leaker Spent Fuel	B(M)
17.	Kansai Electric Power Company, Inc.	〃	Concept Design of BP Carrier Container	–
18.	Mitsubishi Heavy Industries, Ltd. (in-house use)	1983	Concept Design of MSF-II Type for Transporting New Type High Burnup Spent Fuel	B(M)
19.	Mitsubishi Heavy Industries, Ltd. (in-house use)	〃	Detailed Design of MSF-1 Type Shipping Cask.	B(M)

No.	Place of Delivery	Year Delivered	Designation of Work	Type
20	Japan Nuclean Ship Research and Development Agency	1984	Concept Design of Spent Fuel Shipping Cask for Nuclear Ship "Mutsu"	
21	Central Research Institute of Electric Power Industry	〃	Technical Evaluation of REA Type Transportable Storage Cask in Dry Storage of Spent Fuel	S(M)
22	Central Research Institute of Electric Power Industry	〃	Technical Evaluation of Dry Storage Facility	

SPECIAL TESTING AND DEVELOPMENT PROGRAM

CARRIED OUT BY MHI

1. Basic Studies

(1) Compression Characteristic Test of Various Shock Absorbing Materials for Shock Absorber

Both statical and kinetic compression characteristics of the main wooden material and plastic, etc., were obtained.

(2) Welding Studies of Copper Fins

A study was made of the welding conditions when welding copper fins to stainless steel or carbon steel.

(3) High Temperature Strength Test of Lead

A test was made under high temperature to obtain the tensile strength of lead and the compressed strength of lead when casted inside the can and the coefficient of friction.

(4) Heat Transfer Performance Test of the Inner Fin

A test was made regarding heat transfer performance of the inner fin for heat transfer installed inside of the high modecule material.

(5) Development of a Highly Effective Neutron Shielding

Silicon rubber, a neutron shielding material with outstanding thermal resistance and fire resistance was developed.

(6) Evaluation of Burnup Behavior of High Molecule Neutron Shielding Material

An analysis method of high molecule material filled inside colsed vessel in fire condition was established.

(7) Evaluation of Heat Transfer Performance in Spent Fuel Assembly under a Dry Horizontal and Vertical Position.

Projecting the establishment of an analysis method of a maximum rod temperature for PWR spent iuel assembly during a dry storage.

2. Studies for Practical Use

(1) Demonstration test of MS-I Type Shipping Cask

(2) Demonstration test of Steam Generator Extraction Tube Shipping Cask

(3) Fire Test of MSF-I Type Shipping Cask by a sectional model

(4) Conceptual design and detailed design of MSF-I Type Shipping Cask

(5) Conceptual design of new type Shipping Cask for high burnup spent fuels

(6) Study to improve fabricating process of lead ring (Under study)

(7) Model test of MSF-1 Type Shipping Cask

(8) Demonstration test of New-Type PWR fresh fuel Shipping Cask

3. Development of Analysis Code

(1) CASH-II CODE

A shock absorber performance evaluation code for the cask shock absorber based on the Uniaxial Displacement Method

(2) FINPAC CODE

An impact characteristic evaluation code of the circular fin.

(3) CAFAD CODE

A cask kinetic response evaluation code when an earthquake occurs at the time of stored in upright position

(4) CAPUC CODE (Under development)

A penetration resistance performance evaluation code at the time of cask penetration test (Drop Test II)

