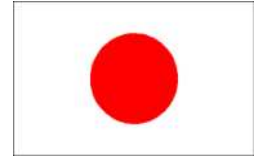




The 2nd Japan-Arab Economic Forum



السَّلَامُ عَلَيْكُمْ

# Mitsubishi Nuclear Power Plants



December 12, 2010

**Takashi SUDO**

Executive officer, Senior Vice President, Nuclear Energy Systems Headquarters  
**Mitsubishi Heavy Industries, Ltd.**

# Contents

1. Introduction and Experiences of MHI
2. Activities on Mitsubishi PWRs
3. Line-up of Mitsubishi PWR



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# Mitsubishi Heavy Industries, Ltd. (MHI)

(Foundation : 1884)

- **About MHI**

2008-2010 average

**Capital**                      **3.0 bil. US\$**

**Orders Received**                      **33.1 bil. US\$**  
(consolidated basis)

**Sales**                              **35.3 bil. US\$**  
(consolidated basis)

**Domestic Offices**                      **193**  
(consolidated base)

**Research & Development Centers**                      **6**

**Works**                                      **7**

**Overseas Offices**                      **141**  
(consolidated base)

**Employees**                              **67,699**  
(consolidated base)                      (as of March 31, 2010)

US \$1    90 yen

# MHI's Wide Activities

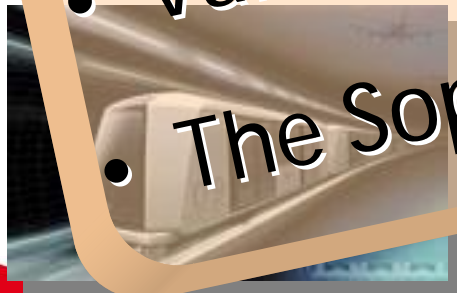


Over 700 products

H- Rocket



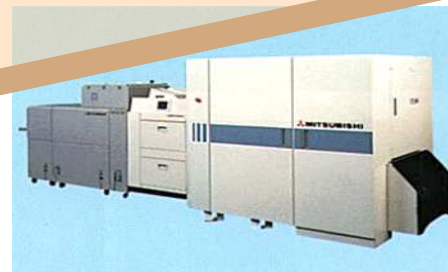
- Various technologies can be applied to
- The Sophisticated products to the Society



