Main Infrastructure Preparation and Local Human Resource Development for the First Nuclear Plant Construction

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2. Steps & Key Issues for Site Construction
3. Site selection & Infrastructure
4. Human Resource Development Program
5. Technology Introduction & Development
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Hitachi –GE Nuclear Energy
Uninterrupted Construction Experience

**Advanced Boiling Water Reactors**

- 40 years of continuous experience
- Continuous workforce development
- Additional ABWR orders in the future

Japan Total (~50GWe)

- 24 PWRs
- 32 BWRs (4 ABWRs)

- **TSURUGA-1**
- **SHIMANE - 1**
- **FUKUSHIMA I - 1**
- **HAMAOKA - 1**
- **FUKUSHIMA I - 4**
- **TOKAI - 2**
- **HAMAOKA - 2**
- **FUKUSHIMA II - 4**
- **OHMA**
- **FUKUSHIMA II - 2**
- **ONAGAWA - 3**
- **SHIKA - 2**
- **KASHIWAZAKI-KARIWA 6**
- **SHIMANE - 2**
- **HAMAOKA - 4**
- **KASHIWAZAKI-KARIWA 5**
- **SHIKA - 1**
- **HAMAOKA - 5**
- **KASHIWAZAKI-KARIWA 4**
- **KASHIWAZAKI-KARIWA 7**
- **SHIMANE - 3**
- **SHIKIKA - 2**

* COOPERATION CONSTRUCTION

- Construction Start
- Commercial Operation

Two BWRs are in process of decommissioning

Advanced BWR phase

Improvement and Standardization phase

Domestic Production Phase

Japan Total (~50GWe)
ABWR has adopted Proven Technologies in Japan

- 1980
- 1990
- 2000
- 2010
- 2020

BWR

Operating Plant

ABWR

Retrofit

Verification Tests
- New Pumps
- Seismic Tests
- Safety Systems
- Containment Vessel
- Reactor Internals

Utility Requirement
First of a kind development by manufacturer
Utility acceptance

Evaluation by Advisory Gr. (Government level)

Adoption

Construction/Operation

1990

ABWR has adopted Proven Technologies in Japan

- New Pump Verification
- Seismic Verification

1-2
ABWR has Approved by Japanese Licensing Process

- Under the Support or Accreditation of IAEA,
- Adoption of Similar Licensing Concepts to Those in Vender Country
- Validation by Specific Requirement in Acceptor Country

License Application
License Evaluation
License Approval
Construction/Operation
Fully Proven NPP

License Application
with Licensed NPP in Vender Country

License Evaluation by Regulatory Body
Specific Requirement in Acceptor Country
License Approval (Validation)
Licensed NPP in Acceptor Country

Vender Country
Recipient Country
ABWR Technology was Fully Established through Construction

With Modularization Method

<table>
<thead>
<tr>
<th>Milestones</th>
<th>S/C</th>
<th>R/I</th>
<th>F/C</th>
<th>M/C</th>
<th>O/C</th>
<th>P/S</th>
<th>RPV H/T</th>
<th>F/L</th>
<th>C/O</th>
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</thead>
<tbody>
<tr>
<td>Construction Period = 38M (actual First ABWR)</td>
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</tbody>
</table>

Excavation

R/B Building Work

RCCV Installation

Frame Work

Commissioning

Mechanical & Electrical Work in R/B

Displayed Weight shows approximate value

Critical Module

RCCV Lower Liner (630t, Composite)

Base Mat (460tons)

Mechanical module (270t, Composite)

Mechanical module (40tons)

Off Gas (27tons)

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ABWR have been Improved Plant by Plant

~The only plant of third generation in operation in the world~

- Provided full-plant or major equipments in all 4 completed ABWR projects

- Continue to provide series of ABWR projects:

  - Chugoku Electric Power CO. Shimane-3 (Under construction) (NSSS and BOP)
  - Electric Power Development CO. Ohma (Under construction) (NSSS (Full MOX ABWR))
  - Tokyo Electric Power CO. Higashidori-1 (Under Licensing Review) (H/T Consortium)
ABWR will be Constructed Continuously and Improved More in Japan