MHI CASK DEVELOPMENT VIEW

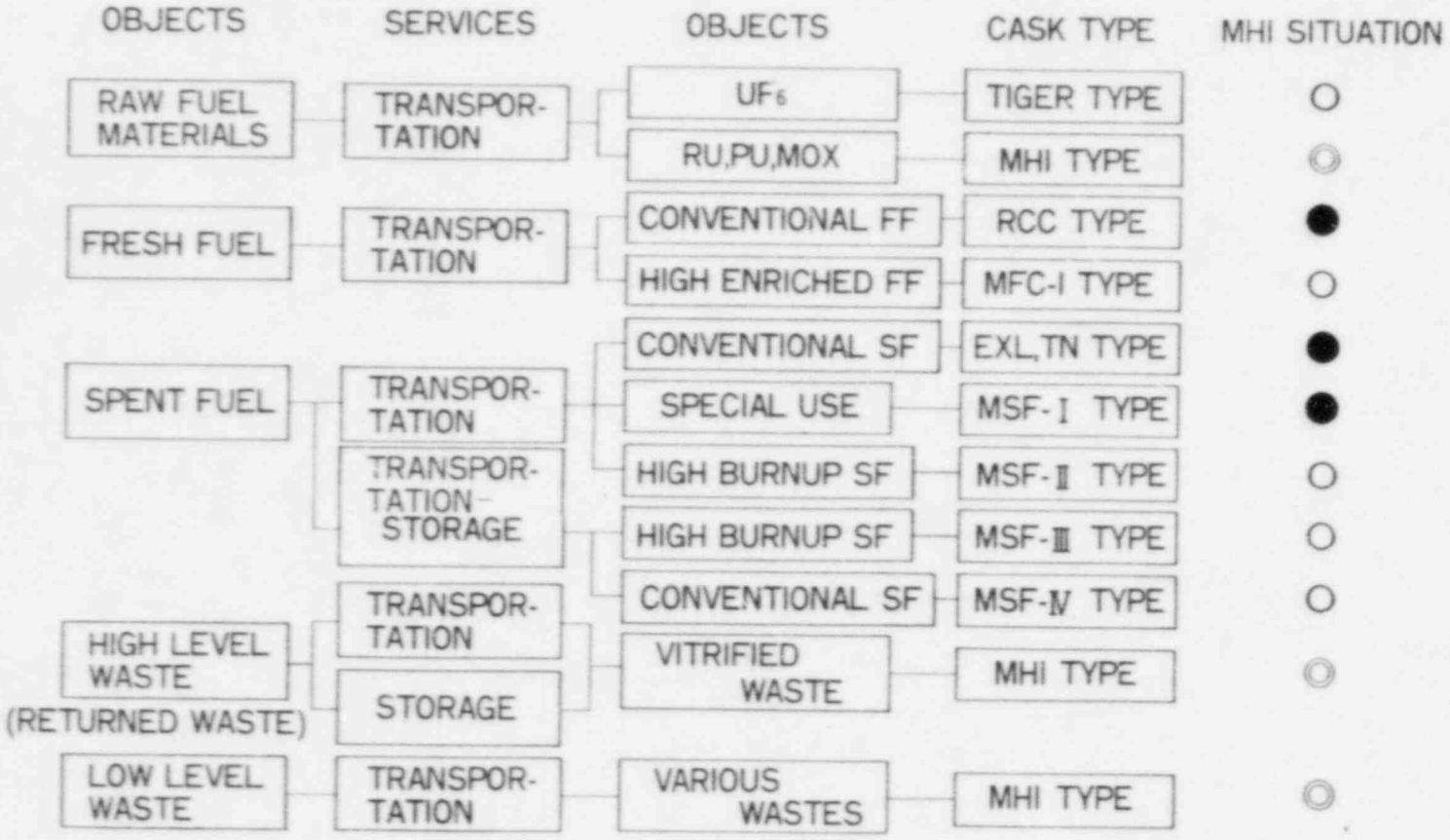
MHI's cask has been developing with high technology experienced in PWR power plants.

MHI recognizes casks are devices to link fuelcycle facilities each together. MHI can design well-matched casks to these facilities with high technology experienced in nuclear industries field.

MHI will develop casks to meet new requirements from these facilities.

- o High enriched fresh fuel shipping cask
- o High burnup spent fuel shipping cask
- o High level waste shipping cask

MHI SITUATION OF CASK DEVELOPMENT



● : DEVELOPED ○ : DEVELOPING ◎ : INTERESTED

o DESIGN

(1) MSF-I Type Shipping Cask

MSF-I type shipping cask will be used to transport a leaker fuel, and a high burnup fuel assembly.
Detail design was carried out and Safety Analysis Report (SAR) has been completed.
SAR has been approved by Japanese Competent Authority

(2) MSF-II Type Shipping Cask

MSF-II type shipping cask will be used to transport new type high burnup fuel assemblies. Conceptual design was carried out.

