

# Nuclear Energy Systems Business Operation

June 3, 2009

 **MITSUBISHI HEAVY INDUSTRIES, LTD.**

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- 1. FY 2008 Results and Special Measures for FY 2009**
- 2. Business Environment**
- 3. Business Field and Medium/Long-term Business Plan**
- 4. After-sales Services**
- 5. New Plant Construction Projects**
- 6. Nuclear Fuel Cycle and FBR**
- 7. How to boost our business strength**

# 1. FY 2008 Results and Special Measures for FY 2009

## **FY 2008 Results**

### Order received:

- A rapid increase in earthquake proofing works and preventive maintenance services due to the occurrence of the Chuetsu-oki earthquake.
- Development of global business corresponding to the Nuclear Renaissance

### Net sales/operating income:

- Growth in net sales and operating income

### Major actions/achievements:

- Licensing for US-APWR (COL application docketed in Dec. 2008)
- Construction of Tomari No. 3 of Hokkaido Electric Power Co., Inc. (Initial criticality in Mar. 2009)
- Nuclear fuel business strengthened by reorganizing Mitsubishi Nuclear Fuel Co., Ltd.” (Apr. 2009)

## **Special Measures for FY 2009**

**Contribution to reduction of CO<sub>2</sub> emissions.**

⇒ Continuous provision of resources to achieve high availability factor of plants.

**Short-term actions and special measures**

### **(1) Cost reduction**

- Shortening Work periods by improving the accuracy of project planning and management (after-sales services and construction).
- Elimination of nonconformance by thorough advance verification.
- Planned procurement of large/special materials.

### **(2) Securing sales revenues**

- Provision of fine-tuned services corresponding to the requirements of each plant

## 2. Business Environment

## Change of environment

### ➤ Overseas

### ➤ Japan

### ➤ Financial crisis

### ➤ Obama administration

### ➤ CO<sub>2</sub> reduction

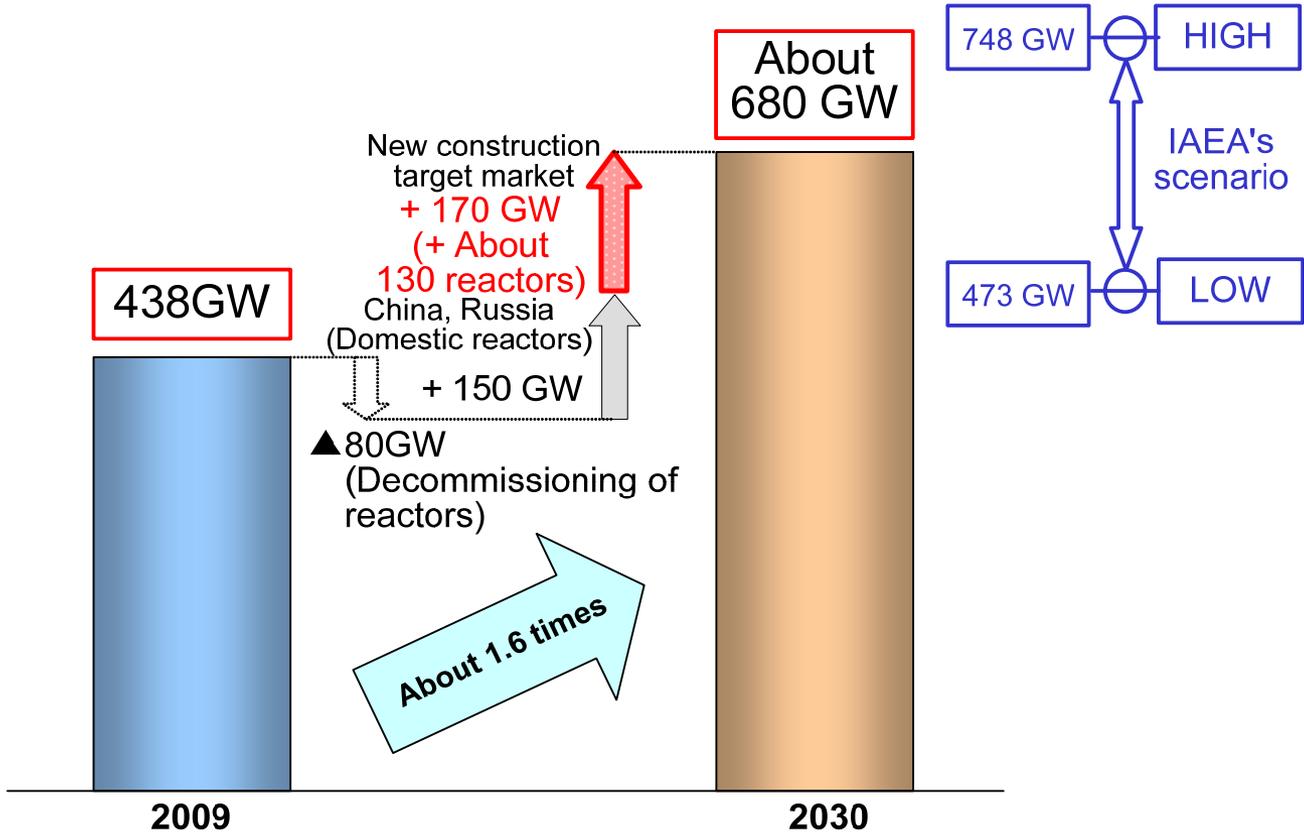
### ➤ Fossil fuel exhaustion

## Impact on the nuclear business

- ⇒ Construction projects newly planned and reopened in Europe and Middle East (UK, Italy, Sweden, Poland, Hungary, etc.). Over 100 units of reactor expected to start operation before 2020 in China.
- ⇒ Focused on improvement of availability factor of plants and establishment of nuclear fuel cycle
- ⇒ No significant impact observed on the currently planned projects.
- ⇒ The importance of nuclear power remains unchanged as a base power source.
- ⇒ Nuclear power plays an important role toward realization of a low-carbon society.
- ⇒ The value of nuclear power is becoming more recognized because it is less affected by variation in the price of fuel.