Transportation



Petro-chemical Plant

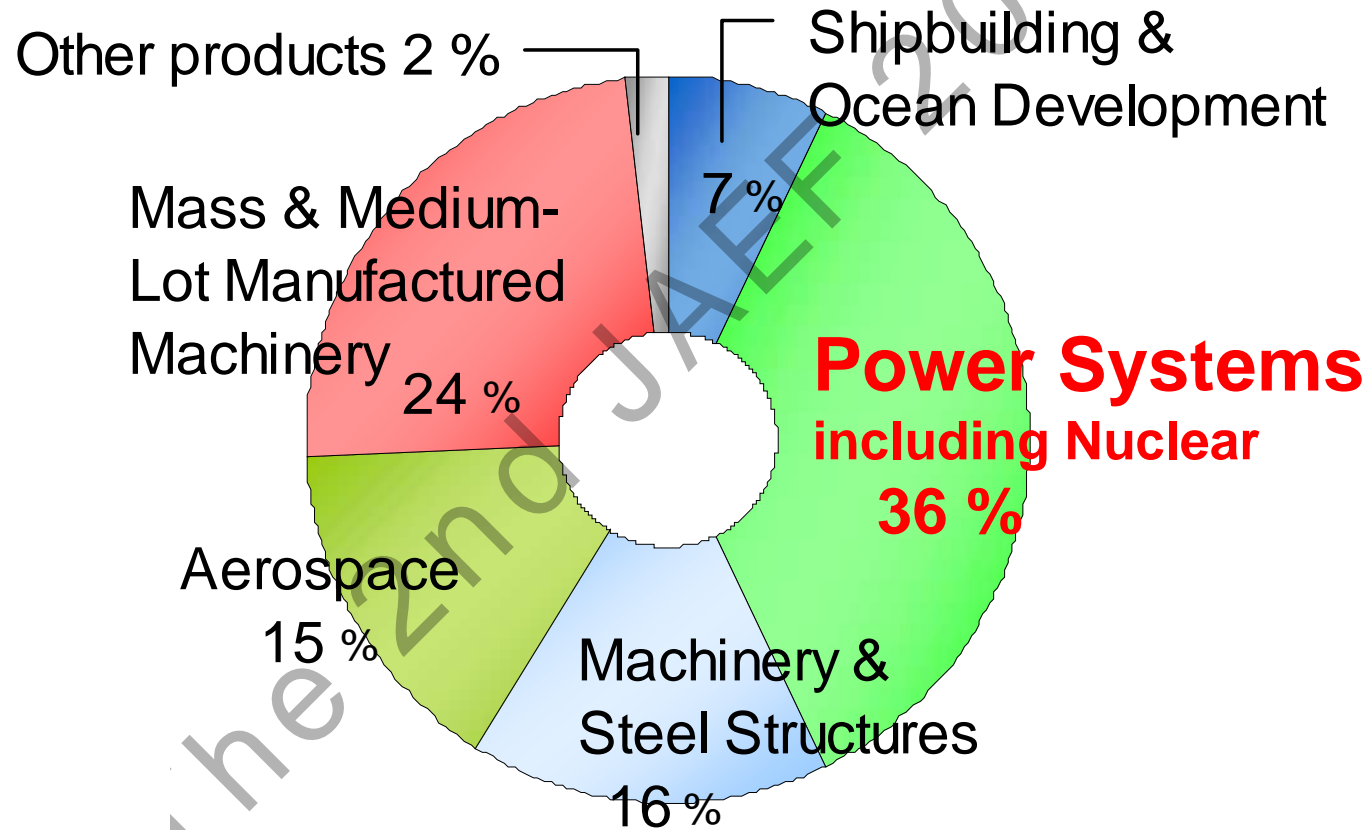


Printing Machine

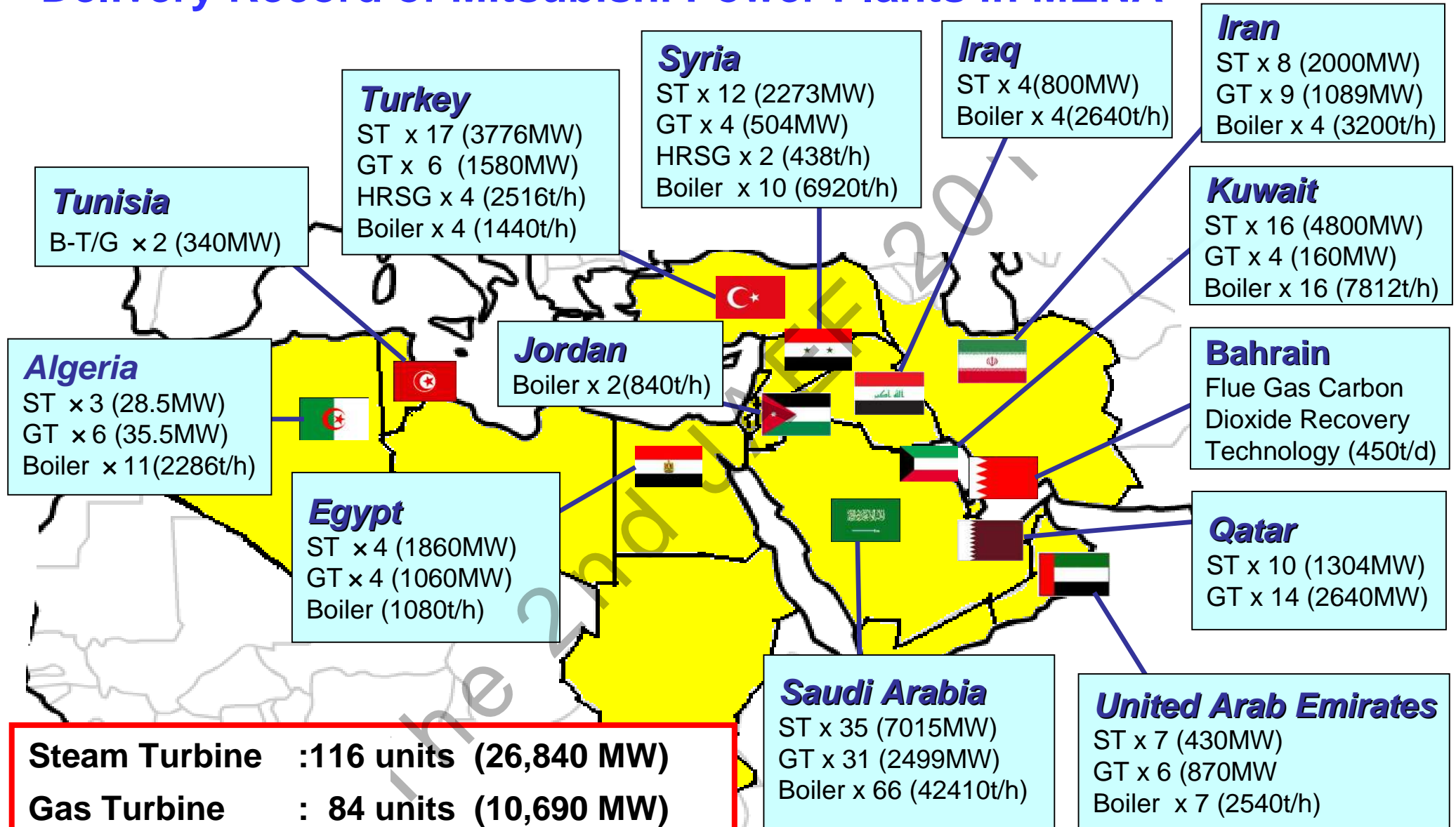


Air Conditioning Unit

# Sales, by Segment



# Delivery Record of Mitsubishi Power Plants in MENA



<b>Steam Turbine</b>	<b>:116 units (26,840 MW)</b>
<b>Gas Turbine</b>	<b>: 84 units (10,690 MW)</b>
<b>Boiler</b>	<b>:131 units (80,129 t/h)</b>

( MENA : Middle East North Africa )

# Delivery Record of Various Petro-chemical Plant in MENA

## Iraq

- Fertilizer Complex × 9 (8,080 T/D)
- LPG Plant (1.2 MM T/Y)
- Gas Compressor Stations × 8 (20 MM)
- Degassing Station (300,000 BPD)
- Crude Oil Storage Tank Yard × 2 (1,920,000 kl)