(3) MSF-Ⅲ Type Transportable Storage Cask.

MSF-Ⅲ type cask will be used to transport and storage high burnup fuel assemblies. Conceptual design was carried out.

o DESIGN AND MANUFACTURE

(1) 100-Ton Class Spent Fuel Shipping Cask

This was designed and manufactured in order to test and demonstrate the reliability of this cask, HZ-Type and EXL-Type now in commercial use.

MSF-I TYPE SHIPPING CASK SPECIFICATION

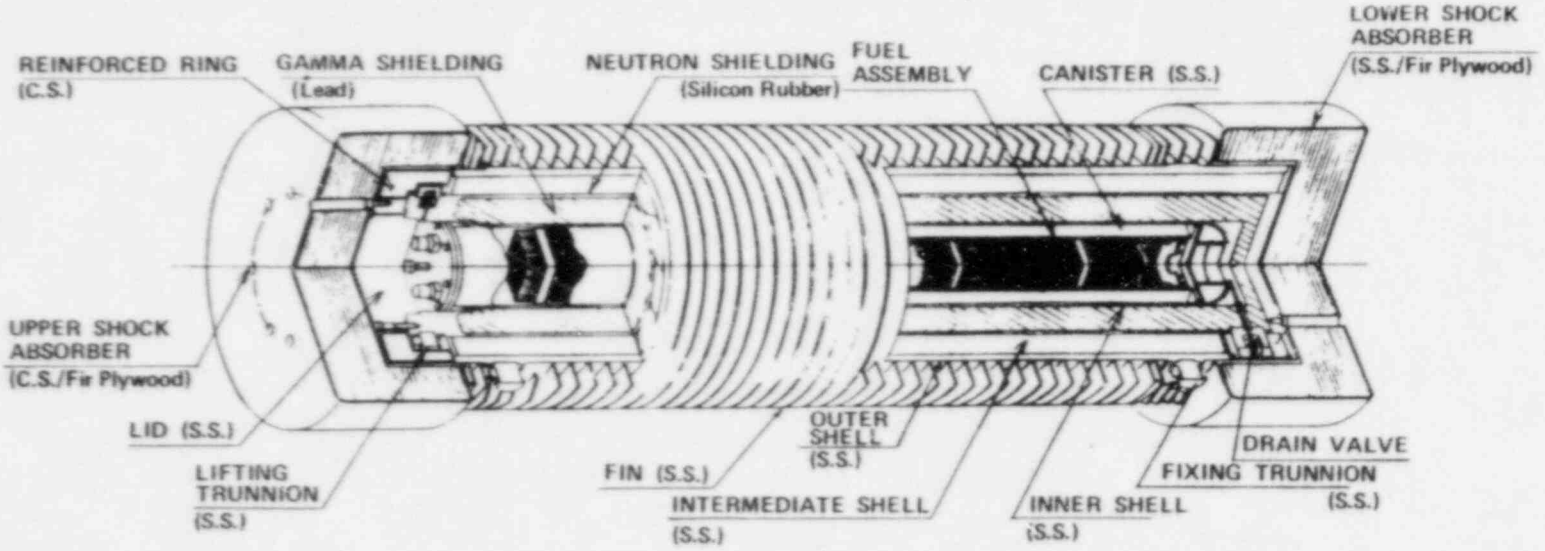
(1)	Package Type	:	B(M) Type Fissile Class I Package
(2)	Max. Weight	:	Abt. 45 Ton
(3)	Max. Length	:	6220 mm
(4)	Max. Width	:	1800 mm
(5)	Max. Outer Diameter of Main Body	:	Abt. 1410mm
(6)	Cavity Diameter	:	Abt. 410 mm
(7)	Cavity Length	:	4800 mm
(8)	Burnup Condition (For PWR Spent Fuel)		
	(a) Burnup	:	45000* MWD/MTU
	(b) Enrichment	:	Max. 4.2 wt%
	(c) Specific Power	:	Max. 43 MW/MTU
	(d) Cooling Time	:	Min. 360 Days
(9)	Number of Units Housed	:	PWR: 1 Assembly
		:	BWR: 2 Assemblies
(10)	Max. Decay Heat Power	:	Max. 10.0 KW
(11)	Cavity Condition	:	Wet Type

* This cask also has capability to contain more high-burnup fuel assembly (max. 56000 MWD/MTU).