# Global Market of Nuclear Power Generation

- Increase in the number of new construction projects ⇒ Expansion of global market (about 1.6 times over 2009)
- In our target market ⇒ About 130 new reactors due to an increase of 170 GW
- China's policy for locally made reactors ⇒ Our company to deal with supplying components



Sources: Prediction for 2009: Generation capacity from "World Nuclear Power Plants 2009" issued by Japan Atomic Industrial Forum, Inc. (both in operation and under construction)  
Prediction for 2030: Our own estimation, from 2008 IAEA (International Atomic Energy Agency) Prediction for 2030

# **3. Business Field and Medium/Long-term Business Plan**

# Our Business Field

## Domestic light water reactor plants



- After-sales services for existing plants
- Tomari No. 3 Reactor and Tsuruga No. 3 and No. 4 Reactors
- Next-generation new plants

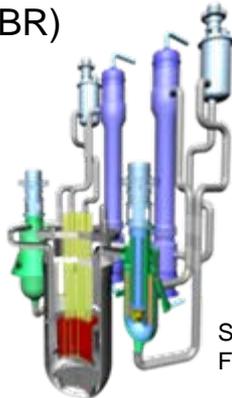
## Fuel



Mitsubishi Nuclear Fuel CO., LTD.

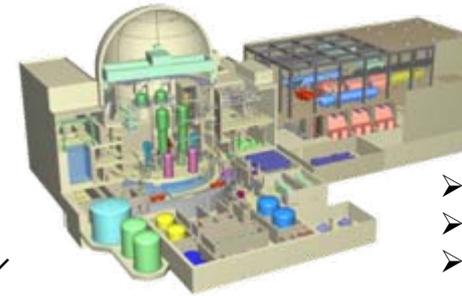
## Fast breeder reactor (FBR)

(FBR)

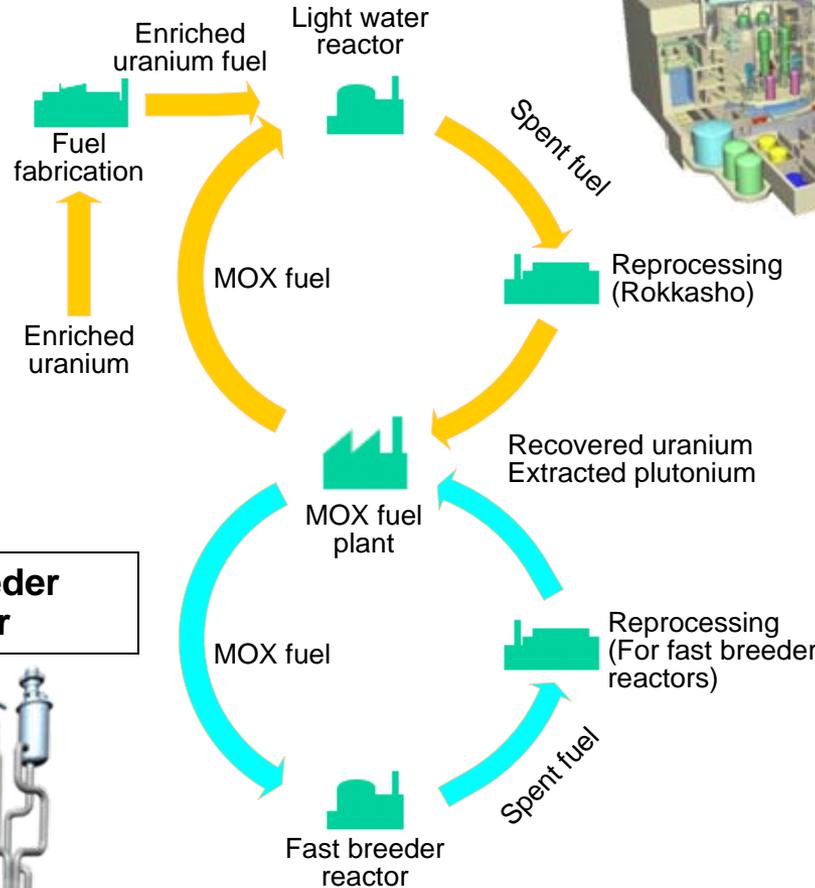


Source: "JAEA-Research 2006-042", Fig. 2.1.1-4, p. 69 (2006)