- Crude Oil & Gas Pipeline (110km)
- Sulfur Recovery Plants × 4 (400 T/D)

## Iran

- PTA (350,000 T/Y)
- LNG Plant (2.8 MM T/Y)
- Sour Gas Sweetening Unit(4,000,000 Nm3 /D)
- Sulfur Recovery Plants(585 T/D)

## Bahrain

- Urea Granulated (1,700 T/D)

## Qatar

- Offshore NGL Project (4.2 MM Nm3 /D)

## United Arab Emirates

- Water Injection Barge (500,000BPD)

## Oman

- Fertilizer Complex (5,500 T/D)

## Saudi Arabia

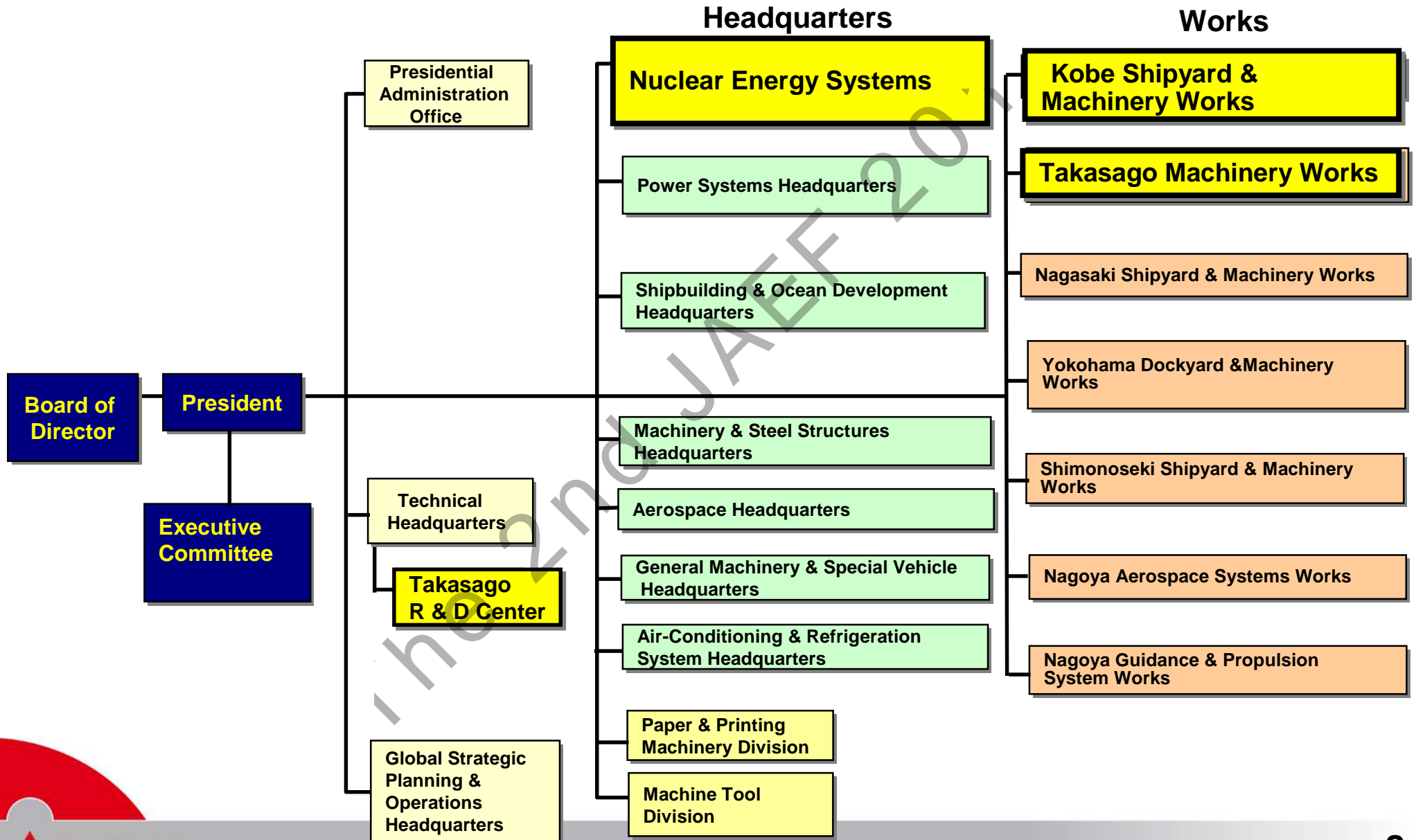
- Methanol Plant × 5 (13915 T/D)
- Polyethylene × 6 (1,702,000 T/Y)
- Polypropylene (260,000 T/Y)
- Offshore Oil Platform (200,000 BPD)
- Crude Oil Loading Terminal × 3 (1,050,000 DWT)
- Desalter, Dehydrator & Modules (6,765,000BPD)