MSF-I TYPE SHIPPING CASK

(For Leaker Spent Fuel and High Burnup Spent Fuel)

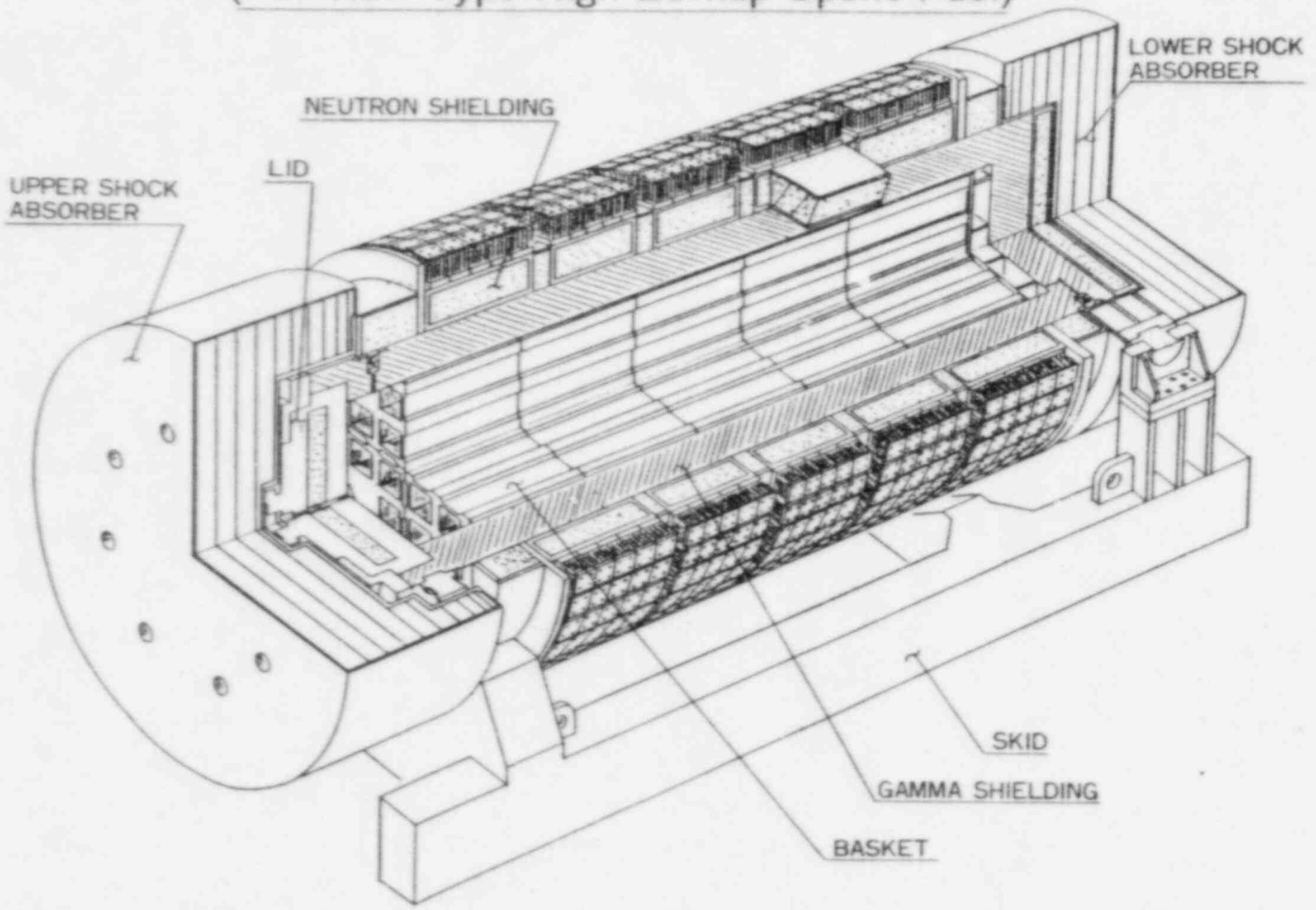
Approved package design by Japanese competent authority.