## Overseas light water reactor plants



- US/EU-APWR
- ATMEA1
- Overseas after-sales services



## Nuclear fuel cycle



- Reprocessing plant

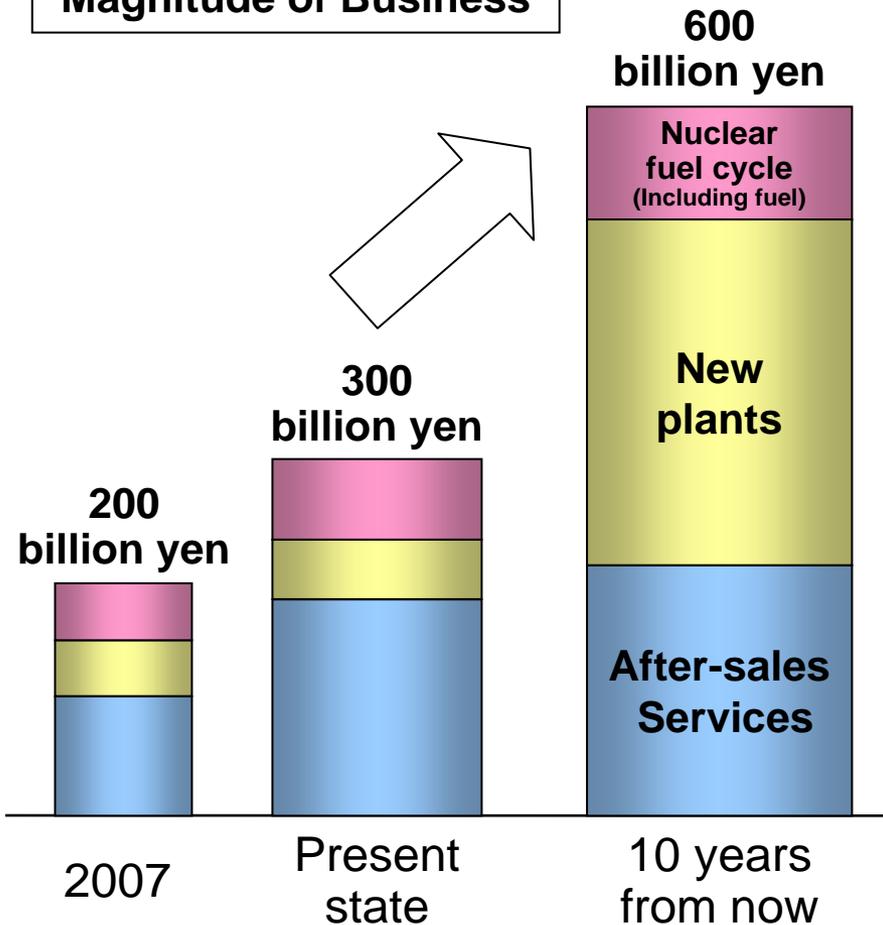


- MOX fuel plant

# Medium/Long-term Business Plan

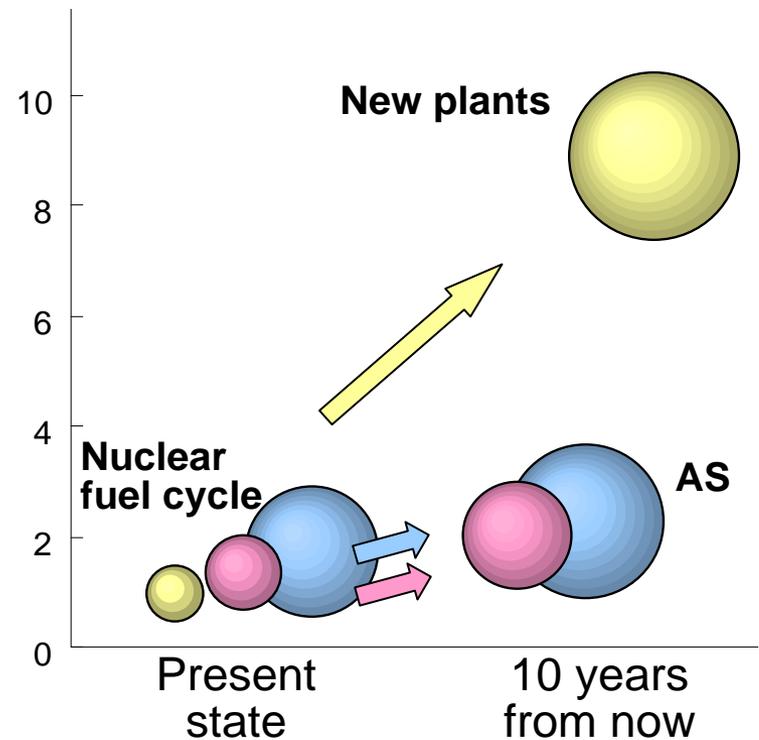
Magnitude of business, based on after-sales services, doubled by new plant construction and nuclear cycle business

**Magnitude of Business**



**Growth potential**

Compared with 2007  
(times)



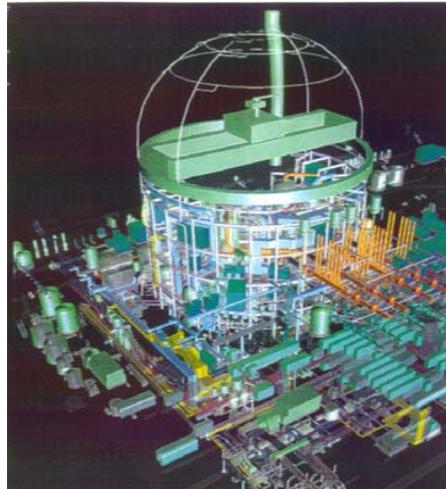
# Measures to Achieve the Medium/Long-term Business Plan (Overview)

After-sales services	Promote preventive maintenance activities together with clients based on our high advanced technologies in order to ensure order receipt and sales stability.
New plant construction projects (Expanding field)	Respond to new domestic and international plant construction projects and expand receiving orders by offering nuclear power plants meeting customer needs. ( Domestic most-sophisticated light water reactors, US-APWR (USA), EU-APWR (Europe), ATMEA1 (worldwide), new generation light water reactors]
Nuclear fuel cycle and FBR (Growing field)	Provide solutions through the best mix of our own technology and technologies from our partners and enlarge business steadily. (Fuel, nuclear fuel cycle, FBR)
Measures for boosting our business strength	Through promotion of manufacturing process innovation, enhancement of production facilities and upgrading and expanding of EPC performance capability.