## Algeria

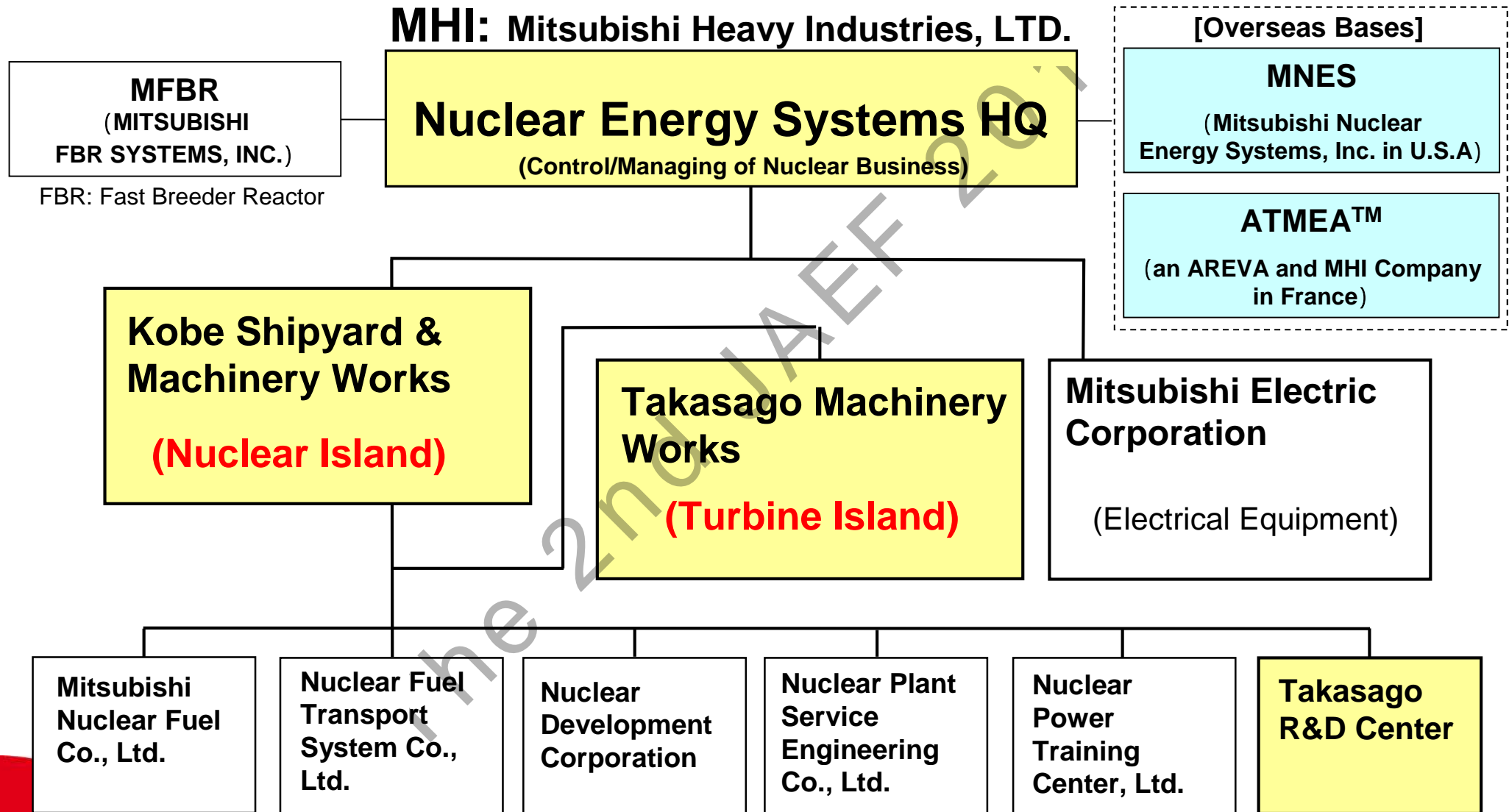
- Gas Compressor Station (1.4 MM S m3 /D)
- LPG Recovery Plant × 2 (8.6 MM N m3 /D)
- Compressor Station for Gas Lifting (4 MM S m3/ D)
- Compressor Gas Turbine Station (1.4 MM N m3 /D)
- Associated Gas Pipeline × 2 (150 km)
- Fertilizer Complex × 4 (11,000 T/D)



# MHI's Organization



# Mitsubishi Nuclear Organization



# Kobe Shipyard & Machinery Works



- Established : 1905
- Employees : 3,900  
(For Nuclear Division: 1,700)
- Land Area
  - Main Plant : 669,100m<sup>2</sup>
  - Futami Plant: 501,100m<sup>2</sup>
- Nuclear products
  - Steam Generator ]
  - Containment Vessel etc. ]
  - Reactor Vessel ]
  - Core internal ]



RV (Reactor Vessel)



RV Head



Steam Generator



MHI Kobe  
Engineering Center

# Takasago Machinery Works



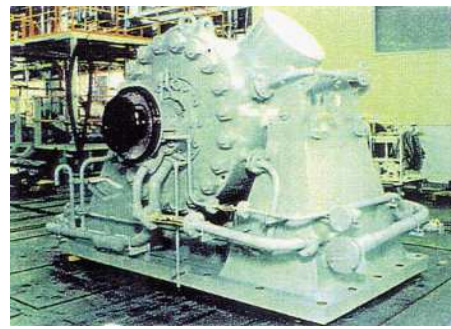
- Established : 1962
- Employees : 3, 300  
(For Nuclear Division: 500)
- Land Area
  - Main Plant : 873,800m<sup>2</sup>
  - Iwanai Plant: 7,100m<sup>2</sup>
  - Orland Service Center: 60,000 m<sup>2</sup>
- Nuclear products
  - Steam Turbine
  - Pump
  - Condenser etc.