MSF-II TYPE SHIPPING CASK SPECIFICATION

(1)	Package Type	: B(M) Type Fissile Class I Package
(2)	Max. Weight	: Abt. 110Ton
(3)	Max. Length	: 6300mm
(4)	Max. Width	: 2500mm
(5)	Max. Outer Diameter of Main Body:	Abt. 2500mm
(6)	Cavity Diameter	: 1240mm
(7)	Cavity Length	: 4300mm
(8)	Burnup Condition	
	(a) Burnup	: 51000MWD/MTU
	(b) Cooling Time	: 1years
(9)	Number of Units Housed	: 12Assemblies (PWR)
(10)	Max. Decay Heat Power	: Abt. 100KW/Package
(11)	Cavity Condition	: Dry Type (He Filler)

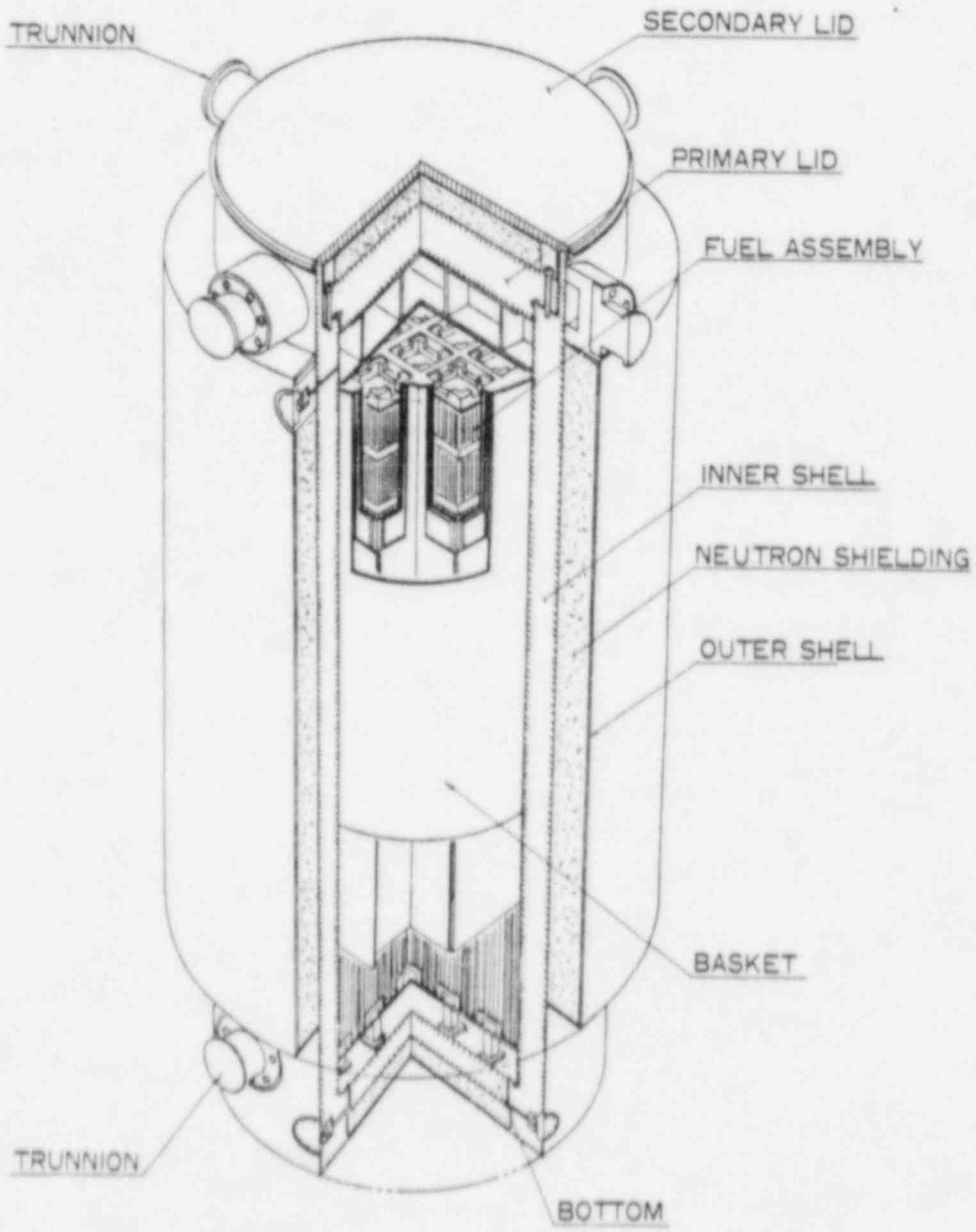
MSF-Ⅱ TYPE SHIPPING CASK
(For New Type High Burnup Spent Fuel)



