Advanced Construction Technologies and Further Evolution Towards New Build NPP Projects

International Conference on Opportunities and Challenges for Water Cooled Reactors in the 21st Century

Hitachi-GE Nuclear Energy, Ltd.(HGNE)
Junichi Kawahata
HGNE’s NPP Construction Experience

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**HGNE’s BWR plants**

- In Operation: 20 units
- Under Construction: 1 unit

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**NET OUTPUT**

- **(MWe)**
  - 0
  - 5,000
  - 10,000
  - 15,000
  - 20,000

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**Domestic Production Phase**

- Improvement and Standardization phase
- Advanced BWR phase

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**Oversea Projects**

- Qinshan III
- HIGASHI-DORI-1
- OMA-1
- ONAGAWA - 3*
- SHIKA - 2
- HAMAOKA - 5*
- HAMAOKA - 4*
- KASHIWAZAKI - KARIWA 7*
- KASHIWAZAKI - KARIWA 6*
- KASHIWAZAKI - KARIWA 4
- HAMAOKA - 3*
- SHIKA - 2
- HAMAOKA - 2*
- FUKUSHIMA-II-4
- FUKUSHIMA-II-2
- FUKUSHIMA-I-3
- FUKUSHIMA-I-1*
- TSURUGA - 1*

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**5 ABWRs Continuous Construction Experience**

- 20 units
- Under Construction: 1 unit

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**HGNE’s NPP Construction Experience**

- Tsuruga
- Shika
- Kashiwazaki kariwa
- Shimane
- Hamaoka
- Oma

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**Advanced BWR phase**


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**HGNE’s BWR plants**

- Continuous Construction Experience
- SHIMANE - 1
- SHIMANE - 3
- SHIMANE - 4
- SHIMANE - 5
- SHIMANE - 6
- SHIMANE - 7

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**Advanced BWR phase**


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**Advanced BWR phase**

HGNE’s Construction Strategy

- On-site Work Reduction
  - Modularization with Large crane

- On-site Work Leveling
  - Open-top & parallel construction

- Improvement of On-site Work Efficiency
  - Detailed engineering before on-site work

- Improvement of On-site Work Support Efficiency
  - Engineering & Delivery Schedule Control System
  - Construction Support System

Integrated Engineering System
HGNE’s Construction Strategy

Integrated Engineering System

- On-site Work Reduction
- On-site Work Leveling
- Improvement of On-site Work Efficiency
- Improvement of On-site Work Support Efficiency

Modularization with Large crane

Open-top & parallel construction

Detailed engineering before on-site work

Engineering & Delivery Schedule Control System

Construction Support System
History of HGNE’s Module Application

Note:
*1). The numbers above include those of mechanical modules and of some large scale civil modules like base mat and top slab modules on construction critical path in whole plant (N/I and T/I). Note that hundreds of pre-fabricated rebar modules are not included.
*2). For Plant F/G, HGNE’s scope was T/I for Plant F and N/I for Plant G. The numbers are the summation of them.
*3). For Plant H, HGNE’s scope was T/I only.
HGNE’s Construction Strategy

- On-site Work Reduction
- On-site Work Leveling
- Improvement of On-site Work Efficiency
- Improvement of On-site Work Support Efficiency

- Modularization with Large crane
- Open-top & parallel construction
- Detailed engineering before on-site work
- Engineering & Delivery Schedule Control System
- Construction Support System

Integrated Engineering System
Strategy-2: On-site Work Leveling
Open-top & Parallel Construction
Strategy-2: On-site Work Leveling
Floor Packaging Method

### Conventional Method
- B1F
- 1F
- 2F

- Pres. Test
- Remaining Work

**Need to wait for all piping installation**

![Construction schedule](image)

### Floor Packaging Method
- B2F
- B1F
- 1F
- 2F

- Pressure Test
- Open Top Parallel Const.

