CNRA/WGRNR Workshop
"New Reactor Siting, Licensing and Construction Experience"

Experiences with Tomari-3 Construction

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    - ✓ Modularization in Construction
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< Contributions for All PWR in Japan >

- Mitsubishi has constructed 24 PWR NPPs in Japan.
- Twin APWRs are under licensing.

Tomari-3

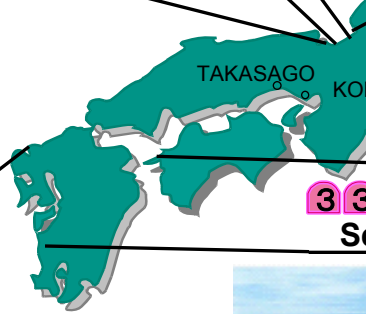
2 2 3 Tomari P/S

4 4 4 4 Ohi P/S

2 2 3 Mihama P/S

4 4 4 Tsuruga P/S

3 3 3 3 Takahama P/S



2 2 3 Ikata P/S

2 2 4 4 Genkai P/S

3 3 Sendai P/S

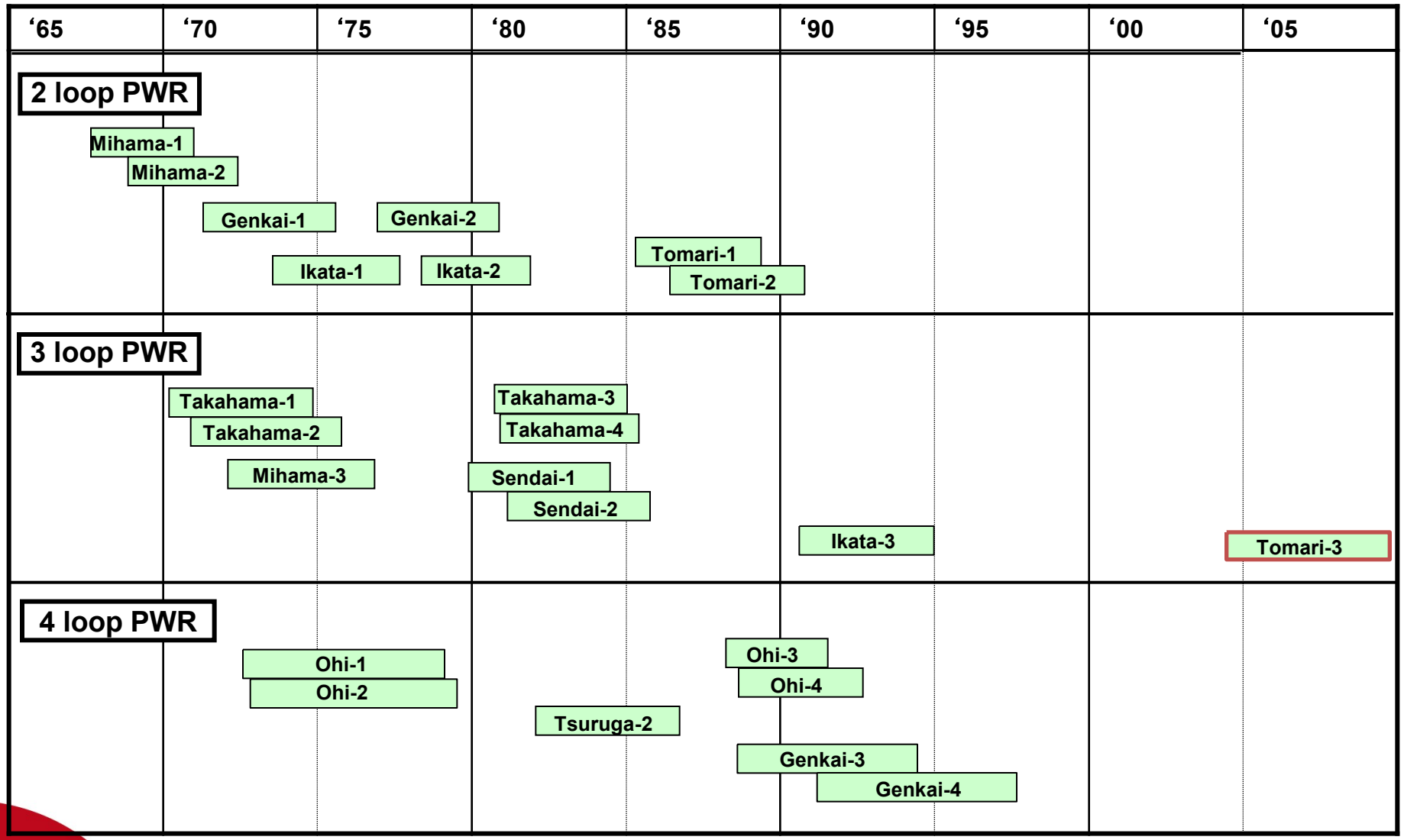
Number of Loops

N in operation

N under licensing (APWR)

Background

< History of Mitsubishi PWR Plant Constructions >



Background

< Continuous Constructions Experiences >

1970s	1980s	1990s	2000s	2010s	After 2020

Plant Construction Experiences

9 units | 7 units | 7 units

Developing our own technology → Safety & Reliability Enhancement → Economy Enhancement

Tomari-3 (Dec.2009)

Tsuruga-3/4 (2016/2017)

Japanese APWR

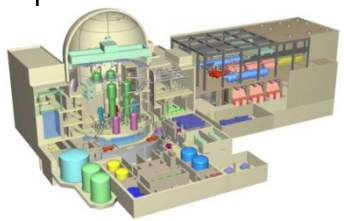
Sendai-3 (2019)

US-APWR

EU-APWR

Major Components Replacement Projects (including Components Supply)