MSF-Ⅲ TYPE TRANSPORTABLE STORAGE CASK SPECIFICATION

(1)	Package Type	: B(M) Type Fissile Class I Package
(2)	Max. Weight	: Abt. 110~120Ton
(3)	Max. Length	: 5400mm
(4)	Max. Outer Diameter of Main Body	: Abt. 2500mm
(5)	Cavity Diameter	: 1500mm
(6)	Cavity Length	: 4200mm
(7)	Burnup Condition	
	(a) Burnup	: 51000MWD/MTU
	(b) Cooling Time	: 5Years
(8)	Number of Units Housed	: 17~21Assemblies (PWR)
(9)	Max. Decay Heat Power	: Abt. 30KW/Package
(10)	Cavity Condition	: Dry Type(He Filler)

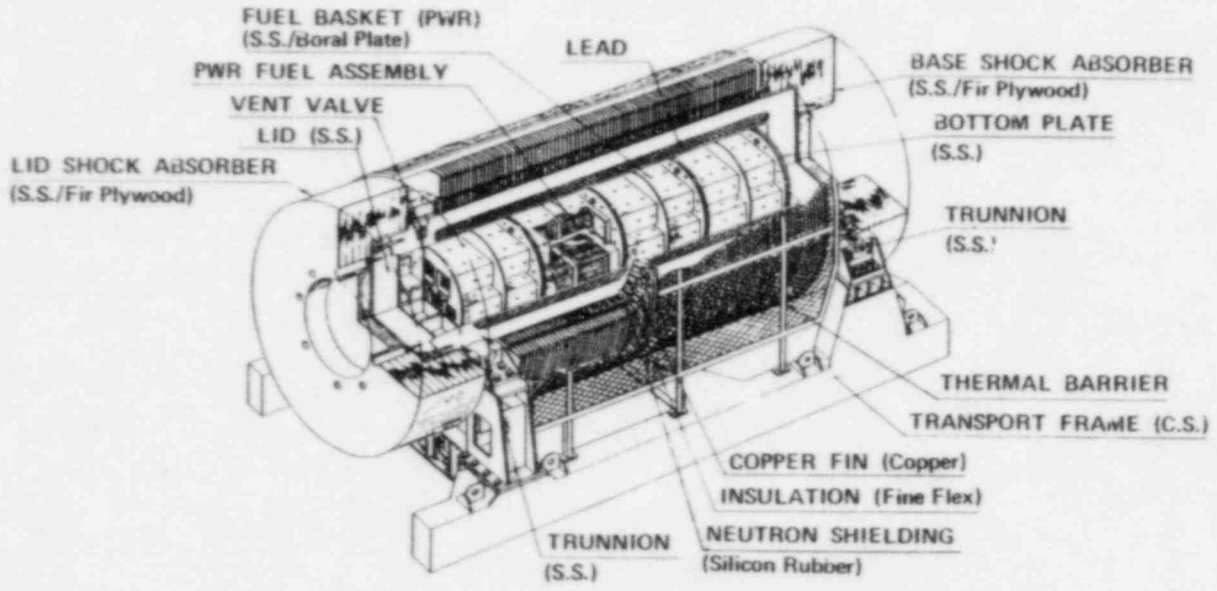
MSF-Ⅲ TYPE TRANSPORTABLE STORAGE CASK



100-Ton CLASS SHIPPING CASK SPECIFICATION

(1)	Package Type	: B(M) Type Fissile Class II Package		
(2)	Max. Weight	: Abt. 105 Ton		
(3)	Max. Length	: 6180 mm		
(4)	Max. Width	: 3000 mm		
(5)	Max. Outside Diameter of Main Body: 2500 mm			
(6)	Cavity Diameter	: 1240 mm		
(7)	Cavity Length	: 4590 mm		
(8)	Burnup Condition			
	(a) Fuel type	PWR 15 x 15	PWR 17 x 17	BWR 8 x 8
	(b) Burnup, (MWD/t)	33000	36000	27500
	(c) Enrichment, (%)	3.4	3.4	2.7
	(d) Specific Power, (MW/t)	35	40	24
	(e) Cooling Time, (day)	360	420	360
(9)	Number of Units Housed	: Max. 12 PWR Assemblies		
(10)	Max. Decay Heat Power	: 56 KW/Package		
(11)	Cavity Condition	: Wet Type		