EPC: Engineering, Procurement, Construction

# 4. After-Sales Services

# Contribution to Safety and Economical Efficiency of Plants by Sophisticated Technologies



Advanced engineering with three-dimensional CAD

## Engineering techniques

- Clarification of events, advance verification
- Evaluation (life, seismic)
- Drawing up of maintenance programs



Training facility for reactor internal replacement methods

## Design and manufacturing techniques Maintenance and construction techniques

- Special testing unit
- Special repairing unit
- Heavy replacing component

- Checks, inspections
- Repair, stress improvement
- Large component replacing work



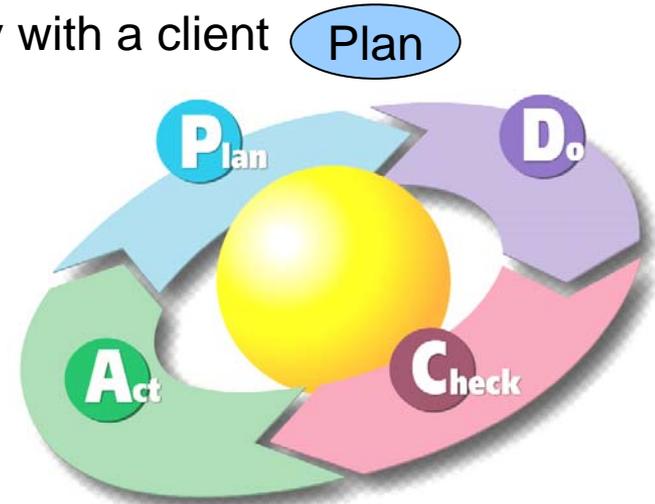
Weld repair robot for steam generator nozzle



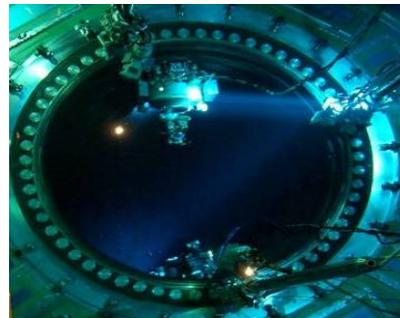
Training for maintenance and repair work

# Preventive Maintenance Activities Working with Clients

- Drawing up a deliberate maintenance program jointly with a client **Plan**
  - Sharing domestic and international information and quick feedback
  - Periodic review of the medium and long-term plan (maintenance review meeting)
- Maintenance work with secure and advanced technologies **Do**
  - High-accuracy inspections
  - Advanced repairs freely using automatic remote devices
  - Stress improvement by the optimal construction method
  - Replacement of heavy components by applying our experiences and achievements of construction work
- Extraction and reflection of items for improvement **Check & Action**



**Thorough advance verification in the planning stage**

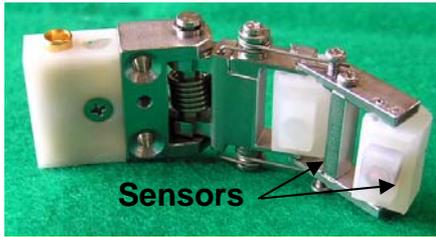


**High-accuracy automatic remote inspection**



**Automatic weld repair of complex shapes**

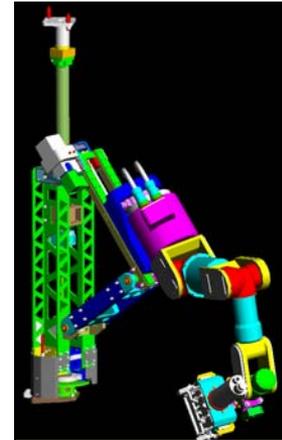
# Maintenance Work Technologies Supporting After-sales Services Business



**Special probe for weld ECT inspection**



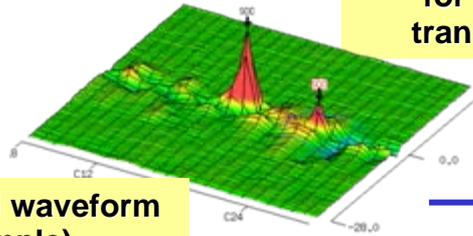
**Inspection robot for SG heat transfer tube**



**Robot arm**



**Automatic remote welding**



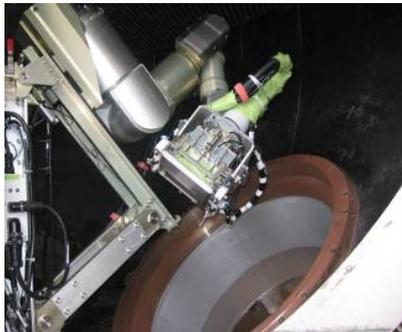
**ECT signal waveform (example)**

**Inspection technique**

**Repair technique**

**Stress improvement technique**

**Heavy component replacement**



**Shot peening stress improvement**



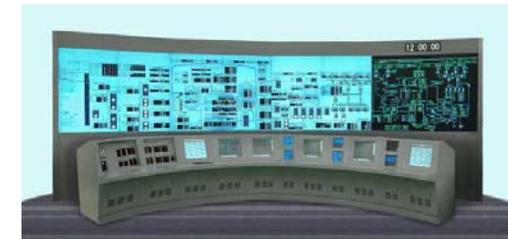
**Water jet stress improvement**



**Reactor internal replacement work**



**Steam generator replacement work**



**Main control board replacement work**

# 5. New Plant Construction Projects

# Full Lineup of Nuclear Power Plants

## ■ US/EU-APWR



Large light water reactor with the world's largest output (1,700 MWe class)

### US-APWR

1. Reactors chosen by Luminant in 2007 (2 units)
2. US DC/COL application docketed

### EU-APWR

1. Conformance certification application to European Utilities Requirements

DC: Design certification  
COL: Combine license

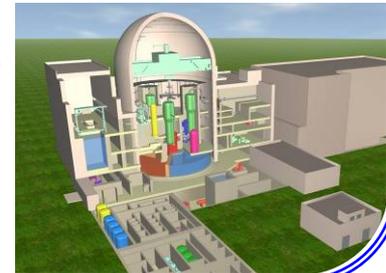


## ■ ATMEA1



Globally compatible intermediate light water reactors (1,100 MWe class)

1. A joint venture established with AREVA in 2007
2. Combine the world's most advanced technologies of both companies.
3. Complete basic design and start sales promotion in 2009.