Under Construction

- Shimane-3
- Ohma
- Kaminoseki-1
- Tsuruga-3
- Tsuruga-4
- Higashidori-1 (TEPCO)
- Fukushima I-7
- Fukushima I-8
- Sendai-3
- Higashidori-2 (TEPCO)
- Kaminoseki-2
- Hamaoka-6
- Namie-Odaka
- Higashidori-2 (TOHOKU)

Based on Power Supply Plan 2009 Japan FY by METI

Technology Development by Continuous Construction

2005  2010  2015  2020 FY

ABWR 11 Units
PWR 3 Units
BWR 11 Units

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Steps for Site Construction

1. Site selection
2. Site Preparation
3. Construction
4. Operation

- Site selection
  - Site Selection
  - Environmental Survey
  - Environmental Assessment
- Site Preparation
  - Site Plot Plan
  - Conceptual/Basic Design
  - Detail Design
- Construction
  - Infrastructure/Preparatory work
- Operation

- Safety Assessment
- IAEA PHASE 2
- IAEA PHASE 3

Some items to be considered during Site selection

Site selection / Permission

On-site

Plant Design/Manufacturing

Plant phase

IAEA PHASE 2

IAEA PHASE 3

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Key Issues for Site Construction

- Establish Energy Policy
- Create a Legal Framework
- Technology Introduction & Development
- Public Acceptance
- Site Selection & Infrastructure
- Human Resource Development

Systematic and Scheduled Approach is necessary to achieve NPP introduction
Systematic and Scheduled Approach is necessary to achieve NPP introduction.

Establish Energy Policy
Create a Legal Framework
Technology Introduction & Development
Public Acceptance
Site Selection & Infrastructure
Human Resource Development
Site Plan of a Nuclear Power Plant

- Harbor Facilities
- Quarry
- Yard and Parking Lot
- On-site access road
- Land acquisition
- Excavation/grading
- Water/Electricity supply for construction
- Concrete batcher plant
- On-site access road
- Off-site access road
- Off-site temporary construction yard
- Village

This figure is extracted from 「火力原子力発電所土木構造物の設計」

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Life Related Facilities

Village (for const.)
- Lodgings
- Fire Station
- Clinic
- Religion Institution
- Amusement Facility
- Supermarket
- Laundry Facility

Nearest Town
- Police Station
- Hospital
- Fire Department
- Bank
- Post Office
- Fuel Supply Vender
- Gas Supply Vender (O₂, N₂, Ar)
Human Resource Development Program

- Establish Energy Policy
- Create a Legal Framework
- Technology Introduction & Development
- Public Acceptance
- Site Selection & Infrastructure
- Human Resource Development

Systematic and Scheduled Approach is necessary to achieve NPP introduction
Construction Scheme for first NPP

Utility Company

Turn-Key Contractor

Main Component Suppliers

Civil/Architecture Technical Advisors

Mechanical/Electrical Technical Advisors

Auxiliary Component Suppliers

Civil/Architecture Construction Company

Mechanical/Electrical Installation Company

Construction/Installation work and some auxiliary components need to be acquired locally
Human Resource Development (HRD) at Construction & Installation Phase

- Design Planning
- Manufacturing Procurement
- Construction Installation
- Operation Maintenance

- Identify which process should become locally necessary
- What kind of HRD should be done to achieve the planning above
- When and How the HRD should be performed and maintained
- TT and PDCA cycle of further HRD for successive Nuclear Plants
What is required for Installation work?