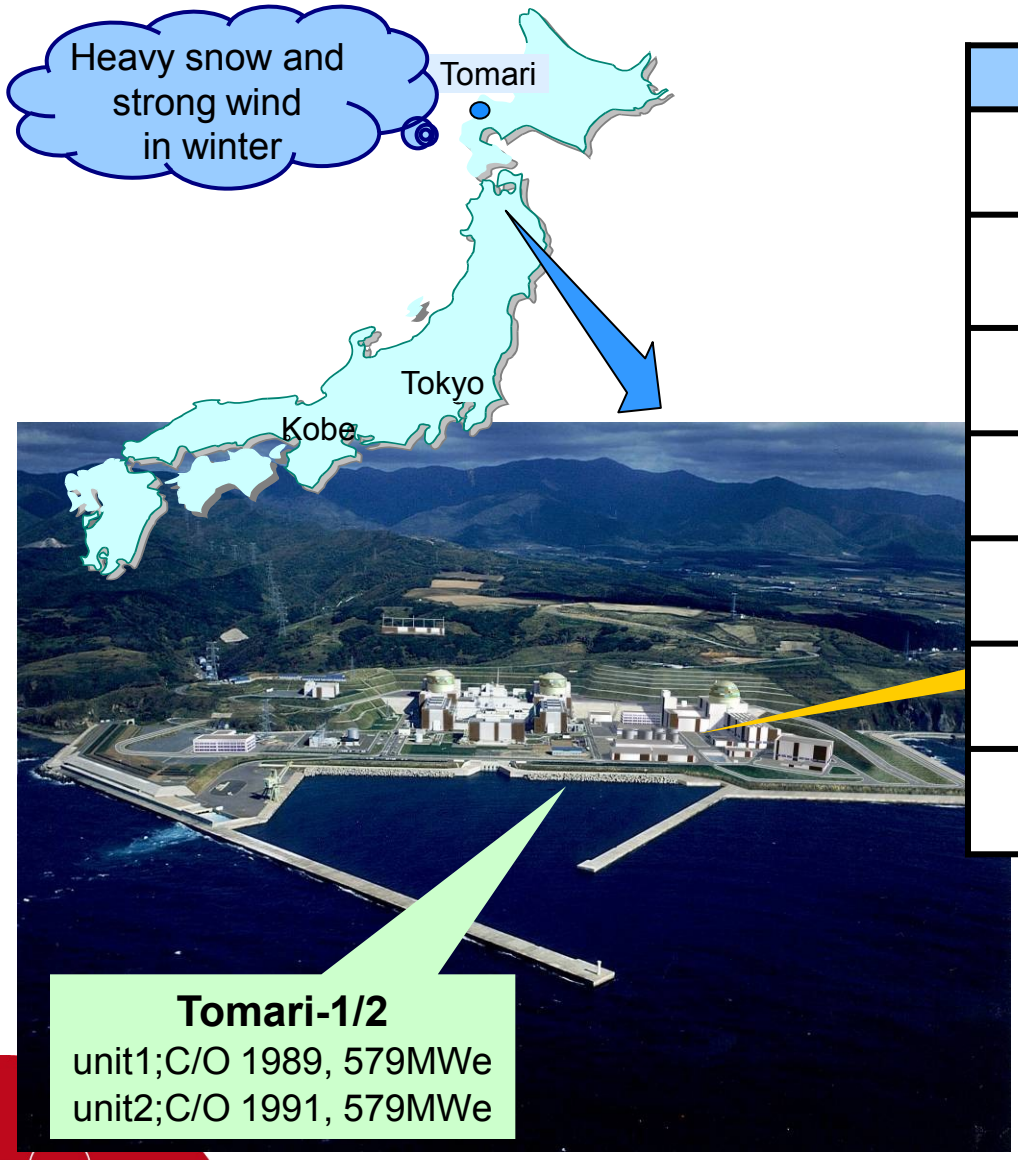
Steam Generator	20
Reactor Vessel Head	14*
Core Internal	4
Turbine	14*
Control Boards	6



*:including 2 foreign plants

Tomari-3 Construction

< Overview >



	Tomari-3
Utility	Hokkaido Electric Power Co., Inc
Manufacturer /Constructor	Mitsubishi Heavy Industries, ltd.
Reactor	PWR (3 Loop)
Electric power output	912 MWe
Fuel assembly	17 x 17 / 12ft
Number of fuel assemblies	157
Frequency	50Hz

Tomari-3 Construction

< Construction Schedule >

2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009

License Approval

Rock Inspection

Commercial Operation

Loose Excavation

Base Concrete

Inner Concrete of Containment Vessel

Fuel Loading

Construction of Containment Vessel

Installation and Function test of MEF

MEF : Mechanical and Electrical Facilities

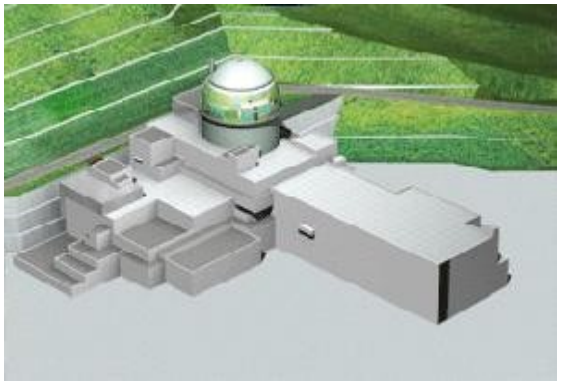
Start-up Test

Construction completed just on schedule

Tomari-3 Construction

< Plant & Construction Aspects >

- **Plant Aspects**
  - **Proven Design**
    - ✓3-loop conventional type PWR using highly reliable components
  - **New Technology**
    - ✓Fully digital I&C system
  - **Advanced Engineering**
    - ✓3D-CAD engineering
    - ✓Integrated Database System
    - ✓Jobsite Construction Control System
- **Construction Aspects**
  - **Site-work in Winter Season**
  - **Modularization in construction**