Steam Turbine



Reactor Coolant Pump



Main Feed Water Pump



Education and Training Center of Technical and Human Skill

# Special Factory for Nuclear

- Production system capable of making two plants a year



For Steam generator (Kobe)



For Reactor vessel / Reactor internal (Futami) under construction



For Turbine plant (Takasago)

FY	2004	2005	2006	2007	2008	2009	2010	2011
Kobe		Steam generators				Nuclear reactor vessels / reactor internals		
Takasago			Nuclear power turbine					

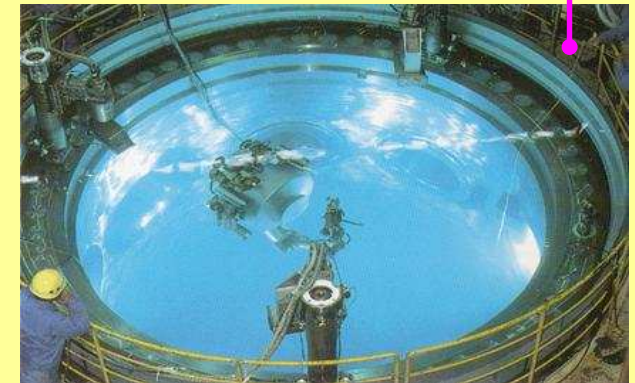
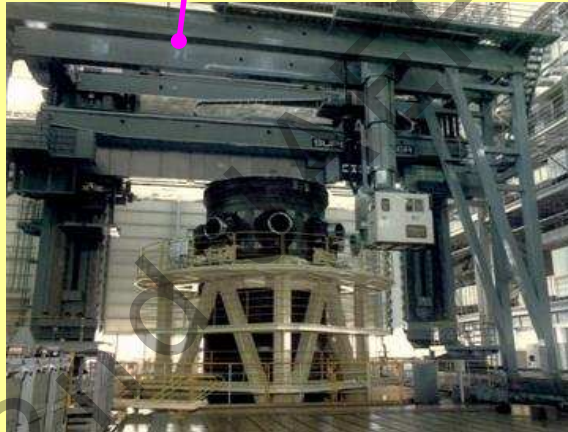
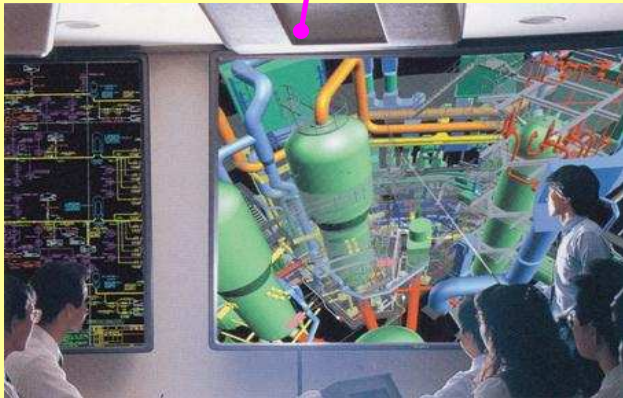
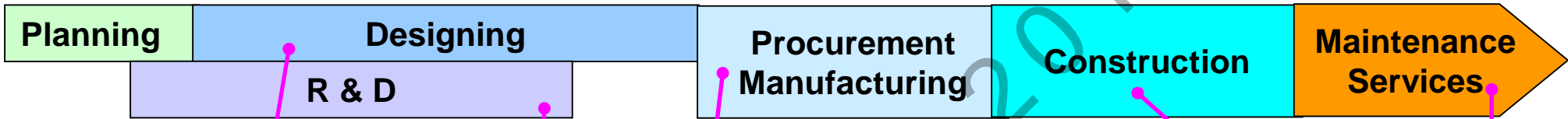
# Contents

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# Total Capability

MHI support all fields through Total Life of Plant **with single responsibility**

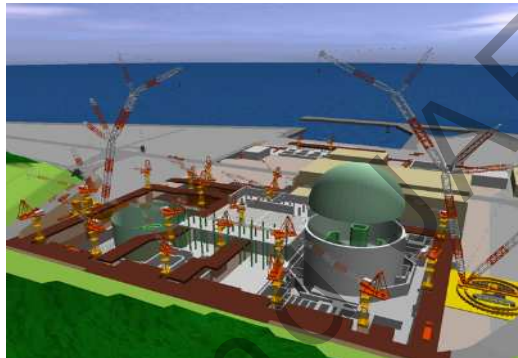


# 3D-CAD Unified Data Base be Utilized

## Layout · Piping Design



## Construction Plan

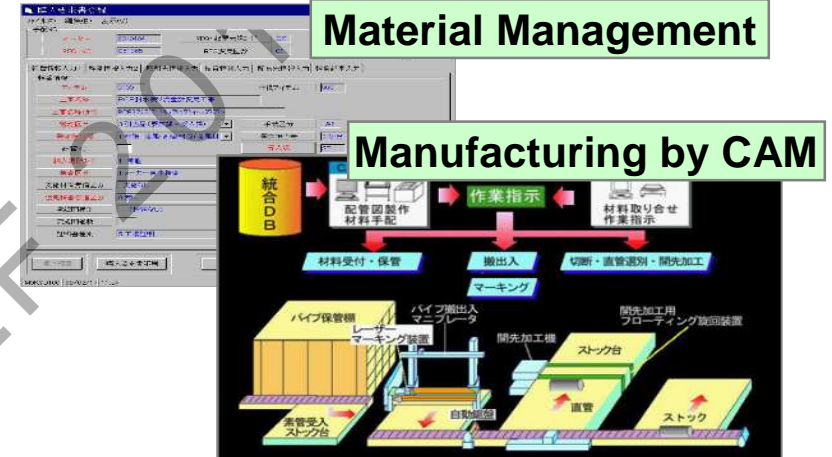


## Maintenance Procedure



## Material Management

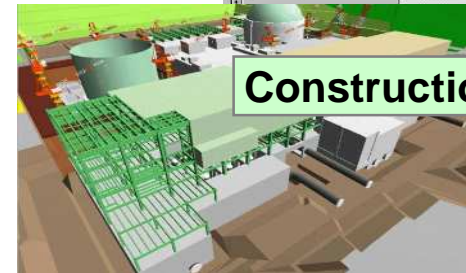
## Manufacturing by CAM



## Inspection Management

検査項目	検査内容	検査結果	検査日時	検査者
1	パイプ径	OK	2010/10/10	山田太郎
2	パイプ厚	OK	2010/10/10	山田太郎
3	パイプ材質	OK	2010/10/10	山田太郎
4	パイプ色	OK	2010/10/10	山田太郎
5	パイプ形状	OK	2010/10/10	山田太郎
6	パイプ位置	OK	2010/10/10	山田太郎
7	パイプ向き	OK	2010/10/10	山田太郎
8	パイプ接続	OK	2010/10/10	山田太郎
9	パイプ固定	OK	2010/10/10	山田太郎
10	パイプ塗装	OK	2010/10/10	山田太郎