- Safety Knowledge
- Required Skill level
- Quality Controls
- Codes and Regulations
- Health and Welfare
- Man power Acquisition

Installation Work
- Iron Works
- Welding
- Scaffolder
- Plumber
- Electrician etc.
## Job Classification (Mechanical/Electrical)

<table>
<thead>
<tr>
<th>Item</th>
<th>Ratio</th>
<th>Foreman</th>
<th>Worker</th>
<th>Helper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler Maker, Iron Worker</td>
<td>8%</td>
<td></td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Millwright</td>
<td>7%</td>
<td></td>
<td>70%</td>
<td></td>
</tr>
<tr>
<td>Pipe Fitter, Plumber</td>
<td>13%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welder</td>
<td>25%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scaffolder, Carpenter</td>
<td>14%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheet Metal Worker</td>
<td>5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrician</td>
<td>13%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument Worker</td>
<td>3%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Worker</td>
<td>2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Painter</td>
<td>3%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement Finisher</td>
<td>1%</td>
<td></td>
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</tr>
<tr>
<td>Others</td>
<td>6%</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>20%</strong></td>
<td><strong>70%</strong></td>
<td><strong>10%</strong></td>
</tr>
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Manpower Curve and Peak Reduction Effort

Based on previous ABWR (Conventional Method)

Level-off Manpower Peak

Manpower Distribution

Based on Latest ABWR
## Education and Training System

<table>
<thead>
<tr>
<th>Basic Education (All New Members)</th>
<th>Rules &amp; Regulations, Safety, Quality Assurance &amp; Control, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Technical and Work Skill Training</td>
<td>Piping, Welding, Scaffolding, Lifting, Electric Work, etc.</td>
</tr>
<tr>
<td>Advanced Skill Up Training</td>
<td>Millwright Course, Welder Course, Electrician Course, etc.</td>
</tr>
<tr>
<td>Safety Skill Up Training</td>
<td>Training for the prevision of danger, Lessons learned</td>
</tr>
<tr>
<td>Quality Skill Up Training</td>
<td>Search for Failure in Mock-up Facilities, Lessons learned etc.</td>
</tr>
</tbody>
</table>
Systematic and Scheduled Approach is necessary to achieve NPP introduction
The following factors should be taken into account of, when localizing NPP

1. Scope (Engineering, Manufacturing, Operation etc.)
2. Level (Classification of equipment by importance/safety etc.)
3. Progress (First NPP, Second NPP and succeeding NPPS)

- Strategic Planning for Localization matched with HRD Planning
- Strong Government support for fostering local industries
- Support by IAEA or Cooperation with other Nuclear advanced countries
Step by Step Localization along with Industry Development

- Step-by-Step Localization based on Industry Technical Level of Acceptor Country
- Engineering Localization as well as Equipment to be Considered

<table>
<thead>
<tr>
<th>Category</th>
<th>1st Stage</th>
<th>2nd Stage</th>
<th>3rd Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Equipment</td>
<td>A</td>
<td>B: Foreign</td>
<td>C: Local</td>
</tr>
<tr>
<td>Pumps, Piping, Valves</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Module work</td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Installation work</td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
</tbody>
</table>

1,2: A: Important to Safety and Performance, B: Dedicated Skill, C: Others
3,4: A: Dedicated Skill, B: Others
· 1997/5 Hitachi Established Joint Mechanical Company in Dalian in China

· 1999/5 Shipped Power System Equipment to Qinshan-Phase III in China

· Now Continuing of Manufacturing Equipment of Power, Chemical and other System
An Example of Localization based on Local Industry Ability

Power System Equipment

- Containment Hatch: 36T
- Condenser: 320T
- Deaerator: 258.2T
- MSR: 188.2T
- HP-HTR: 31.5T
- LP-HTR: 43.5T
Conclusions

• Introduction of Fully Proven Technology based on long experience is vitally important to new-comer country on short schedule and on budget construction with optimum infrastructure.

• Site Infrastructure preparation should be well considered during site selection stage and be performed before main Construction starts.

• Human Resource Development at construction & installation phase is vitally necessary as well as design & planning, Commissioning or O&M phase.

• Strategic Planning for Technology introduction & development including localization policy is required with strong government support and local industry ability.
Thank you for your attention!