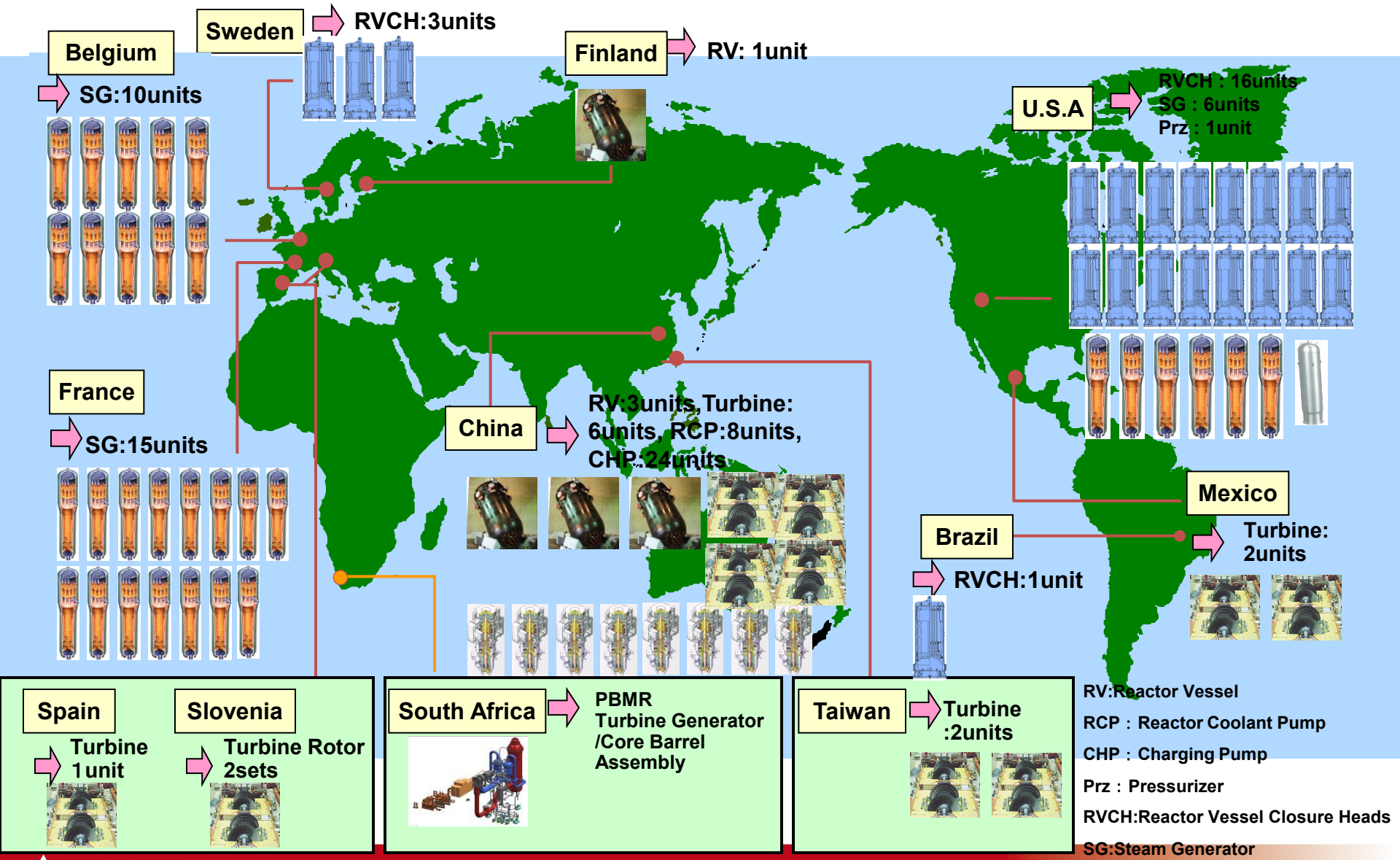
Proven Design

< Highly Reliable Components >

Tomari-3 Steam Generator was celebrated as MHI's 100th delivery with high reliability fostered through long years manufacturing and maintenance experiences.

Proven Design

< World-wide Reliable Components Supply >



New Technology

< Fully Digital Main Control Room >

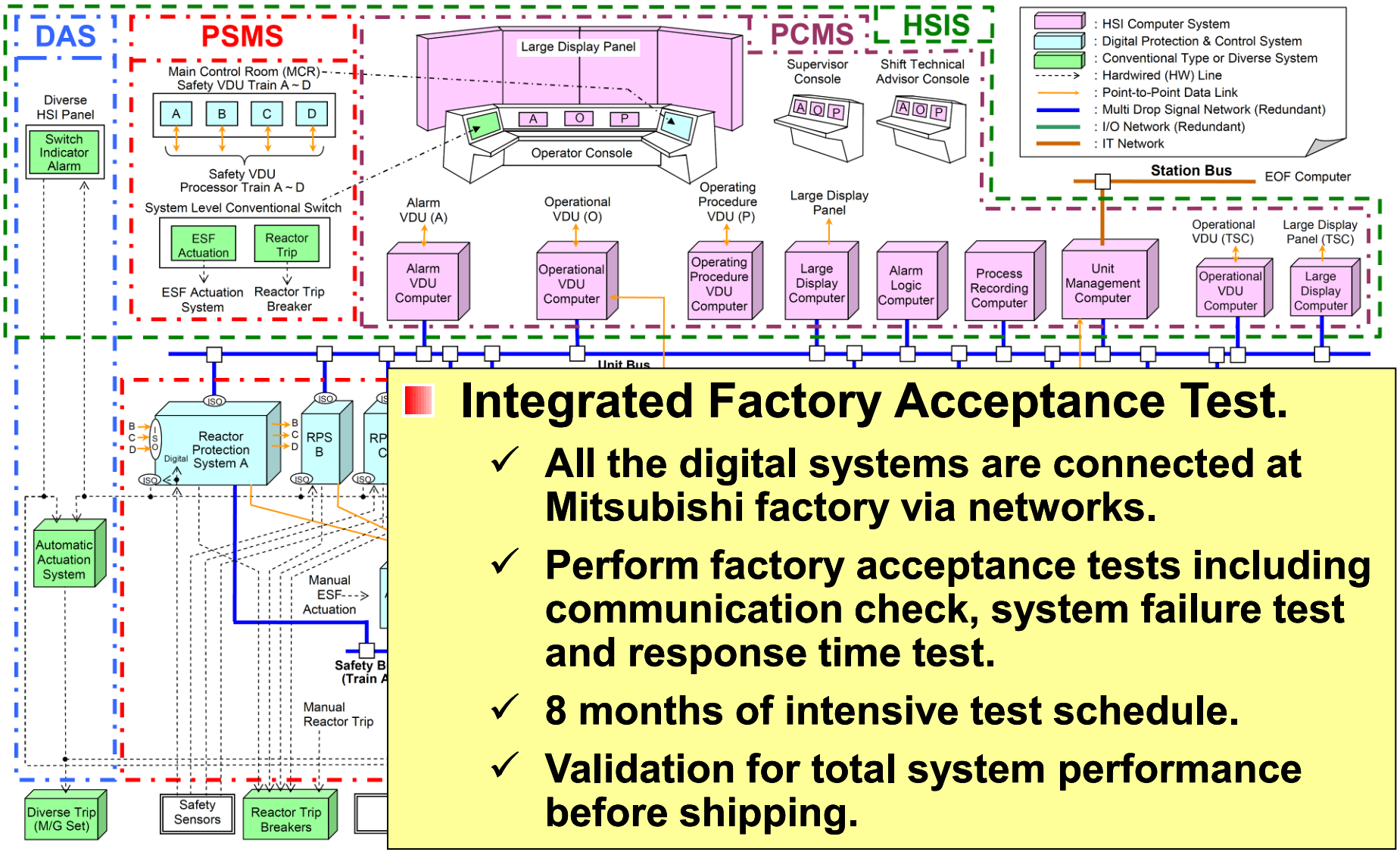
Advanced Control Room

- Large display panel
- Compact operator console
- Soft operation

→ Improved monitoring and operational performance by integrating controls and information display

New Technology

< I&C System Verification Works >



Integrated Factory Acceptance Test.

