Risks and Challenges Associated with Recycling and Waste Disposal: Korean Perspective

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Opinion expressed here is strictly that of the author, it may or may not agree with present affiliations
No Magic Wanda in the Real World

MARIO SAYS
Nuclear is the only realistic solution to solve energy crisis and global warming!!!
Three Roots of a Triangle for Advanced Fuel Cycle

Scientific Evidence

- Feasibility in commercial scale
- Non-proliferation characteristics
- Cost-effectiveness
- Environmental benefit

Authenticity

- Urgent need to solve the SNF accumulation
- Tight plan to enhance transparency & non-proliferation
- History of observing non-proliferation

Fairness

- Avoiding burden to the future generation
**Old Policy (By 2020)**

- **20 units in operation**
  - 16 PWRs (6 OPR1000)
  - 4 PHWRs (CANDU)

- **6 units under construction**
  - 4 OPR1000
    - Shin-Kori: ’05.1 ~
    - Shin-Wolsung: ’05.10 ~
  - 2 APR1400
    - Shin-Kori: ’07.9 ~

- **2 units under preparation**
  - 2 APR1400
    - Shin-Ulchin

**New Policy (By 2030)**

- **Nuclear share**
  - 36% (2007) → 59% (2030)
  - About 10 units more by 2030

• G-5 without NFC???
**Current Status of NPPs:** NE saves 12.4 B US Dollars/yr

- **Installed Capacity (As of Aug. 2008)**
  - Total: 70.4 GWe
  - Nuclear: 17.7 GWe (25.2%)

- **Electricity Generation (As of Dec. 2007)**
  - Total: 403.1 TWh
  - Nuclear: 142.9 TWh (35.5%)

- **In operation**
  - 20 units in operation
    - 16 PWRs (6 OPR1000)
      - 4 PHWRs
  - Under construction
    - 4 OPR1000
    - 2 APR1400
  - Under preparation
    - 2 APR1400 (Ulchin)
Current Status of Industries in Korea

- Kori
- Ulchin
- Wolsung
- Yonggwang

Steel Manufacturing
Car & Ship-building
Busan, 2nd Biggest City
Ship-building
Steel Manufacturing
Chemical Eng
IT
Daegu, 3rd Biggest City
Issues in Nuclear Fuel Cycle & NPPs

- **Storage**: saturation in 2016 at AR facilities
- **Recycling**: minimizing waste volume and toxicity and/or solving the problem of storage
- **Disposal**: The biggest size potential repository to host SNF, more than 100,000 MTU
- **Enrichment**: No problem so far relying on long term commercial supply. What about the future in the advent of Nuclear Renaissance
## SNF Arising

(Unit: MTU)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Site</th>
<th>'03</th>
<th>'04</th>
<th>'05</th>
<th>'06</th>
<th>'07</th>
<th>'08</th>
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<tbody>
<tr>
<td>NPP</td>
<td>Kori</td>
<td>1,346.96</td>
<td>1,414.89</td>
<td>1,475.45</td>
<td>1,562.45</td>
<td>1,623.02</td>
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<td>Yungkwang</td>
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<td></td>
<td>Ulchin</td>
<td>763.53</td>
<td>841.62</td>
<td>948.78</td>
<td>1,053.50</td>
<td>1,213.43</td>
<td>1,294</td>
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<td>Wolsong</td>
<td>3,487.49</td>
<td>3,888.95</td>
<td>4,287.21</td>
<td>4,697.36</td>
<td>5,092.33</td>
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<td></td>
<td>(Sub-total)</td>
<td>6,588.47</td>
<td>7,285.86</td>
<td>7,960.27</td>
<td>8,670.38</td>
<td>9,419.86</td>
<td>10,083</td>
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<tr>
<td>Non-NPP</td>
<td>KAERI Hanaro</td>
<td>0.367</td>
<td>0.413</td>
<td>0.447</td>
<td>0.48</td>
<td>0.52</td>
<td>0.556</td>
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<td>PIEF</td>
<td>3.214</td>
<td>3.231</td>
<td>3.241</td>
<td>3.251</td>
<td>3.266</td>
<td>3.274</td>
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<tr>
<td></td>
<td>(Sub-total)</td>
<td>3.581</td>
<td>3.644</td>
<td>3.688</td>
<td>3.731</td>
<td>3.786</td>
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<td>TOTAL</td>
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<td>6,592.05</td>
<td>7,289.50</td>
<td>7,963.96</td>
<td>8,674.11</td>
<td>9,423.65</td>
<td>13,913</td>
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</table>