Full lineup

## ■ Domestic newly constructing plants

### Domestic light water reactors

1. HEPCO Tomari No. 3 Reactor constructed (Latest 3rd generation reactor)



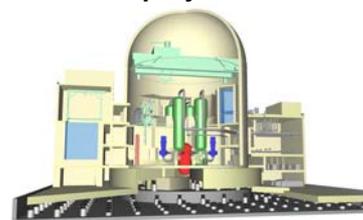
Domestic 24th PWR  
Initial criticality in March this year expected to start operation in December

2. JAPCO Tsuruga No. 3 and No. 4 Reactors (Domestic largest class APWR)  
Under safety review, expected to start operation in 2016 and 2017

## ■ Future reactors

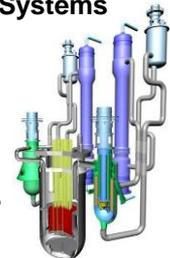
### Next generation light water reactors

Participate in the national project.



### Fast breeder reactors (FBR)

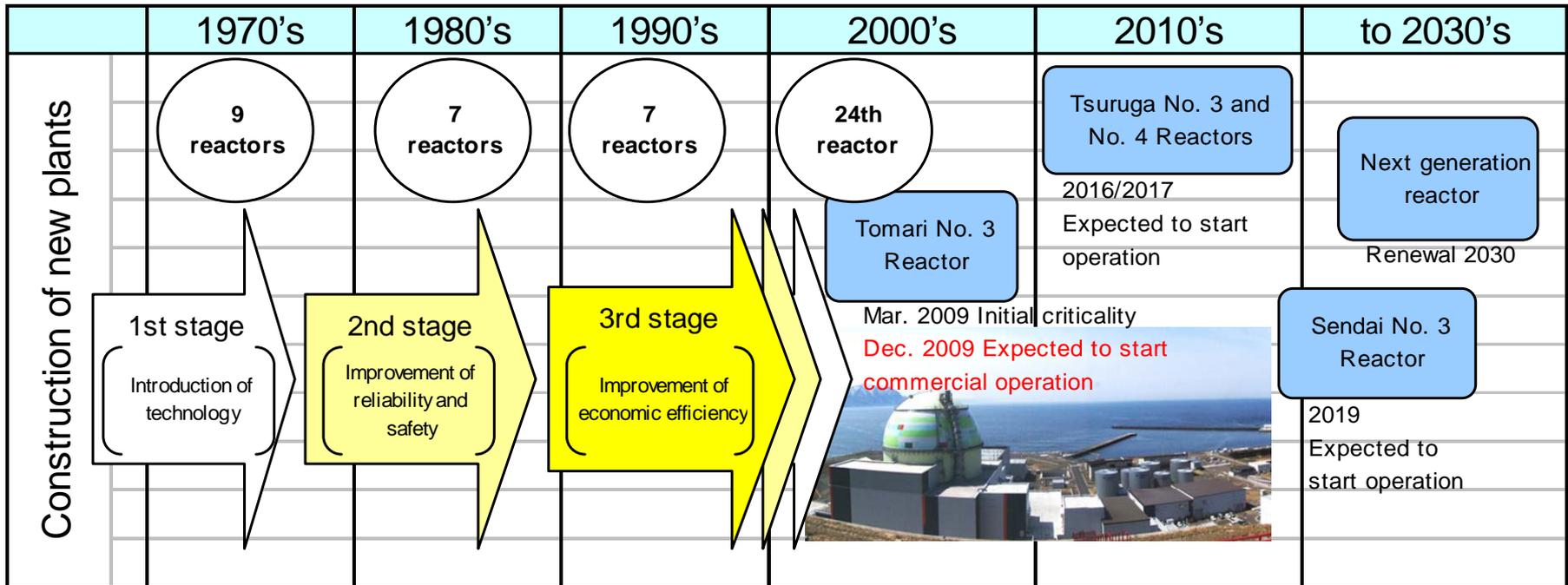
Mitsubishi FBR Systems established (2007)  
Make Japanese technology adopted as a global standard.



Source: "JAEA-Research 2006-042", Fig. 2.1.1-4, p. 69 (2006)