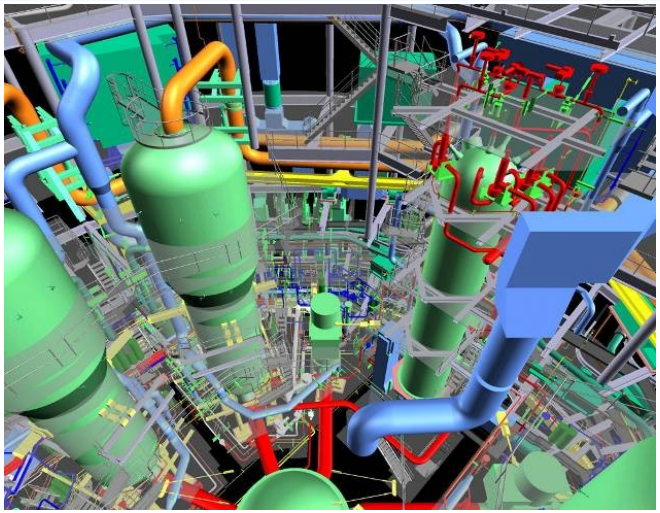
- ✓ All the digital systems are connected at Mitsubishi factory via networks.
- ✓ Perform factory acceptance tests including communication check, system failure test and response time test.
- ✓ 8 months of intensive test schedule.
- ✓ Validation for total system performance before shipping.

DAS : Diverse Actuation System PSMS : Protection and Safety Monitoring System HSIS : Human System Interface System PCMS : Plant Control and Monitoring System

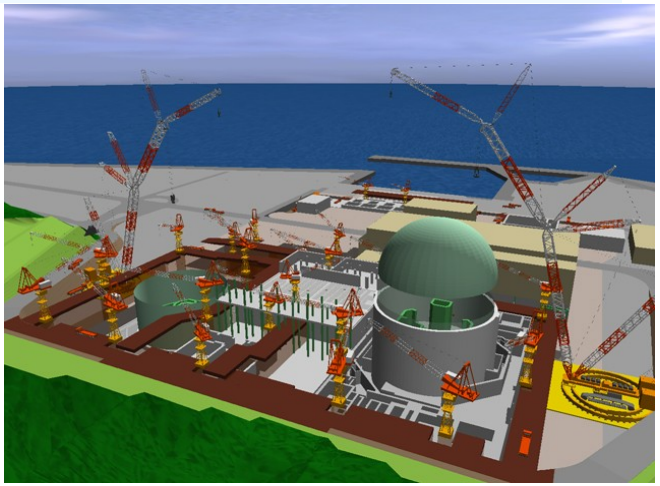
Advanced Engineering

< 3-D CAD Systems >

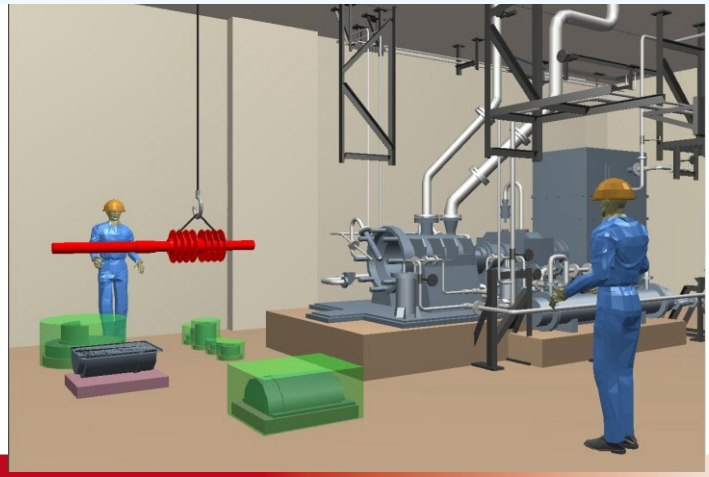
Layout･Piping Designing



Construction Planning



Maintenance Demonstration



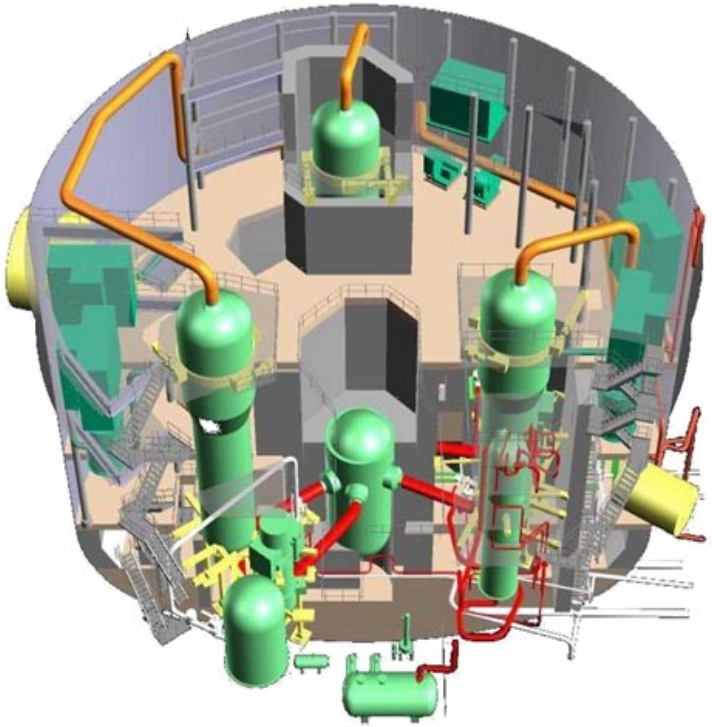
- ✓Improving design and construction accuracy and efficiency.
- ✓Improving operation and maintenance management.