- **By 2050:** 30,000 MTU PWR + 20,000 MTU CANDU
- **By 2100:** More than 80,000 MTU (Ref 100,000 MTU)
Solutions

- Near Term: Storage
- Mid Term: (Potential Recycling/MNA or ?)
- Long Term: Final Disposal

Policies:
- Implementation based on the recommendation from KPSE by MKE
- R&D Action Plan by MEST
## Surveillance

### Near Term:

<table>
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<tr>
<th>Option</th>
<th>No</th>
<th>Priority</th>
<th>Prob</th>
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<td>ISFSI</td>
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<td>Adaptive Approach</td>
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<tr>
<td>Off-shore reprocessing</td>
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<td>MNA Storage/reprocessing</td>
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<td>0.055</td>
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<td>Geologic disposal</td>
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<tr>
<td>P &amp; T</td>
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<td>9</td>
<td>0.029</td>
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<tr>
<td>Transmutation of U &amp; Pu in reactor</td>
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<td>9</td>
<td>0.029</td>
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<tr>
<td>MNA Disposal</td>
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<td>11</td>
<td>0.02</td>
</tr>
<tr>
<td>Incineration</td>
<td>14</td>
<td>11</td>
<td>0.02</td>
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<tr>
<td>Incineration in a smelting furnace</td>
<td>15</td>
<td>13</td>
<td>0.015</td>
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</table>
Recommendation

Near Term:

- AR
- AFR
- ISFSI
- Off-shore reprocessing
Birth of KRMC

- Promised by the previous national president
- Birth on Jan 1\textsuperscript{st} 2009
- Independent body similar to RWMC + NUMO
- 201 Staffs in action by April 2009
  - From the main office of KHNP
  - From NETEC in KHNP
  - From MKE
  - Recruits
- Responsible for
  - LLW disposal
  - Short Term Management of SNF
  - Public and Stakeholder Confidence
  - Radioactive Waste Management Fund
  - R&D on LLW & SNF Management
Public and Stakeholder Confidence

- Decision by KAEC in December 2004
- Starting from March 2006 via Conflict Management Committee
- Korean Public and Stakeholder Engagement TFT in 2007
  - Recommendation report in April 2008
- Proclamation of KPSE in September 2008 by Minister of MKE
- Start of the 1st Phase in Dec 2008
  - Main Team
  - Inventory Verification Team
  - Scenario Development Team
  - Social Involvement Team
- Main KPSE from the middle of 2009
Action Plans

- 256th AEC
  - Separation of LLW from SNF
  - Interim Storage by 2016
  - After 2016, KPSE on SNF Management Implementation inclusive of Storage
- R&D Action Plan in 2008
R&D

- National R&D Action Plan in 2008 Approved by KAEC
- R&D on Pyro-processing to minimize SNF accumulation
- Transparency and Non-proliferation First
  - Timely warning
    - National framework
    - Conversion time vs Detection opportunity: SQ, Frequency of detection, the role of IAEA, Minimizing or Optimizing Standard deviation of MUF, risk of detection, confidence on correct monitoring
  - Technology
- Confidence Building in International and domestic societies
- Many issues:
  - Full pyro-processing
  - QA
  - International environment
Key R&DD’s in KAERI

R&Ds Based on 2008 National Action Plan

- AR Storage
- Interim Storage
- Policy Decision
- Pyroprocess
- SFR
- HLW
- Disposal
- Once-through
- PWR and/or CANDU SF

On-going Discussions
Milestones

SFR

Conceptual Design & Component Tests (~ 2016)

Proof Principle (~ 2009)

Lab-scale Verification

‘11

Verify Technology (2006 ~ 2016)

Engineering-scale Verification

‘16

Install Demo Facility (2017 ~ 2025)

Demonstration Facility

‘25

Demonstration (2026 ~ )

Operation and TRU Fuel Supply

‘30
Waste Disposal

Disposal Density

- PWR: 5.3 kg/m² max.
- CANDU: 26 kg/m² max.
Conclusions

Straight Forward with full transparency & Care for the Earth!
- Thank you for your attention -
Principles of PRESIDENT

- Participation
- Responsibility
- Ethic
- Sincerity
- Independence
- DEliberation
- Non-linear
- Transparency