# Steadily Promoting the Construction of Most-sophisticated Light Water Reactors

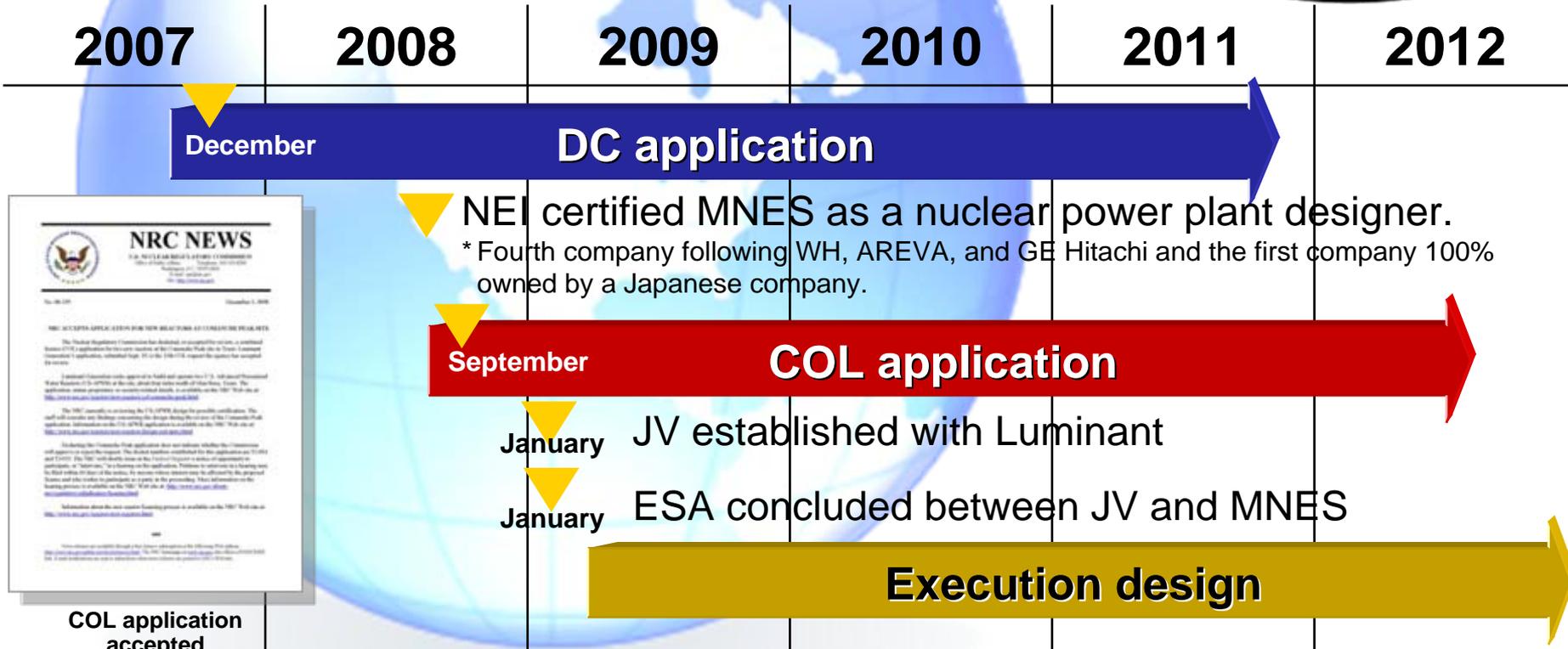
- (1) HEPCO Tomari No. 3 Reactor is scheduled to start commercial operation in December. (Domestic 24th newly constructed PWR plant)
- (2) JAPCO Tsuruga No. 3 and No. 4 Reactors are under safety review (scheduled to start operation in 2016 and 2017).
- (3) Soliciting the local community to support construction of Kyuden Sendai No. 3 Reactor (scheduled to start operation in 2019)
- (4) Developing a next generation light water reactor as a national project (To meet renewal around in 2030)



# Steadily Progressing US Operations

## ➤ US-APWR (1,700 MWe class large strategic reactors)

- (1) A review is steadily progressing for both DC and COL.
- (2) ESA was concluded between Luminant JV and MNES, starting execution design.
- (3) In sales promotion for new contract following Luminant



COL application accepted

DC: Design Certification, COL: Combined License for construction and operation, ESA: Engineering Service Agreement, NEI: US Nuclear Energy Institute, MNES: Our subsidiary in US

## ➤ **EU-APWR (1,700 MWe class large-sized reactor)**

- (1) Applied for a conformance review to the European Utilities Requirements (EUR).
- (2) Carrying out FS and sales promotion for European major power companies



## ➤ **ATMEA1 (1,100 MWe class mid-sized reactor)**

- (1) An IAEA review for conceptual design was completed in July 2008.
- (2) Design steadily progressing and sales promotion started



## ➤ **Nuclear turbines**

- (1) Entering into Chinese market in cooperation with Harbin Power Equipment Co., Ltd.
- (2) Received orders from Sanmen and Haiyang (4 units in total).

## ➤ **International cooperation**

- (1) Positively participate in international cooperation activity of the Japanese government.
- (2) Cooperate with the light water plans of Vietnam, etc.



EUR: European Utilities Requirements, FS: Feasibility Study  
IAEA: International Atomic Energy Agency

# Development of a Next Generation Light Water Reactor as a National Project

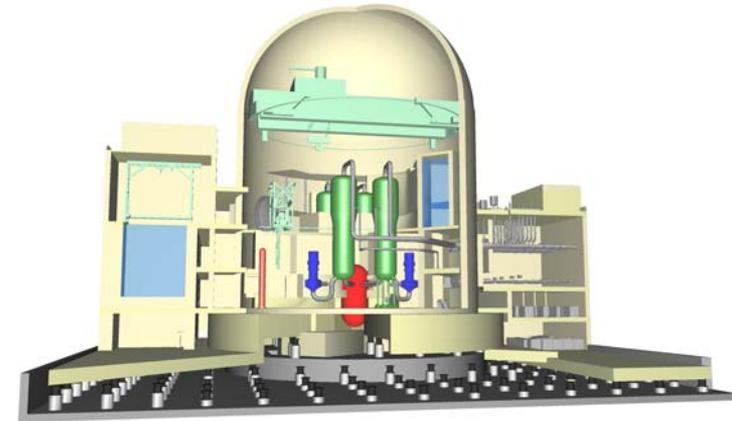
- With the outlook for demand for domestic replacement and the global market around in 2030
- Sophisticated autonomous type plant realizing **3S + 3E**