Advanced Engineering

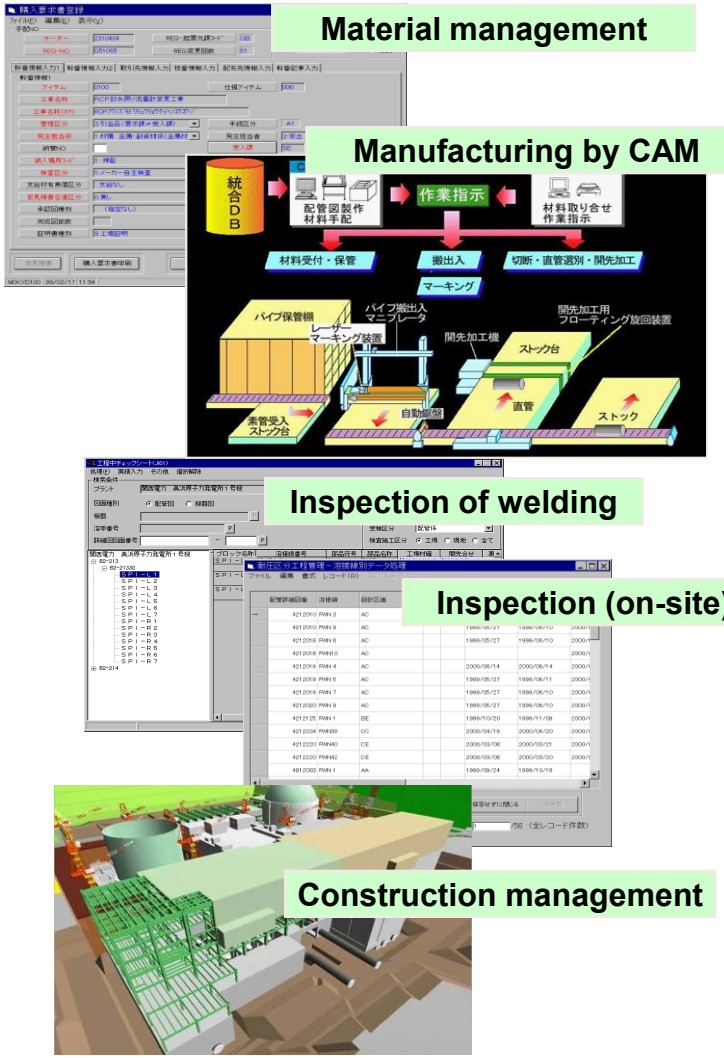
< Integrated Database Systems >

3D-CAD Management

✓ ***Integrated common database from design, procurement, inspection and construction***



Integrated Database



Advanced Engineering

< Construction Control System >

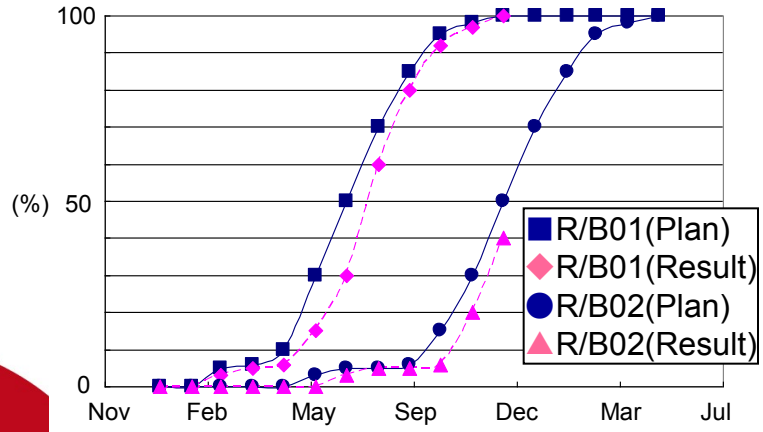
JCCS (Jobsite Construction Control System)

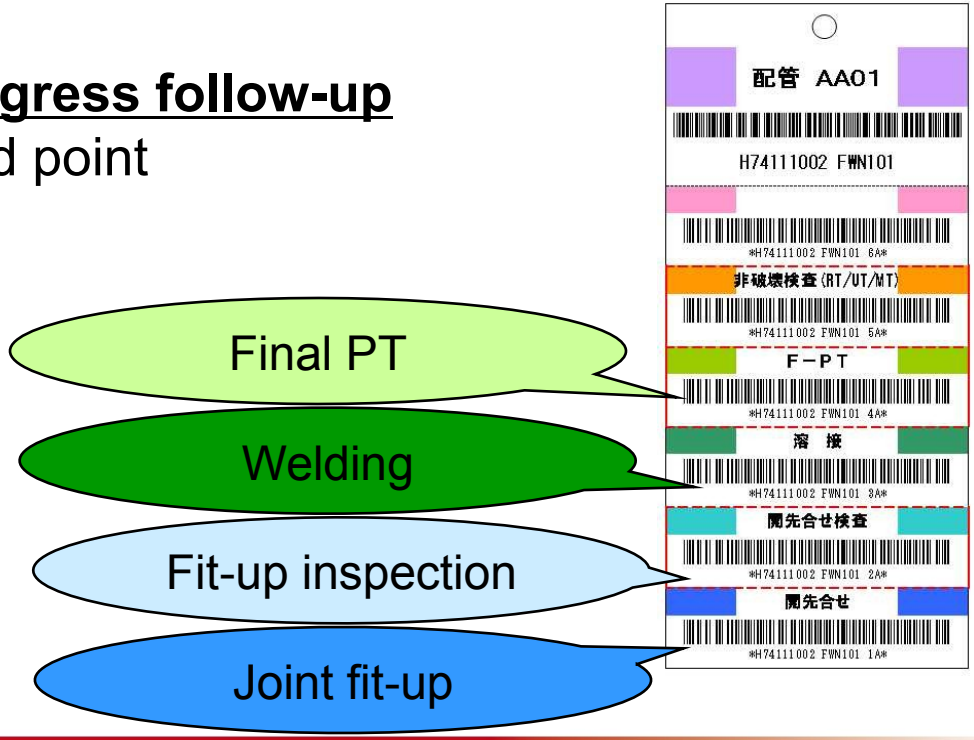
Drawing control

- Distribution by E-file. (in parallel with Hard copies)
- Multi-level security control
- Status control