**Earlier Floor Const. Completion**

![Construction schedule](image)

#### Work Force

- B2F: Completion of Construction
- 1F: Hydrostatic Testing
- 2F: Peak Construction

**Peak Reduction**

- Disassembly of Scaffoldings
- Pre-Operation Test
Strategy-2: On-site Work Leveling

Track Record in Work Leveling

- Site Manpower
- Construction Time

- Peak Reduction
- On-Site Manpower Leveled Off
- Latest ABWR Completed
- First ABWR

Month: 1 6 11 16 21 26 31 36 41

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HGNE’s Construction Strategy

On-site Work Reduction

On-site Work Leveling

Improvement of On-site Work Efficiency

Improvement of On-site Work Support Efficiency

Modularization with Large crane

Open-top & parallel construction

Detailed engineering before on-site work

Engineering & Delivery Schedule Control System

Construction Support System

Integrated Engineering System
High-End IT Systems Applied for Construction

Construction Schedule Planning

Module Engineering

Yard / Crane Engineering

Simulation

Schedule + 3D-CAD

Feedback

3D Module Design

Module Evaluation, Improvement Indices

Crane, Equipment Model

Simulation

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HGNE’s Construction Strategy

On-site Work Reduction
- Modularization with Large crane

On-site Work Leveling
- Open-top & parallel construction

Improvement of On-site Work Efficiency
- Detailed engineering before on-site work
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Improvement of On-site Work Support Efficiency
- Construction Support System

Integrated Engineering System

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Construction Management System Concept
Integrated System from Design to Construction

Features
- Business Process Innovation
  - Installation & Inspection Process Standardization
  - Zero Defect Cost (Shorten Lead Time)
  - Paperless Business
  - Ubiquitous Environment (using RFID)
  - Workforce Leveling
- Information Sharing
  - Design Office - Site
  - HGNE - Corporate Firms
- Integrated Construction Mgt.
  - Design-Procurement -Delivery-Construction

Just in Time
- Data Visualization
- Process Standardization
- Numerical Evaluation

PDCA
- Plan
- Visualization
- Problem Prediction
- Countermeasure

Product (Material) Control
- Schedule Control
- Document Control

Data Just in Time

Construction Management System
**Construction Management System**

**Delivery Schedule Control**

**e.g.) Equipment** (Target Date from Design to Site)

- Requisition
- Fabrication Schedule
- Material Receiving
- Shipping List Issue

-25
-18
-8
-3

-20
-13
-8

Contract with Vendor
Material Order
Fabrication Start
Site Receive

Material Control
Delivery Control
Schedule Control
Document Control

Material Order
Fabrication Start
Construction Management System

Product
Schedule
Document

Shipping Information
Warehouse Management
Work Instruction

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**Construction Management System**

**Work Instruction Function** -(ex. Pipe Fit-Up Work)

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**CONCORD 現場管理システム -- Web ページ タイプログ**

**作業指示書作成画面**

- 施工番号：7M2H259-631
- 取手番号：F3
- 番号表示

**フランジ絹付作業指示書兼記録**

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<th>カラム (詳細番号)</th>
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<th>レイティング</th>
<th>電極</th>
<th>溶接位置</th>
<th>有効長</th>
<th>有効厚</th>
<th>品番</th>
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**Work Instruction & Work Record System**
Input Actual Data using PDA & RFID
Construction Management System
- Progress Evaluation Function -

Progress Monitoring & Evaluation System
Construction Management System
- Creating Electric Construction manual -

- **Accumulating Real Construction Know-How**
- **Easy and Steady Traceability**
- **Further Enhancement of Construction Quality**
Conclusion

- **HGNE has continuously constructed 20 BWRs (4 ABWRs) over 35 yrs since 1970’s with NO delay in their planned Commercial Operating Dates (COD’s).**

- **During this period, various “Advanced Construction Technologies” have been developed based on its accumulated experiences and lessons learned, and they are proven to be effective for Nuclear Power Plants Constructions.**

- **HGNE is one of the very few companies which can complete NPP construction in “On-schedule” and “On-budget” manner in the world.**