Development and Global Deployment of ABWR

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Toshiba Corporation
Contents

- Development Overview of ABWR
- New ABWR Construction in U.S.
- ABWR Deployment in Europe
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- Development Overview of ABWR
- New ABWR Construction in U.S.
- ABWR Deployment in Europe
Toshiba entered business in 1966, constructed 22 units, including 17 units as prime contractor.

BWR is the highest market share in Japan.

Reference: Nuclear Power Plants in the World 2009, JAIF

Construction Experiences of Light Water Reactors in Japan

Ratio of Gross Output
As prime contractor

PWR 39% (23 units)

TOSHIBA 34%

BWR 61% (32 units)

TOSHIBA

GE

Hitachi

W

M

Ohma-1

Tohoku, HIGASHIDORI-1

ONAGAWA-3

HAMAOKA-5

LUNGREN-2

LUNGREN-1

KASHIWAZAKIKARIWA-7

KASHIWAZAKIKARIWA-6

ONAGAWA-2

HAMAOKA-4

KASHIWAZAKIKARIWA-3

HAMAOKA-3

KASHIWAZAKIKARIWA-2

FUKUSHIMA-I-3

ONAGAWA-1

FUKUSHIMA-I-1

KASHIWAZAKIKARIWA-1

HAMAOKA-2

FUKUSHIMA-I-6

FUKUSHIMA-I-5

HAMAOKA-1

FUKUSHIMA-I-3

FUKUSHIMA-I-2

FUKUSHIMA-I-1

TSURUGA-1

ABWR

First Concrete  Fuel Lording

Constructed plants  Under construction

Construction Experiences

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FUKUSHIMA-I-2

FUKUSHIMA-I-1

TSURUGA-1

ABWR

First Concrete  Fuel Lording

Constructed plants  Under construction

Construction Experiences

BWR is the highest market share in Japan
# Development history of ABWR

<table>
<thead>
<tr>
<th>'70s</th>
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<th>'90s</th>
<th>'00s</th>
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<tbody>
<tr>
<td>Japan</td>
<td></td>
<td>Latest Proven Plant</td>
<td>TEPCO Higashidori unit 1</td>
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<tr>
<td>Conceptual design</td>
<td>Fundamental design</td>
<td>Common eng'g</td>
<td></td>
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<tr>
<td>ABWR common design by AET*</td>
<td></td>
<td>K-6/7</td>
<td>H-5</td>
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<tr>
<td>USA</td>
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<td>TVA DOE study</td>
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<td>ABWR in USA</td>
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<tr>
<td>Europe</td>
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<td>ASEA ATOM</td>
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<td>US ABWR</td>
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<td>Japan</td>
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<td>ABWR in USA</td>
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<td>EU-ABWR</td>
<td>Latest Generation III+ Reactor</td>
<td>Potential demands in Europe</td>
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<tr>
<td>Latest evolitional ABWR in the world</td>
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</table>

- **AET**: TOSHIBA, TEPCO, GE, Hitachi, ASEA-ATOM
- **ABWR**: BWR90, BWR90+, ABWR for STP3/4
- **EU-ABWR**: Latest Generation III+ Reactor
- **Potential demands in Europe**
- **Latest evolitional ABWR in the world**
Safety in ABWR

Testing for Verification & Optimization

In-house Test Facility

- RIP Performance Test
- CRD Performance Test
- Hydraulic Test In Pressure Vessel
- Seismic Test of CRD

Demonstration Test of RCCV (Seismic Test) (by Government)

High reliability by building test facilities
Safety Nuclear Power Plant  ABWR

- The latest and Proven BWR to receive Design Certification from the US-NRC
- The first unit started operation in 1996
- Four ABWR in operation in Japan

ABWR (Japan)

<table>
<thead>
<tr>
<th></th>
<th>3926MWt</th>
<th>1350MWe</th>
<th>60 years</th>
<th>90%</th>
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<tbody>
<tr>
<td>Thermal Power</td>
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<td>Life time</td>
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<tr>
<td>Availability</td>
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Tested and Proven Light Water Reactor
ABWR in Japan

Kashiwazaki-Kariwa Unit 6/7
- The first Generation III Reactor in the world  
  (C/O: November 1996)
- Short construction period  
  37 months (1st concrete – FL)
- Built on schedule and budget