Piping/Support construction progress follow-up

- Bar-code Multi-Tag for each weld point
- Progress monitoring





Site-work in Winter Season

< Winter Restriction at Tomari Site >

1. Construction is difficult in winter season because of heavy snow and strong wind (end of Nov. – beginning of Mar.)

2. Heavy Duty Crane should be used for construct containment vessel before winter season

Site-work in Winter Season

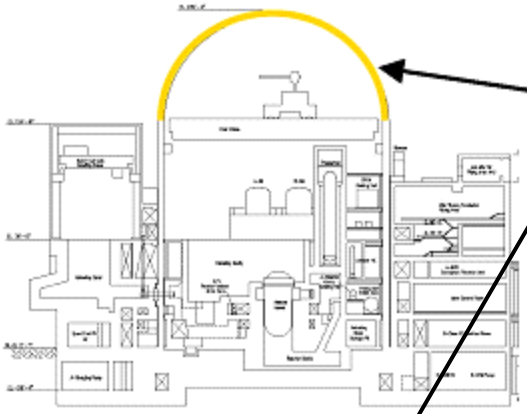
< Modified Setup Processes >

3. Early setup of outer shield is to enable inside work during winter season.

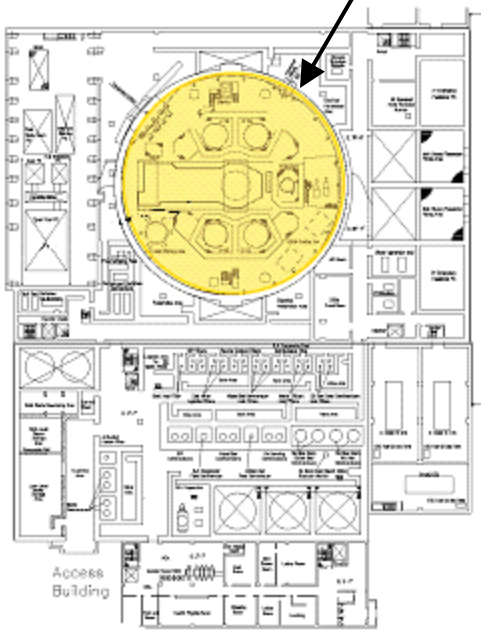
Modularization in construction

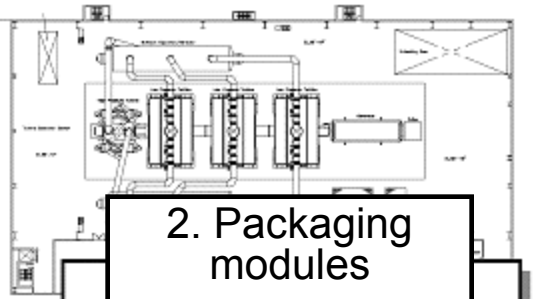
< Shortening Construction schedule >

1. Piping modules

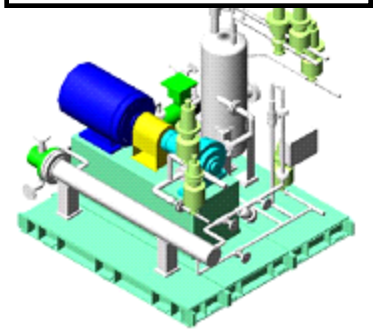


3. CV upper head



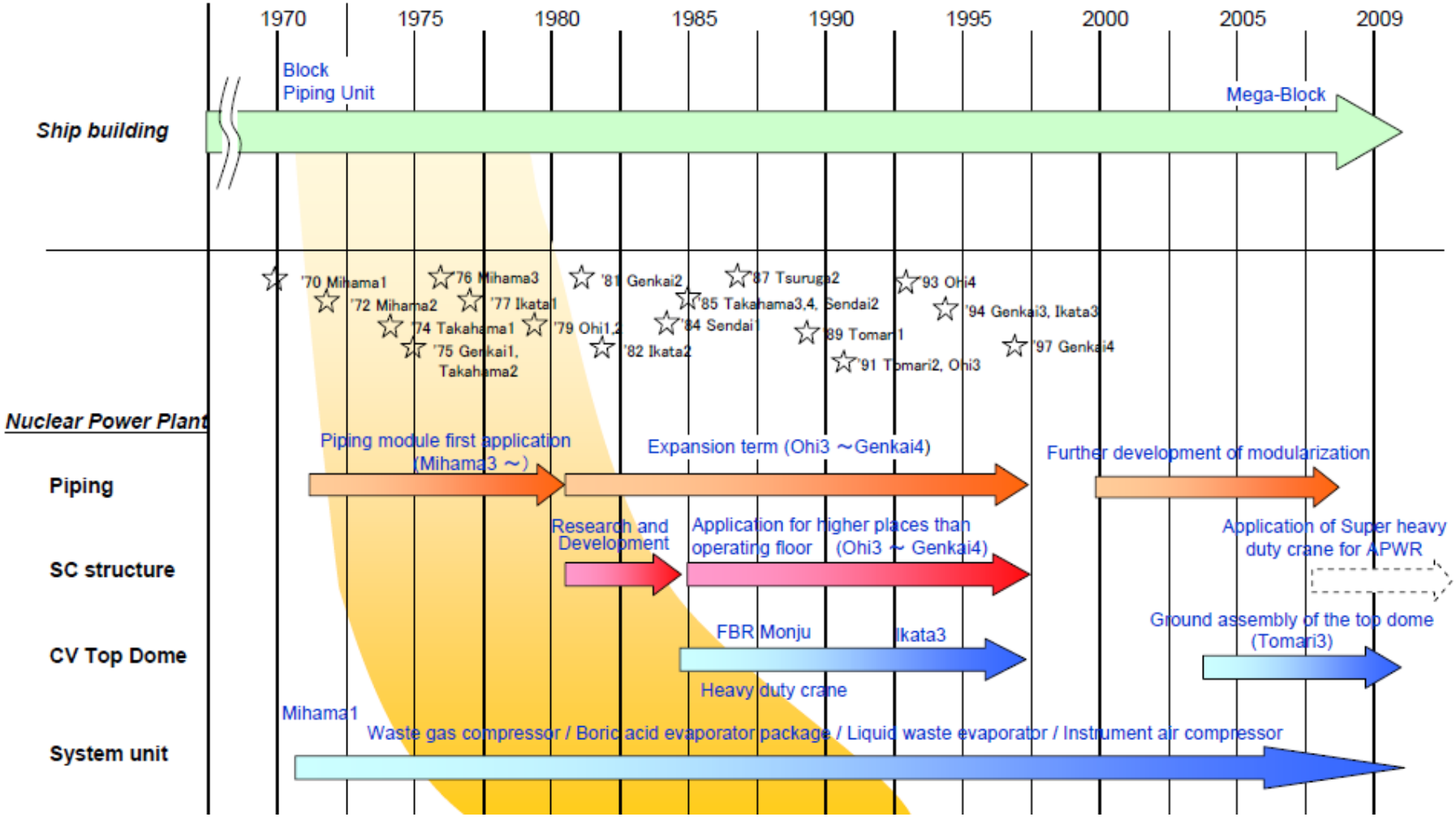


2. Packaging modules



Modularization in construction

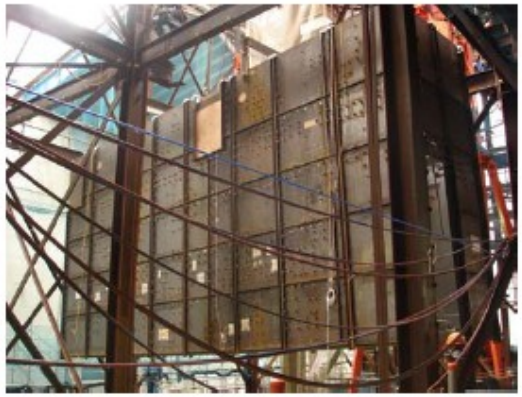
< Modularization History >

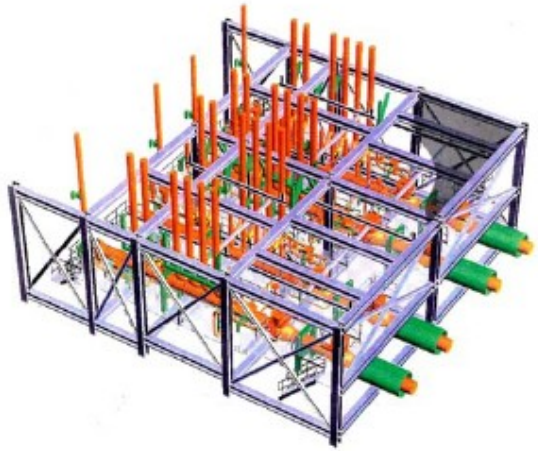


Modularization in construction

< Piping Modules >

Multiple types of piping modules