- (1) Advanced autonomous safe design
- (2) Enhancing resistance to aircraft collision, etc.
- (3) Seismic isolation design adopted as standard
- (4) Adoption of long life fuel and innovative core
- (5) Achievement of the world's highest efficiency (about 40%)
- (6) Considerably shortened term of construction work (about 30 months)

**3S:** Safety, Security, Safeguard

**3E:** Environment, Efficiency, Economy

Autonomous type: A reactor requiring no external support even in case of an accident

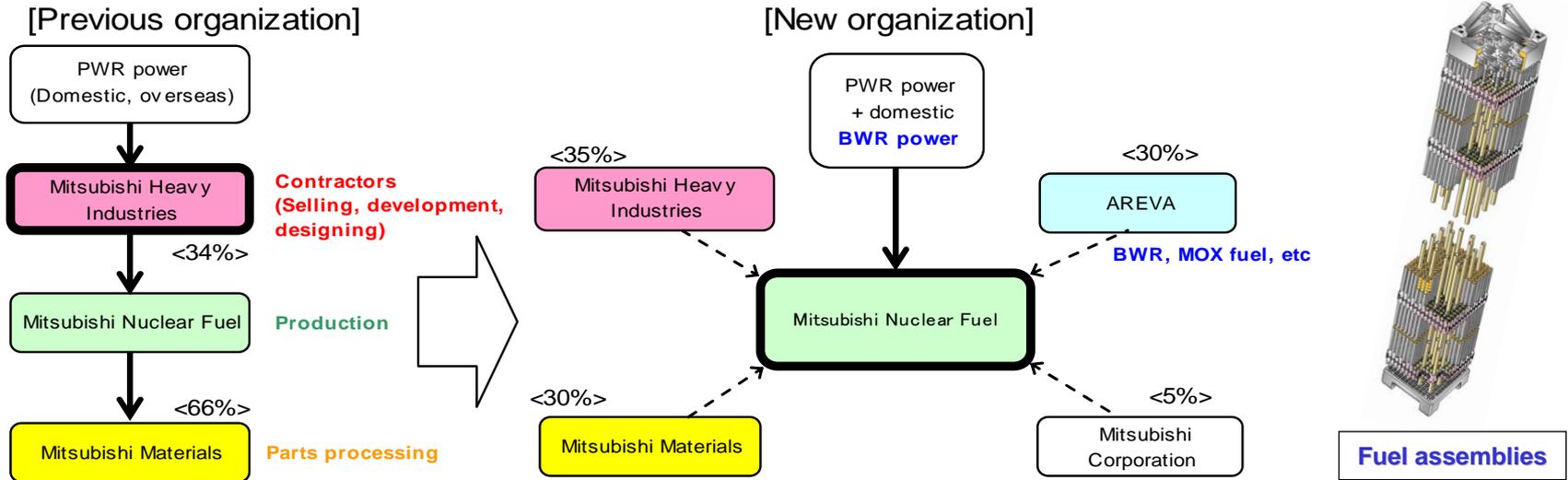


# 6. Nuclear Fuel Cycle and FBR

# Promoting the Fuel Business as a Growth Area

## (1) Reorganizing and strengthening Mitsubishi Nuclear Fuel CO., LTD.

- Three Mitsubishi Group Companies (MHI, Mitsubishi Corporation, Mitsubishi Materials Corporation) and AREVA jointly established an integrated nuclear fuel company to perform design, development, production and sales.



## (2) Promotion of the pluthermal program < MOX fuel arrived in Japan >

- Pluthermal power generation is expected to begin at the KYUDEN Genkai No. 3 Reactor and YONDEN Ikata No. 3 Reactor.
- We contribute to arrangement for fabrication, handling of approval and license, and MOX fuel loading.

## (3) Working on the front end business with relevant companies in the Mitsubishi Group

# Offering Solutions to Establish a Nuclear Fuel Cycle

## ➤ To establish “energy security”

### (1) Light water reactor fuel cycle

- Rokkasho reprocessing plant: Safety operation support, maintenance support, proposal of equipment upgrading
- J-MOX fuel plant: Designing and construction of MOX fuel manufacturing facility
- Interim storage facility: Provision of interim storage cask and spent fuel storage rack
- Waste disposal/disposal facility: Proposals of facilities for reduction processing of amount of discarded material and long-term safe disposal



Cask for interim storage



Spent fuel storage rack

### (2) FBR fuel cycle

- Next generation reprocessing plant: Development of reprocessing technology excellent in nuclear proliferation resistance and economy

# Promoting Project for Constructing a FBR Demonstration Reactor

- (1) Accumulate engineering and design techniques for the whole field of FBR.
- (2) Have promoted technical development with an independent sodium testing facility since 1970's.
- (3) Chosen as a leading firm by the government and established Mitsubishi FBR Systems in 2007.
- (4) Established the FBR Promotion Department for integral administration in our company in April 2009.