100-Ton CLASS SHIPPING CASK

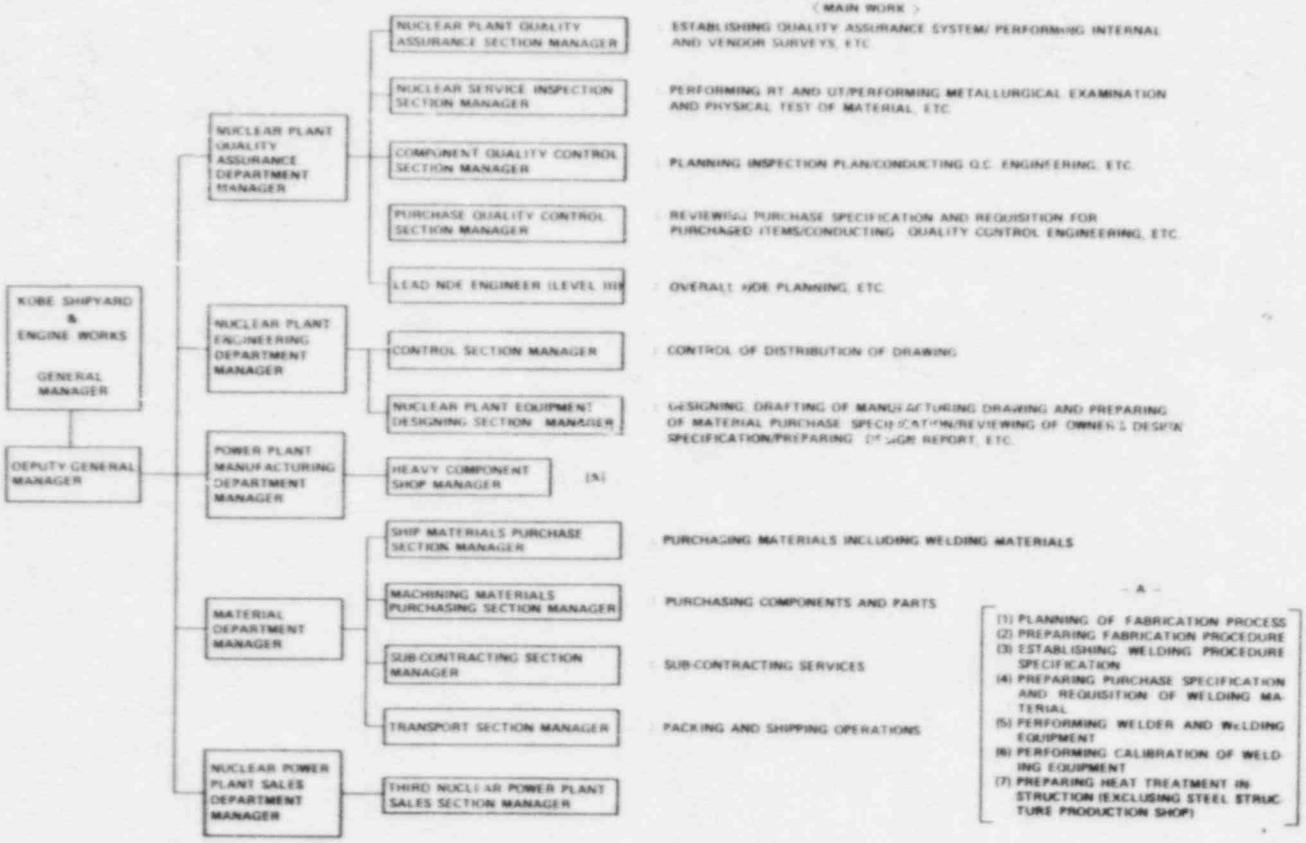


ORGANIZATION CHART

OF

SHIPPING CASK FABRICATION

ORGANIZATION CHART OF SHIPPING CASK FABRICATION



LIST OF MAJOR FACILITIES

ON HEAVY COMPONENT SHOP

IN KOBE SHIPYARD & ENGINE WORKS

LIST OF MAJOR FACILITIES ON HEAV'. COMPONENT SHOP (1/2)

Item	Equipment	Description	Q'ty
1. Shop Area		45,000 m^2	–
2. Lifting	Overhead Crane	Capacity 450 ton	1
		200 ton	2
		120 ton	4
		Others	many
3. Forming	(1) Press	Capacity 6,000 ton	1
		1,500 ton	1
		Others	4
	(2) Bending Roller	Max. thickness 115 mm	1
		Max. width 4,000 mm	
4. Machining	(1) Horizontal Boring Mill	Spindle Dia. 225 mmø	3
		Vertical Travel 5,500 mm Max.	
	(2) Vertical Boring Mill	Max. Work Dia. 11,000 mmø	3
		Max. Height 6,000 mm	
		Max. Work Weight 150 ton	
	(3) Deep Hole Drilling Machine (Gun Drill)	2-Spindle Hole Dia. 25.4mmø	3
		Hole Depth 915 mm	
		3-Spindle Hole Dia. 25.4 mmø	1
		Hole Depth 800 mm	
	(4) Planomatic Mill (Longi.-Edge Preparation)	Width 6,000 mm	
		Height 3,475 mm	1
		Length 8,500 mm	
5. Heat Treatment	(1) Furnace	o 8mW x 8mH x 16mL	1
		Load: 600 ton,	
		Max. Temp.: 1200°C	
		o 6mW x 6mH x 16mL	1
		Load: 250 ton,	
		Max. Temp.: 800°C	
		o 6mW x 3mH x 10mL	1