## Construction Management



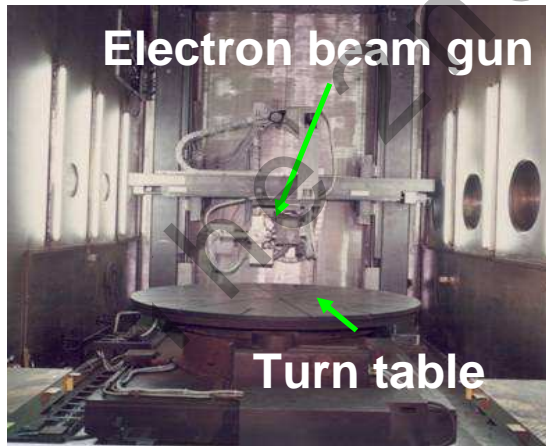


# Manufacturing with high accuracy, efficiency, and reliability

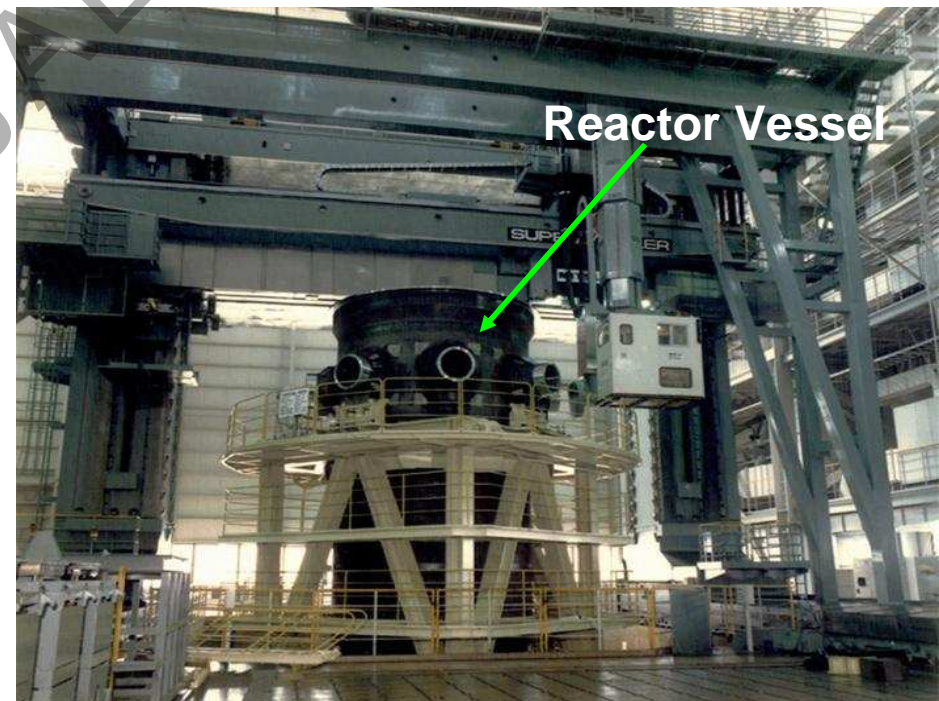
**6000 ton  
Hot press  
forming**



**150kW  
Electron beam  
welding  
machine**

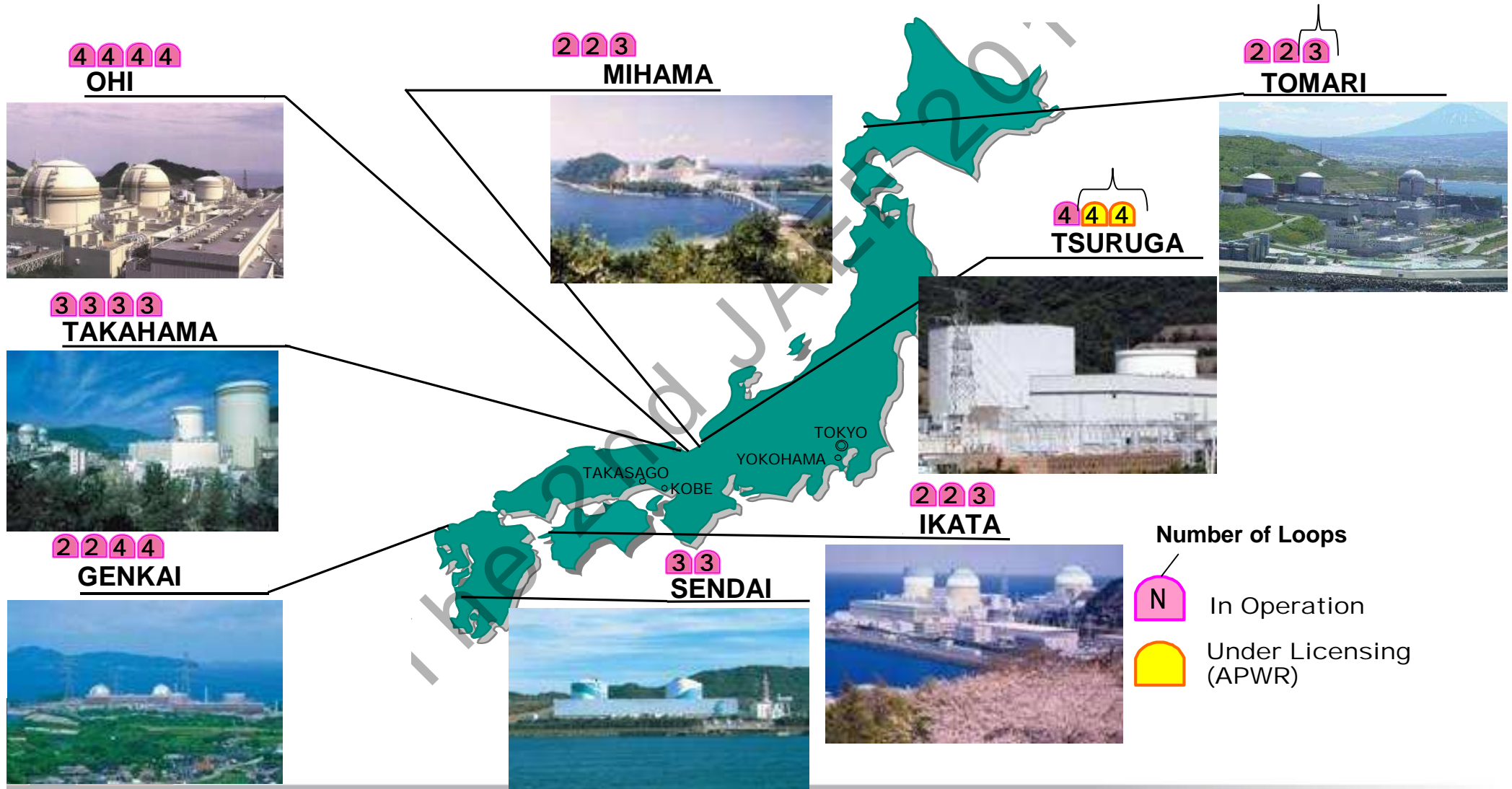


**Super large  
Multi-functional NC- machine  
“Super Miller”**



# All PWR Plants Construction Experience in Japan

The **24<sup>th</sup> PWR** plant entered in commercial operation last December  
 A twin **APWR** Plant is now proceeding

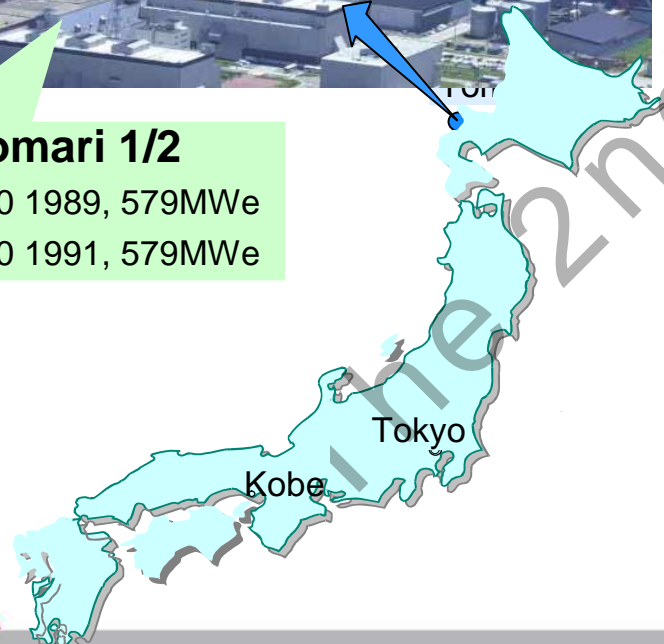


# Latest Construction Experience: Tomari 3

- Approval License of Construction: July, 2003
- Commercial Operation: December, 2009 **(ON SCHEDULE )**



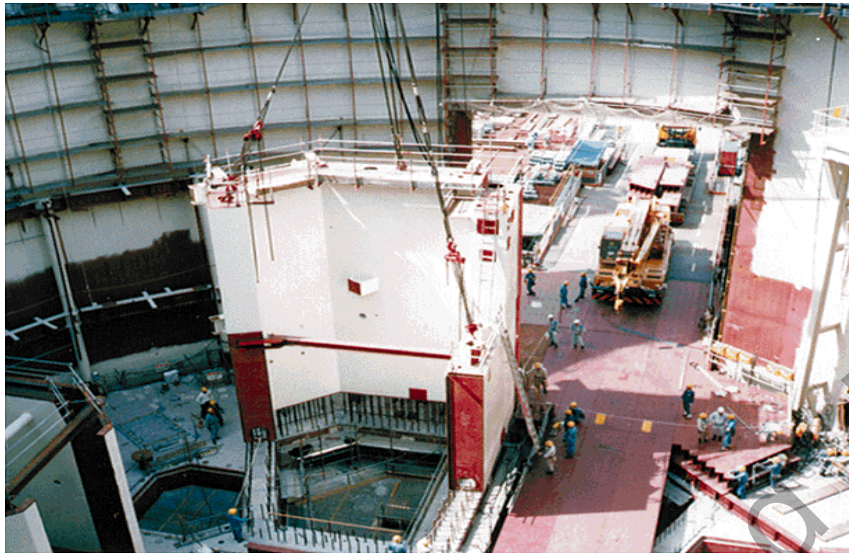
**Tomari 1/2**  
 unit1;C/O 1989, 579MWe  
 unit2;C/O 1991, 579MWe



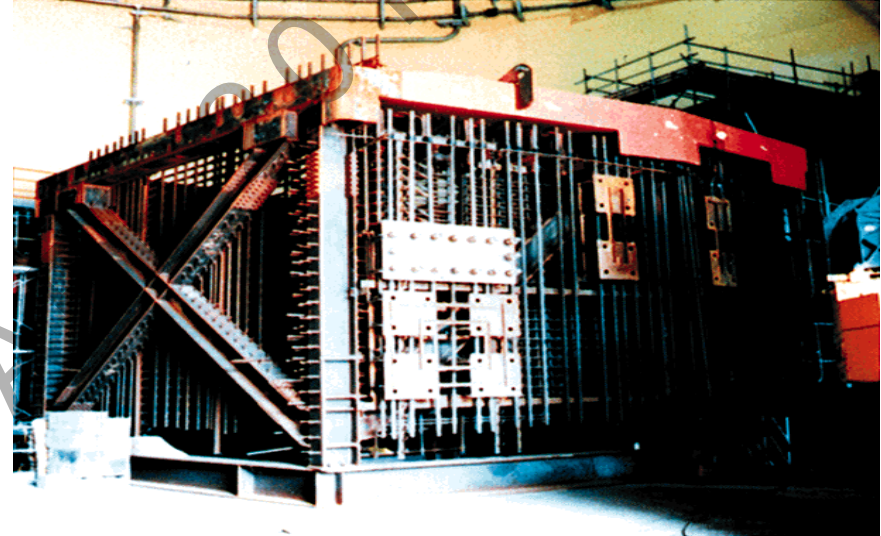
Utility	Hokkaido Electric Power Co., Inc.
Thermal Power Output	2,660 MWt
<b>Electric Power Output</b>	<b>912 MWe</b>
Reactor	Mitsubishi 3 Loop PWR
Fuel	Low Enriched UO <sub>2</sub> 17 x 17 12ft
Condenser Cooling	Sea Water
Layout	Single Unit
<b>Commercial Operation</b>	<b>December 2009</b>
Cycle	50 Hz

# Construction : How to keep the Schedule

## ■ Reduction of on-site work (**Modularization, Large Block**)



• **Internal Structures Using SC**  
(Steel Plate Reinforced Concrete)



• **Large Prefabricated Blocks**

### Experienced Period

( 1<sup>st</sup> Concrete  
to  
Fuel Loading )