Hamaoka Unit 5
- World’s 3rd ABWR  
  (C/O: January 2005)
- Latest technologies applied
- Combined type reactor building for the high seismic condition

On time, On budget and High Seismic Safety
Contents

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**TVA DOE funding study in 2004, 2005**

- ABWR Cost/Schedule/COL Project at TVA’s Bellefonte Site

- Cost and Schedule
- ABWR 2 units
- 1350 – 1500 MWe class
- PJ Deployment model
- ABWR Enhancements
- Fuel Supply Plan

**ABWR Team**

<table>
<thead>
<tr>
<th>Toshiba</th>
<th>GE</th>
<th>Bechtel</th>
<th>USEC</th>
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<tr>
<td>TVA</td>
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**DOE study schedule (2004 ~ 2005)**

- Application/Award
- Contract/Start Study
- Draft report
- Final report

**Starting point of Global ABWR Deployment**
**New LWR Construction in U.S.**

**Ready for Construction**

**[COL Status]** COL: Combined Construction and Operating Licensing

<table>
<thead>
<tr>
<th>LWR Type</th>
<th>COL applied</th>
<th>COL in preparation</th>
<th>EPC contract</th>
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</thead>
<tbody>
<tr>
<td>ABWR</td>
<td>1site, 2units</td>
<td>-</td>
<td>1site, 2units</td>
</tr>
<tr>
<td>AP1000</td>
<td>7sites, 14units</td>
<td>2sites, 2units</td>
<td>3sites, 6units</td>
</tr>
<tr>
<td>EPR</td>
<td>4sites, 4units</td>
<td>2sites, 2units</td>
<td>LLM (part)</td>
</tr>
<tr>
<td>ESBWR</td>
<td>5sites, 6units</td>
<td>-</td>
<td>LLM: 3units</td>
</tr>
<tr>
<td>APWR</td>
<td>1site, 2units</td>
<td>-</td>
<td>-</td>
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</tbody>
</table>

Source: NEI HP (09/03)  
With TOSHIBA’s assumptions

Construction of ABWR begins the Nuclear Renaissance in USA.
STP3/4 project in U.S.

ABWR in USA

EPC contract Feb 9, 2009 as TOSHIBA prime contractor
Current Status of STP3/4 project

STP3/4 Project Outlines
- Customer: STPNOC
- ABWR 2 units (1380MWe/Gross)

Features
- Actual 1st BWR project as a revival of nuclear industry in U.S.
- Leading success with maximum application of excellent experiences for design, construction and operation of ABWRs in Japan.

Current Project Status
- COLA rev.2 provided by STPNOC to NRC with Toshiba technology
- EPC contract was established in 2009 as Toshiba prime contractor
- The date of Commercial Operation expected in 2016 for Unit No.3.

STP3/4 project is on going in U.S.
Contents

- Development Overview of ABWR
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Deployment of ABWR in Europe

- European BWR Technologies are applied in European ABWR
- ABWR is changed to meet European safety requirements

RCCV
- Provisions for Hydrogen Generation

Armored R/B
- Airplane Crash

PCCS
- Core Catcher
  - Provisions for Molten Core Cooling
- Severe Accident Management
  - 100% x 3 Independent ECCS (N-2 Requirement)

1600 MWe output
- 72 inch Turbine

Severe Accident Management

Heat Removal by PCCS

Design changes are minimum to satisfy safety requirements
Plant Specification

- Reactor Thermal Power: 4300MW
- Electrical Output: >1600MW
- Plant efficiency: >37%

Plant availability

- Design life: 60 years
- Plant availability: >90% over lifetime

Thermal Power increases from 3926 MW to 4300MW.
Global Deployment of ABWR

Japan

USA

US-ABWR

Europe

EU-ABWR (ABWR III+)

Latest Generation III+ Reactor

To be the World Standard LWR

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Global Deployment of ABWR

- Only Generation III Reactor under Operation with excellent operating experience in Japan.
- High certainty for schedule based on the actual construction experiences in Japan.
- Implementation for the development of the STP3/4 project is under going in U.S. based on the results of TVA DOE funding study.
- Specific regulation will be considered for ABWR promotion in Europe as well.

Expanding ABWR construction worldwide
Summary

We provide the BWR technologies and contribute to “The Nuclear Renaissance”.

Nuclear Renaissance