## Our Takasago Research & Deve. Center- Sodium testing facility



Thermal transient test facility for structure



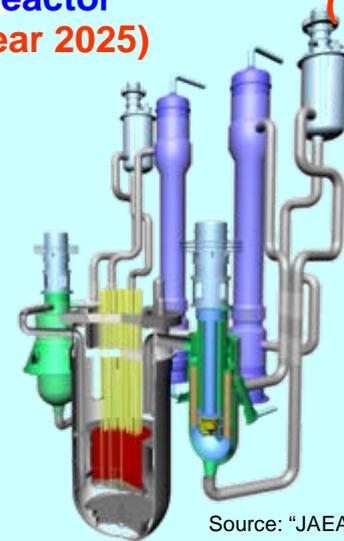
Multi-purpose test facility



Thermal hydraulics test facility

Demonstration reactor (Year 2025)

Commercial reactor (Year 2050)



Source: "JAEA-Research 2006-042", Fig. 2.1.1-4, p. 69 (2006)

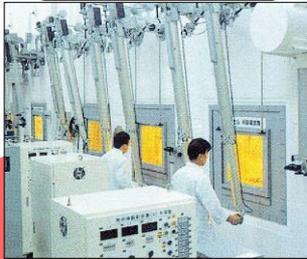
# 7. How to boost our business strength

# Our Business Strength

Fully integrated technological capability from development to after-sales services

Thorough proactive verification and design completion

Research & development



Designing



After-sales services



Construction



Manufacturing



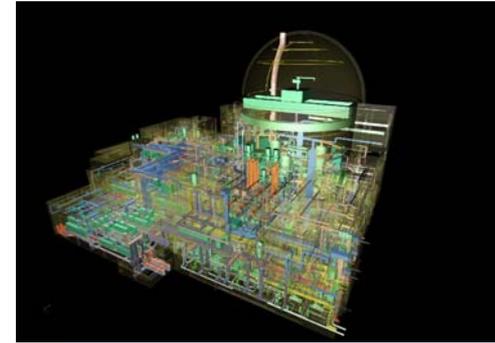
World-leading high quality and manufacturing capacity

Plentiful achievements by constructing all domestic PWR (24 units)

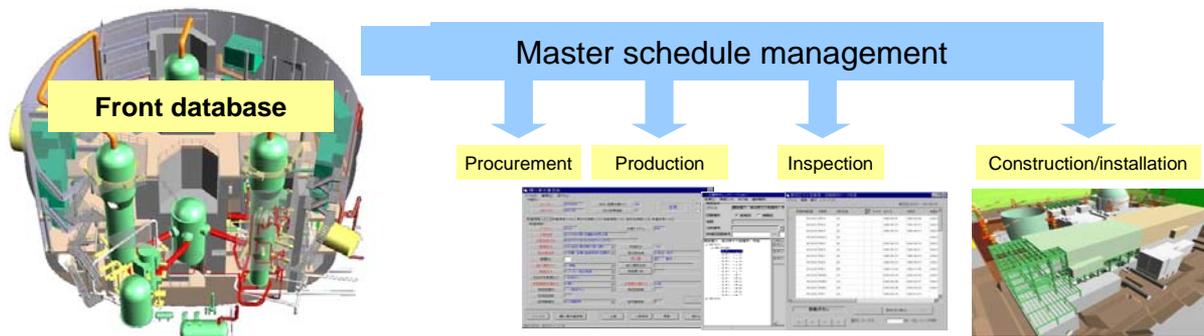


Delivery of 100th steam generator  
(For HEPCO Tomari No. 3 Reactor in July 2007)

- (1) Promotion of MD (Modular Design) and DFX (Design for X)
  - Almost completed standardization of main components.
  - Promote standardization including the BOM and manufacturing process.
- (2) EPC innovation through the comprehensive database
  - Increase the BQ accuracy by 3D-CAD creation of engineering models.
  - Online engineering with global partners for procurement, manufacturing and construction through the centralized database



Extensive use of 3D-CAD



MD: Standardization/common design of component parts, DFX: Design compositely considering procurement, manufacturing, installation, and maintenance

BOM: Bill of Materials / Parts List, EPC: Engineering, Procurement, Construction, BQ: Bill of Quantities / Quantity List

## Streamlining the production capacity increase for main components (annual delivery of two plants)

- Steam generator: Complete the production system of two plants per year (Jul. 2008).
- Turbine: 10 rotors/year (2009/8)
- Reactor vessel: 2 plants/year (Sep. 2011)
- Reactor internals: 2 plants/year (Sep. 2011)



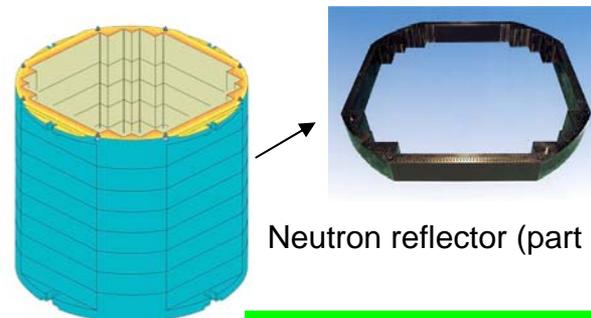
Nuclear-turbine-only plant (Takasago)



Production plant for reactor vessel/reactor internals (Futami)



70-inch class blade fabrication



Neutron reflector (part of reactor internals)

- (1) Reinforcing human resources
  - 1) Enhancing design capacity
    - Vigorously engaged in licensing and conforming to basic design (new graduates/careers also employed)
    - Merged engineering companies in the Group into one. (Apr. 2009 MNEC)
  - 2) Steadily increasing manufacturing personnel and upskilling
    - Hire and nurture such employees at proper time responding to actual work.
  - 3) Mobilizing management capability for construction
    - Make the best use of field-experienced personnel from internal resources for large domestic and overseas projects.
- (2) Fostering of human resources for higher level by training using individual curriculums  
Nuclear Engineer Base Reinforcement System, Monozukuri Training School, PM/CM Training, etc.
- (3) Taking advantage of global alliances

Partner	Subject business field
AREVA	ATMEA1, nuclear fuel, EPR main equipment
Harbin Group	Turbine system equipment for China
Powerful companies in U.S. and Europe	Plant construction and after-sales services

## Leading company in the global nuclear energy field



**“Safety and reliability” of our nuclear energy technology  
contributes to the global environment.**



Our Technologies, Your Tomorrow

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