Lessons Learned from the Fukushima Daiichi Accident, Actions Taken and Challenges Ahead

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(1) Establishment of Nuclear Regulation Authority (NRA)
Impact of Fukushima Daiichi Accident

Fukushima Daiichi Accident on 11 March, 2011 gave serious impact to the Japanese society, in addition to evacuation, including:

2. People’s attitude toward nuclear energy deeply divided. (60% of people against restart of NPPs)
3. Reform of nuclear regulatory framework/organs was inevitable if Japan was to continue the use of nuclear energy.

- The Investigation Commission of the National Diet pointed out “Collusion” and “Regulatory Capture” of regulatory bodies as fundamental causes of the accident.
- Harsh discussion took place between the ruling and opposition parties in the National Diet in 2012 regarding nuclear energy.
Change in Regulatory Framework

Structural defects before Fukushima Daiichi Accident

✓ Regulatory and promotional sections in the same ministry
✓ Different competent ministries for different types of facilities such as power reactors and research reactors
✓ “Double-checking” system made the regulatory responsibility rather ambiguous.
✓ Safety, security and safeguards under different jurisdictions

New direction based on lesson learned from the accident

✓ Clear separation of regulation from promotion
✓ Integration of regulatory functions on all nuclear facilities and radiation sources.
✓ Integration of all nuclear regulatory functions; “3S”.

NRA, Japan
Nuclear Regulation Authority
The ruling and opposition parties had come to an agreement on the regulatory system bill after long discussions at the Diet and the bill was enacted on June 2013.

1. **Independent and Integrated Commission** (Article 3 Authority)
   - Clear *separation of regulation* from promotion as an external organ of the Ministry of the Environment.
   - Integration of various authorities from several organizations.

2. **Drastic Amendments of Relevant Acts and Regulations**
   - Development of *new regulatory requirements*
   - Introduction of “back-fitting” system
   - Introduction of *40-year operating period*  
     (Extension possible up to 20 years once.)
   - Prohibition of staff rotation to promotional side ("No-return rule")
Independence and Integration

Before

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<thead>
<tr>
<th>MOE</th>
<th>METI</th>
<th>MEXT</th>
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<tbody>
<tr>
<td>AEC</td>
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<td>NRA</td>
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<td>NSC</td>
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AEC  : Atomic Energy Commission
METI  : Ministry of Economy, Trade and Industry
MEXT  : Ministry of Education, Culture, Sports, Science and Technology
MOE  : Ministry of the Environment
NISA : Nuclear and Industrial Safety Agency (abolished)
NSC  : Nuclear Safety Commission (abolished)

After

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<tr>
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<tr>
<td>AEC</td>
<td>METI</td>
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<td>MEXT</td>
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Regulatory

promotional

Promotion of nuclear energy
R&D of nuclear
Regulation on RR, RI, Safeguards, Monitoring
Safety, Security, Safeguards, RI, Monitoring, etc.
NRA’s Core Values and Principles

■ **Mission**
Our fundamental mission is to protect the general public and the environment through rigorous and prudent regulations of nuclear activities.

■ **Guiding Principles for Activities**
(1) Independent Decision Making
(2) Effective Actions
(3) Open and Transparent Organization
(4) Learning and Commitment without Complacency
(5) Agile Response to Emergency

■ **Integrated Management System**
Started implementation in April, 2015.
Fostering Safety and Security Culture

**The Statement on Nuclear Safety Culture** (in May 2015)

1. Priority to safety
2. Risk awareness and decision-making
3. Fostering, sustaining and strengthening safety culture
4. Learning organization
5. Communication
6. Questioning attitude
7. Rigorous and prudent judgment and action with agility
8. **Harmonization with nuclear security**


1. Awareness of a threat
2. **Harmonization with nuclear safety**
3. Initiative of senior management
4. Education and self improvement
5. Protection of information and communication
(2) New Regulatory Requirements for Nuclear Facilities
New Requirements Based on Lessons Learned

- Large scale **common cause failures** due to extreme natural hazards led to long lasting **SBO / LUHS**, resulting in **severe accidents**.

- Enhanced measures against **natural hazards**
  - Not only earthquakes and tsunamis but also **volcanic activities**, **tornadoes**, **forest fires**, etc.