		Load: 120 ton,	
		Max. Temp.: 1200°C	
		o Others	4
	(2) Quenching Bath	7mW x 8mL x 6mD, 6.7m^3/nr	1
	(3) Induction Heater	Capacity 160 KVA	15

LIST OF MAJOR FACILITIES ON HEAVY COMPONENT SHOP (2/2)

Item	Equipment	Description	Q'ty
6. Automatic Welding	(1) Submerged Arc Welding Machine (With Manipulator & Side Beam)	Tandem Wire Welding Current AC 1,000A Max. Dia. 8,000 mmø Max. Thickness 500 mm Max. Length of Longi-Weld 9,000 mm	1
	(2) Nozzle Welding Machine	Max. Dia. 2,000 mmø Min. Dia. 200 mmø Max. Thickness 300 mmø	4
	(3) Overlay Welding Machine	Strip & Series Wire Process Welding Current 1,200A	10
	(4) Electron Beam Welding Machine	o Capacity 1,400mmø x 9,000mmL Vacuum Max. 10^{-4} Torr Power 7.5 kW	1
		o Capacity 5,500mmW x 6,700mmD x 7,600mmH Vacuum Max. 10^{-4} Torr Power 45 kW	1
	(5) Hot Tig Welding Machine	Max. Work Dia. 5,000 mmø Max. Work Length 7,300 mm	1
	(6) Positioner	50 ~ 120 ton	5
7. Inspection	(1) Radiographic Apparatus	Source 120 Mev Linac (X-Ray) 2,000 R/m/min. Thickness Max. 450 mm Others (Source X-Ray Co^{60}, Ir^{192})	2 many
	(2) Ultrasonic Apparatus		9
	(3) Magnetic Apparatus		13
	(4) Testing Machine	Universal Testing Machine Impact Testing Machine Hardness Tester	5 2 4