2 Loop(Ikata-2)	: 34.5 months
3 Loop(Takahama-3)	: 37.5 months
4 Loop(Ohi-3)	: 40.0 months

# Construction : How to keep the Schedule

## ■ Efficient construction using Super-large-capacity cranes



## ■ Comprehensive coordination of civil & installation work

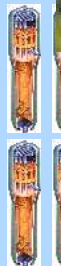
# Components Supply to Global Market

Be  
S



Fra

SG for



RV for C

Spain

Slovenia

Turbine  
1 unit

Turbine  
2sets



VH for Surry #2



RCP : Reactor Coolant Pump  
 CHP : Charging Pump  
 Prz : Pressurizer

# Latest Delivery before Shipping

## ■ Steam Generator for the United States (at Kobe)



# Contents

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# Comprehensive Lineup of Nuclear Technologies

## ■ New plants in Japan

### Domestic PWR plants

1. HEPCO **Tomari** No. 3 (The 24th newly constructed PWR)



Commercial operation  
December 22, 2009

2. JAPCO **Tsuruga** No. 3 and No. 4 Reactors :  
Domestic largest class APWR  
(expected to start operation in 2016 and 2017)

## ■ ATMEA1



# ATMEA1



### Globally compatible intermediate Light Water Reactors (1,100 MWe class)

1. Combine the world's most advanced/proven technologies of AREVA and MHI.
2. Complete basic design and start sales promotion in 2009.



Wide-range offerings

## ■ US/EU-APWR



### The world's largest Light Water Reactor (1,700 MWe class)

1. US-APWR  

[Owner]	[Site]	[State]
Dominion	North Anna #3	Virginia
Luminant	Comanche Peak #3&4	Texas



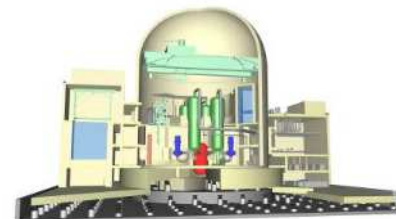
2. EU-APWR  
 Certification of European Utilities Requirements (EUR) is now proceeding .

## ■ Future reactors



### Next generation Light Water Reactors

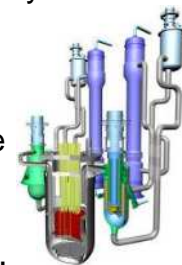
(national project)



### Fast Breeder Reactors (FBR)

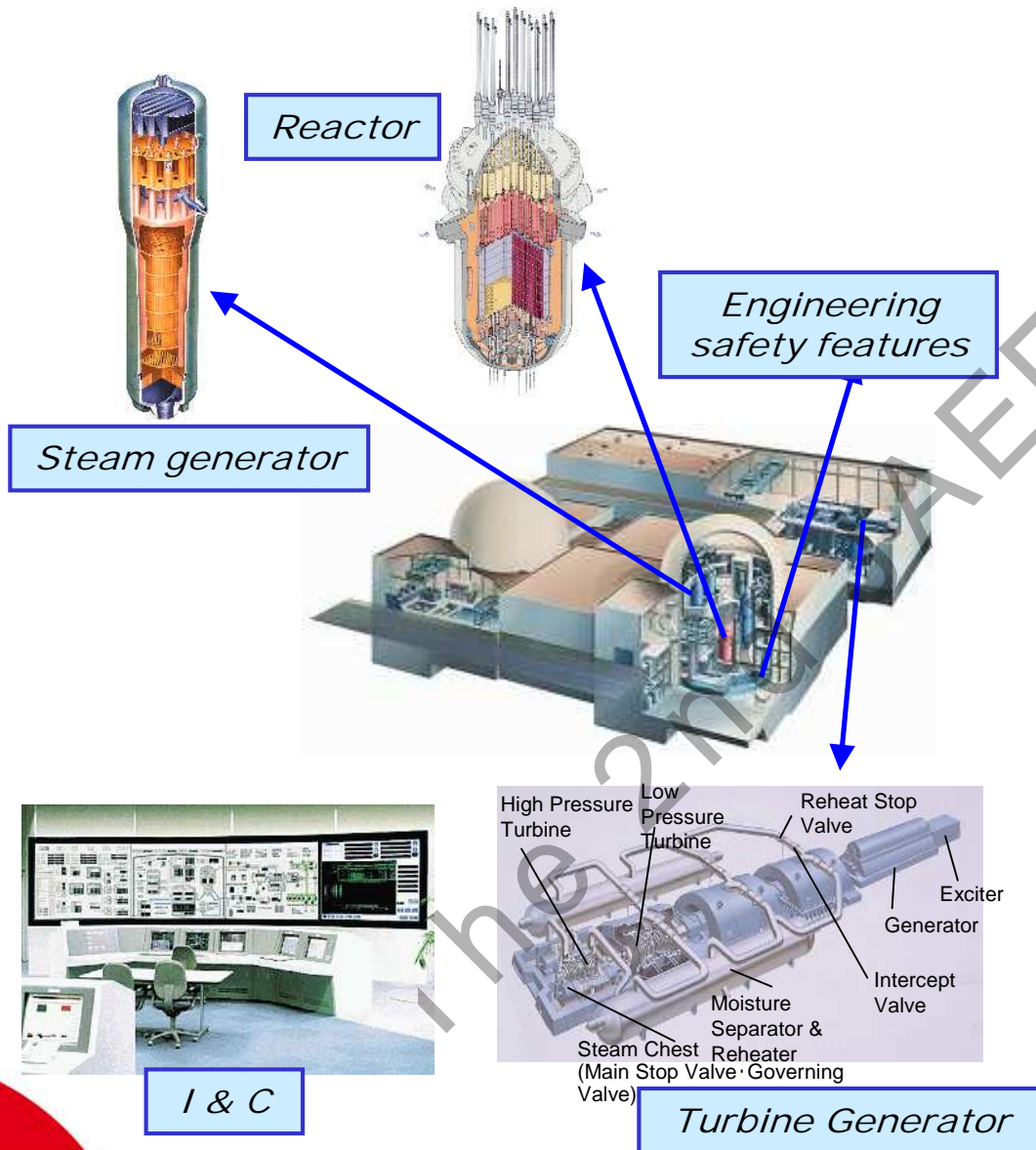
Mitsubishi FBR Systems established (2007)

Make Japanese technology adopted as a global standard.



# Features of APWR

The Japan Atomic Power Company  
Tsuruga 3,4



## Enhanced Safety

- Full 4 train
- Advanced Accumulator
- Refueling water storage pit in CV

## Easy Operation & Maintenance

- Advanced control room
- All digital I&C

## Attractive Economics

- Large capacity component (RV,SG,TG)
- Construction cost reduction (compact layout, simplified systems and component)
- Improved neutron economy (neutron reflector)
- Improved plant availability

## Enhanced Reliability

- Improved core internals
- Improved steam generator

# Comprehensive Lineup of Nuclear Technologies

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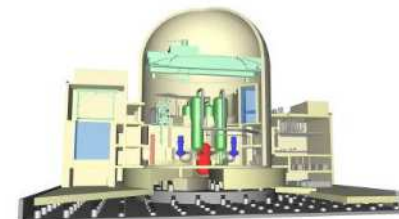
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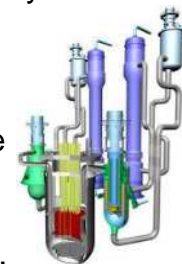
(national project)



### Fast Breeder Reactors (FBR)

Mitsubishi FBR Systems established (2007)

Make Japanese technology adopted as a global standard.