- Enhanced **reliability of safety functions** such as power supply
  - Use of **mobile equipment**, strengthened “**diversity**”

- **Mandatory** measures against **severe accidents**
  - Prevention and **mitigation** of core damage
  - Suppression of radioactive materials dispersion

- **Back-fitted** to existing plants

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SBO: Station Blackout
LUHS: Loss-of Ultimate Heat Sink
Comparison between Previous and New Requirements

<Previous requirement>

- Fire protection
- Reliability of power supply
- Function of other SSCs*
- Natural phenomena
- Seismic / Tsunami resistance

Design basis to prevent severe accidents
(Confirm that a single failure would not lead to core damage)

<New requirement>

- Response to intentional aircraft crash
- Suppression of radioactive materials dispersal
- Prevention of CV failure & large release
- Prevention of core damage (Postulate multiple failures)
- Internal flooding (New)
- Fire protection
- Reliability of power supply
- Function of other SSCs
- Natural phenomena
  (Volcano, Tornadoes, Forest fire: New)
- Seismic / Tsunami resistance

(Against SA* & Terrorism) Reinforced & New

DiD* : Defense in Depth
SSCs* : Structure, Systems and Components
SA* : Severe Accident

3rd Layer of DiD

4th Layer of DiD*
Measures against Tsunamis

Accurate Evaluation Method on Earthquake and Tsunami; Particularly Enhanced Tsunami Measures

- More stringent standards on Tsunami
- Enlarged application of higher seismic resistance

Define “Design Basis Tsunami” that exceeds the largest in the historical records and require to take protective measures such as breakwater wall based on the design basis tsunami.

SSCs for Tsunami protective measures are classified as Class S equivalent to RPV* etc. of seismic design importance classification.

*RPV: Reactor Pressure Vessel

Example of tsunami countermeasures (multiple protective measures)

- Breakwater Wall (prevent inundation to the site)
- Tsunami Guard (prevent water from flowing into the building)
Measures against Intentional Aircraft Crash, etc.

“Specialized Safety Facility” is required to be equipped with adequate measures for preventing containment vessel failure due to severe accident by intentional aircraft crash.

For BWR, one filtered venting for prevention of containment failure and another filtered venting of Specialized Safety Facility are acceptable solution.
Place emphasis on **defense-in-depth** concept

Assess and enhance protective measures against **extreme natural hazards**

Take measures against **severe accidents** and **terrorism**

Eliminate **common cause failures**

Make much account of “**diversity**”, shifting from “redundancy centered”
Application of Conformity Review for Nuclear Power Plants

<table>
<thead>
<tr>
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<th>Application</th>
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<tbody>
<tr>
<td>PWR</td>
<td>16</td>
</tr>
<tr>
<td>BWR</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
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As of April, 2016
A total of **16** PWRs and **10** BWRs have filed application, out of which **five** PWRs received the NRA’s permission for changes in reactor installation. Among them, **two** PWRs restarted. 

As of April, 2016

<table>
<thead>
<tr>
<th>Location</th>
<th>Unit</th>
<th>Permission for Changes in Reactor Installation</th>
<th>Approval of Plan for Construction Works</th>
<th>Approval of Operational Safety Programs</th>
<th>Inspection</th>
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<tbody>
<tr>
<td>Ikata</td>
<td>Unit 3</td>
<td>July 2015</td>
<td>Mar. 2016</td>
<td>Under Review</td>
<td>Ongoing</td>
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2. Challenges Ahead: Outcome of IRRS Mission
The team consists of nuclear regulators from various countries, IAEA specialists and staff, totaling 24 members.
The swift establishment of a legal and governmental framework that supports a new independent and transparent regulatory body with increased powers.

NRA’s prompt and effective incorporation of lessons learnt from the Fukushima Daiichi accident in the areas of natural hazards, severe accident management, emergency preparedness and safety upgrades of existing facilities, into Japan’s new regulatory framework.

The NRA should work to attract competent and experienced staff, and enhance staff skills relevant to nuclear and radiation safety through education, training, research and enhanced international cooperation.

Japanese authorities should amend relevant legislation to allow NRA to perform more effective inspections of nuclear and radiation facilities.

The NRA and all entities it regulates should continue to strengthen the promotion of safety culture, including by fostering a questioning attitude.

The final mission report will be provided in around this April, but NRA has already begun to improve regulatory activities on a voluntary basis.

- Improvement of regulatory inspection
- Human resource development

etc.

NRA plans to make the report public.

NRA will make efforts to further enhance nuclear safety and security in Japan through IRRS Follow-up Mission a few years later.
Thank you for your attention.