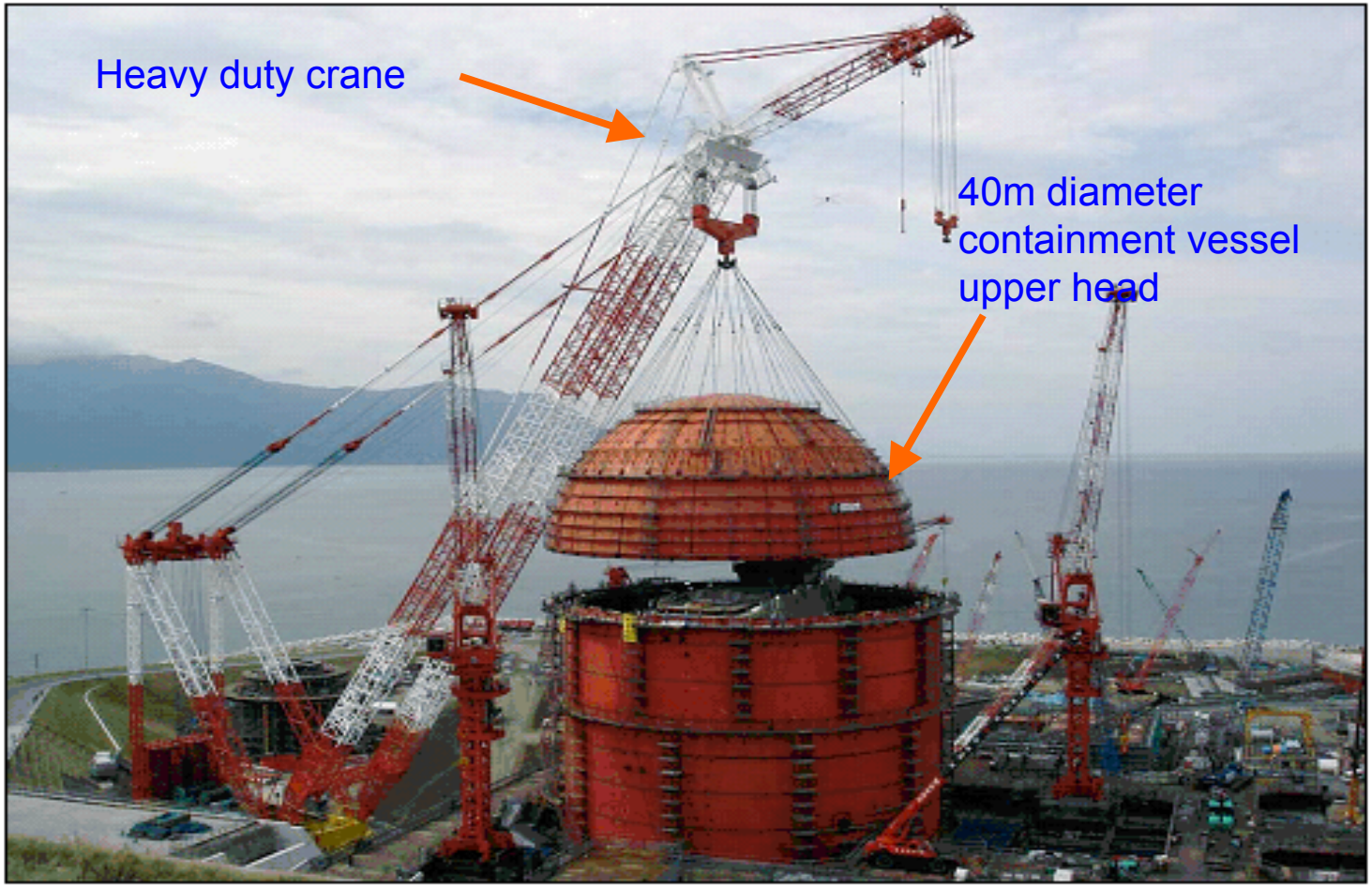
Modularization in construction

< Packaging Modules >

Modularization in construction

< CV Upper Head Installation >

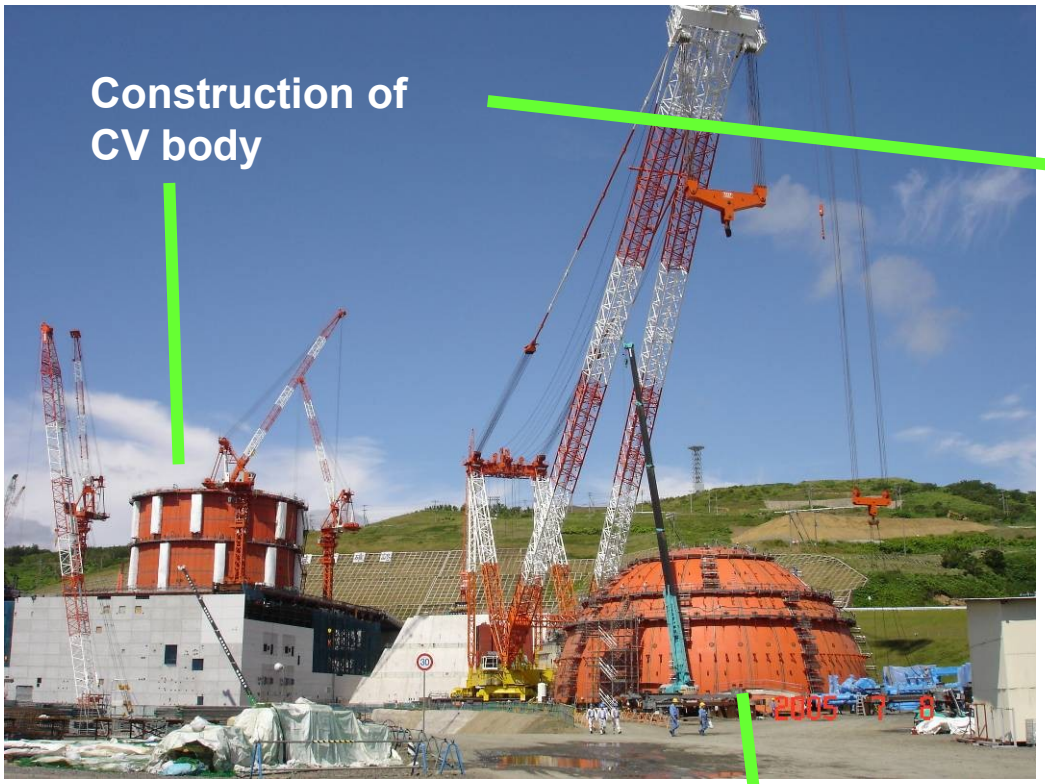
Advanced methods for shortening construction period.



Modularization in construction

< CV Construction in 8-Months >

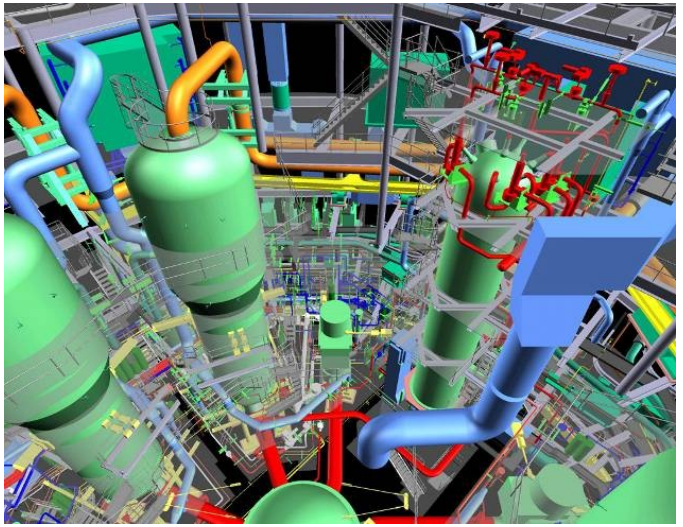
High precision on-site welding for upper head assembly in parallel with CV body construction



Conclusion

< Tomari-3 Successful Construction >

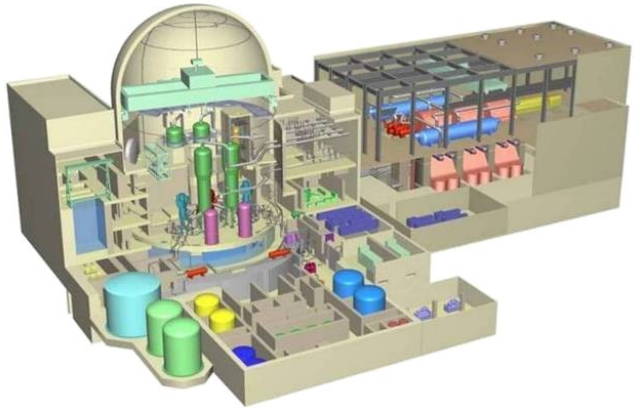
- **Completed just on schedule**
  - **Proven Design**
    - ✓3-loop conventional type PWR using highly reliable components
  - **New Technology**
    - ✓Fully digital I&C system
  - **Advanced Engineering**
    - ✓3D-CAD engineering
    - ✓Integrated Database System
    - ✓Jobsite Construction Control System
  - **Modularization in construction**



Launch Base for APWR worldwide application

APWR Progress Report

- A new generation LWR “APWR” started as Japanese national project more than 20 years ago.
- APWR has been standardized for worldwide market as US-APWR and EU-APWR.
- Larger output and improved reliability based on best mix of proven technologies
  - ✓ 1,700 MWe class power production
  - ✓ 24 months fuel cycle with on-line maintenance
  - ✓ 4 train safety system with advanced accumulator
  - ✓ Fully digital I&C and computerized MC



APWR Progress Report

➢ US-APWR

- ✓ DC application under reviewing by USNRC, planned to be certified in 2011
- ✓ COL applications for two sites under reviewing

➢ EU-APWR

- ✓ Design modifications will be finished this year considering European safety requirements.
  (SA, APC, etc.)
- ✓ Preparing for EUR assessment.

Towards the Future

- Earlier discussion with utility is important for mutual understanding and to achieve on schedule design, licensing and construction.
- Pre-application discussion with licensing authority is quite effective to address important safety issues and to establish clear licensing procedure and schedule
- Worldwide cooperation of industries and authorities is useful to establish international standards.

Thank you for your attention

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