# US-APWR : expanding to US Market from original APWR

## ■ North Anna No.3 Power Plant

- ✓ *Dominion Virginia Power, selected **US-APWR**, and submitted COLA to NRC on **June 28, 2010**.*

*Thanks to MHI's*

- *Good Progress in DC of US-APWR*
- *Excellent Records of Components Deliveries to Dominion*
- *Numerous EPC Achievements in Home Country*



Operating Units at North Anna NPP

NRC Home Page

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ATMEA1



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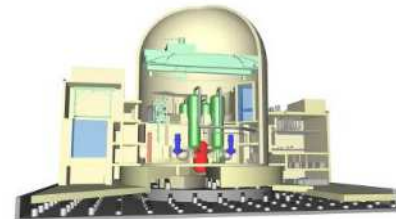
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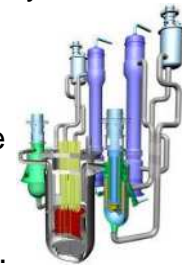
(national project)



### Fast Breeder Reactors (FBR)

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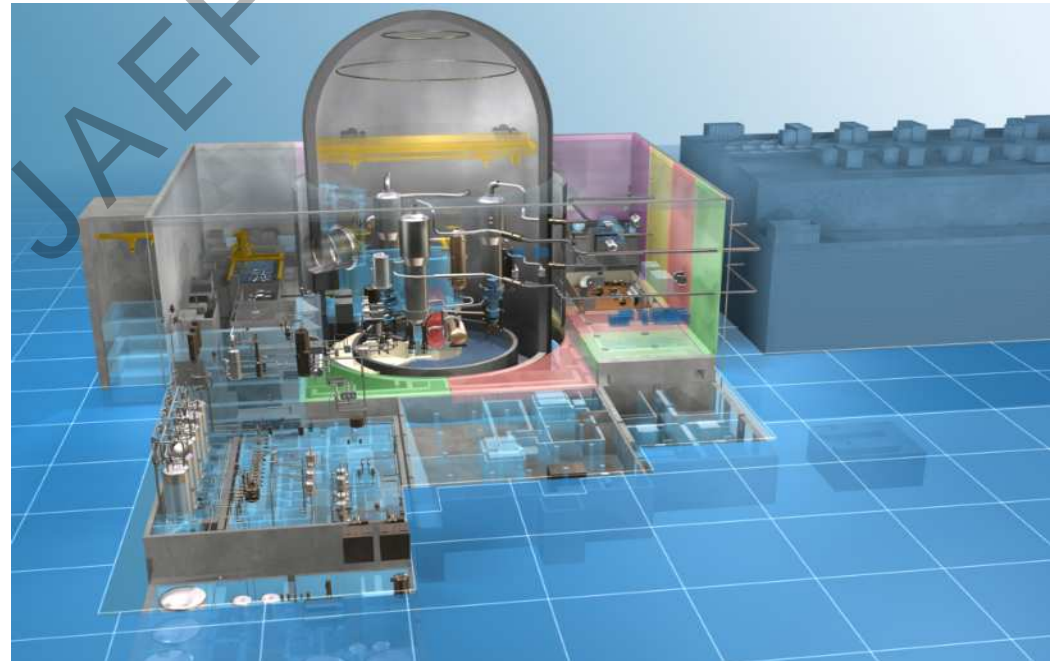


# ATMEA1™: The mid-size Gen-III+ PWR

ATMEA1™ is **a midsize PWR** developed by ATMEA™ which is a joint venture established by **AREVA and MHI**.

## *World Wide Compliance with Regulations and Utilities requirements*

- *Successful IAEA review of the conceptual design (July 2008)*
- *ASN review launched (June 2010-Fall 2011)*



# Comprehensive Lineup of Nuclear Technologies

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**ATMEA1**



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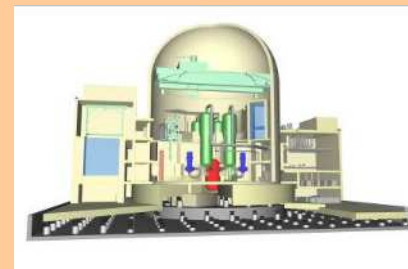
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## ■ Future reactors



### Next generation Light Water Reactors

(national project)



### Fast Breeder Reactors (FBR)

Mitsubishi FBR Systems established (2007)


Make Japanese technology adopted as a global standard.



# Fast Breeder Reactor Development in Japan


- **JOYO, MONJU** : **Constructed**
- **MHI** was selected as **Core Company** of **FBR Development in Japan**
- **MFBR** (Mitsubishi FBR Systems, Inc.) is now carrying out **Engineering for FBR Development.**

**JOYO**  
Experimental FBR  
(140MWt)




- ◆ Verification of Breeding
- ◆ Irradiation Test

**MONJU**  
Prototype FBR  
(280MWe)



- ◆ Demonstration of power plant systems
- ◆ Establishment of sodium handling technology

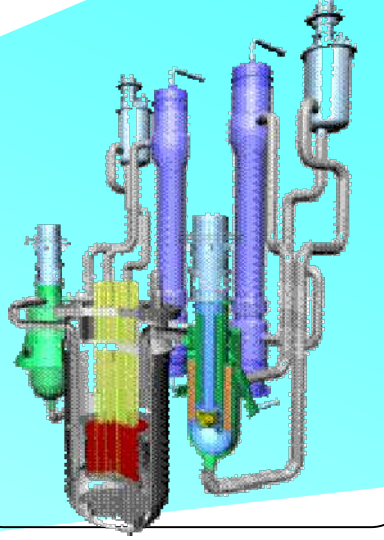
**Demonstration FBR**



- ◆ Demonstration of commercial plant systems and economics

(2025)

**Commercial FBR**  
(1500MWe)



(2050)  
*Concept proposed by Mitsubishi*

\*3:JAEA-Research 2006-042 (2006)



# Conclusions

*Mitsubishi Heavy Industries, Ltd.*

- **has abundant experiences to supply sophisticated PWR plants all over the world and to render excellent services with highest reliability.**
- **has extensive capability to carry out all major activities, such as conceptual design, engineering, manufacturing of main components, construction, commissioning and maintenance.**
- **is ready to contribute to build New Nuclear Power Plants in MENA (Middle East North Africa).**



For the Sustainable Future  
of MENA countries



**MITSUBISHI**  
HEAVY INDUSTRIES, LTD.