Nuclear Fuel Technology & Manufacturing of KEPCO NF

Korea Nuclear Association for International Cooperation

27 March 2012
Part 1

Brief Introduction of KEPCO Nuclear Fuel

- History
- Main Activity
1980’s
1982 KEPCO NF Established
1988 Construction of PWR plant (200 MTU/y)
1989 Commercial Operation of PWR plant

1990’s
1992 R&D Center Established
1998 Capacity Expansion
   (350 MTU/y for PWR, 400MTU/y for CANDU)

2000’s
2005 Tube Mill construction
2006 Commenced Supply of advanced PLUS7™ Fuel
2008 Commercial Operation of Tube Mill (TSA)
2009 Capacity Expansion (700 MTU/y for PWR)

2010’s
2010 Fuel Supply Contract awarded for UAE
2011 S/G Tube Mill Construction,
   Advanced Technology (X-Gen Project)
Main Activity

Reload Design and Safety Analysis
- ICD & Reload Core design and safety analysis for PWR
- Fuel engineering

Supply of PWR & CANDU Fuels
- Uranium Ore
- UO2 Powder and Fuel components
- PWR & CANDU Fuels

Fuel Maintenance and Service
- Coolant Activity Analysis, Root Cause for Leak
- Poolside Examination, Reconstitution, etc

Research and Development
- Nuclear Fuel Components, Materials & Assembly
- Codes, Methodology & Models
Part 2

Fuel Technology

- PWR & CANDU Fuel
- Reload Design & Safety Analysis
- Fuel Performance
- Capacity Factor
Westinghouse Type Plants
- 14X14 OFA
- 16X16 STD
- 17X17 RFA
- 16X16 ACE7™
- 17X17 ACE7™

OPR1000 Plants
- 16X16 Guardian
- 16X16 PLUS7™

CANDU fuel
- 37-element standard fuel

CANFLEX fuel
- 43-element fuel
# Reactor type and its Fuels

## Operation: 21 Units
- Westinghouse Type: 8
- OPR1000 Type: 9
- CANDU Type: 4

## Construction: 11 Units
- OPR1000 Type: 3
- APR1400 Type: 4
- UAE: (4)

<table>
<thead>
<tr>
<th>Description</th>
<th>Westinghouse Type Plants</th>
<th>OPR1000</th>
<th>APR1400</th>
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<tbody>
<tr>
<td>FA Array</td>
<td>14x14 16x16 17x17</td>
<td></td>
<td>16x16</td>
</tr>
<tr>
<td>NSSS Supplier</td>
<td>Westinghouse</td>
<td>Framatome</td>
<td>Doosan</td>
</tr>
<tr>
<td>No. of Loop</td>
<td>2 2 3 3 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Plants</td>
<td>1 1 4 2</td>
<td>9 (3)</td>
<td>(4+4)</td>
</tr>
<tr>
<td>Rating(MWe)</td>
<td>587 650 950 950</td>
<td>1,000</td>
<td>1,400</td>
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<tr>
<td>Fuel Type</td>
<td>W14x14 16ACE7 17ACE7 17ACE7 PLUS7</td>
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</table>

( ) Under Construction
Fuel Performance

Fuel Rod Failure in Korea

Fuel Leak Rate

International Average *

Zero Leak Plant in Korea

Source: IAEA(NF-T-2.1, 2010), Review of Fuel Failure in Water Cooled Reactors

※
Capacity Factor

Year 2010

- Over 15% higher than the world average
- Highest among countries running 10 units or more
- World BEST Quality & Safe Nuclear Fuel

※ Source: Nucleonics Week, April 2010
Part 3
Fuel Manufacturing

- Fuel Fabrication Facility
- Tube Mill
- Quality Assurance System
NSA Plant (SG tubing Mill)

Plant 1
( Rod & Assembling Line)

Plant 2
( Power & Pellet Line)

Plant 3
( Power, Pellet, Rod & Assembling line)

TSA Plant (Techno Town - Zirconium Tubing Mill)

- Project Period: 2011.8~2017.7
- Operation: 2017.8~
- Location: Non-San city (50km away)
- Capacity: 1600km/year

Seoul
Daejon
Pusan

Project Period: 2012 ~ 2016
Operation: 2017.1~
Lines: Reconversion ~ Assembling

12
• The supplies accumulated has been over 6,150 MTU as of December, 2011.
TSA: Techno Special Alloy
Area: 16,529 m²
Capacities: 1,400 km/year
Operated from Nov. 2008

Products: Supply all tubes for PWR since 2009
Build up the foundation of technical development of new alloy cladding tube: HANA Alloy
- Customer’s QA Requirements
- US 10 CFR 50 Appendix B
- ASME NQA - 1
- Korea Atomic Energy Act.
Part 4

Stable Supply of Nuclear Fuel

- NPP capacity and Uranium Forecast
- Security of Fuel Supply
- KEPCO’s Fuel Vision
Additional 10 units will be installed in Korea by 2020 as of 2011.

Secured 43,000 tons of U3O8 in total (1,550 ton / year).

- Waterbury Lake Exploration Project (Canada)
- Denison Mines Corp. (Canada)
- Imouraren Mine (Niger)
- Gas Hill Mine (USA)
Security of Fuel Supply

Security of uranium

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<th>2011</th>
<th>2020</th>
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<tr>
<td>Required</td>
<td>4,500 tons</td>
<td>8,900 tons (domestic+overseas)</td>
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<tr>
<td>Provision</td>
<td>1,550 tons</td>
<td>5,340 tons</td>
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</table>

7th largest uranium producer

60% of required Uranium will be secured by self-development or investment. The remain will be purchased in a market long term contract basis.

Involvement in the whole front-end cycle

- Mining
- Processing

• Conversion • Enrichment • Fabrication

Vertically integrated nuclear fuel company

Expansion • New business • Existing Business
KEPCO’s FUEL Vision

Global TOP 3 Fuel Cycle Company

**Human Performance**
- Global Leader
- Global Expert

**Customer Priority**
- Best NPP performance
- Social Responsibility/Vendor Cooperation

**Technology Innovation**
- Global Competitiveness
- Top-notch Technology

**Business Development**
- Front & Back End Fuel Cycle Business
- Global Marketing
Thank you

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