Use of Risk Information for Improving the Safety of Nuclear Power Generation

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The Federation of Electric Power Companies of Japan
The industry’s effort to comply with the New Regulatory Requirements is still halfway through, with just 5 plants having managed to resume operation. Situations remain tough in terms of both power supply – demand and business revenue – expenditure.

Nuclear power generation is an important source of electricity in Japan. **On the premise of safety assurance, we will work on the restart of plant operations and improvement in plants’ capacity factor after operation restart so as to achieve S+3E, thereby contributing to the Japanese economy.**

### Operation restart status of nuclear power stations

<table>
<thead>
<tr>
<th>Plant Location</th>
<th>Compliance approval status</th>
<th>PWR</th>
<th>BWR</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Approved</strong></td>
<td><strong>12</strong></td>
<td>2</td>
<td></td>
<td><strong>14</strong></td>
</tr>
<tr>
<td><strong>Application filed</strong></td>
<td>4</td>
<td>8</td>
<td></td>
<td><strong>12</strong></td>
</tr>
<tr>
<td><strong>Application not filed</strong></td>
<td>2</td>
<td>15</td>
<td></td>
<td><strong>17</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>18</td>
<td>25</td>
<td><strong>43</strong></td>
</tr>
</tbody>
</table>

The above data includes 3 plants under construction.

### Status of decommissioning units

<table>
<thead>
<tr>
<th>Status of decommissioning units</th>
<th>PWR</th>
<th>BWR</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decommissioning (○)</td>
<td>6</td>
<td>10</td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>
Reflecting upon lessons learned from the accident at the Fukushima Daiichi Nuclear Power Station, the industry has worked on building a mechanism for tackling nuclear plants’ risks and reinforcing countermeasures for external events of significant impact, e.g. mega earthquake and tsunami, so as to improve the safety of nuclear power plants.

Licensees’ initiatives

Identifying important-to-safety matters and implementing effective countermeasures
- Actively utilize new insight (facilities, administration, etc.).
- Maintain and improve technological capacities (for operation, maintenance, etc.) at power stations.
- Maintain and improve emergency-response capabilities.
- Implement safety-improvement measures based on risk information from PRA, etc. (in collaboration with the NRRC).
- Handle risks based on the results of peer reviews (in collaboration with WANO, JANSI, etc.).

...and other initiatives

Basic approach to the initiatives for safety improvement

It is important to work on the notion that you could never completely eliminate risks, and adopt “Risk Management,” in which nuclear licensees assume primary responsibility in implementing voluntary actions for safety improvement, expansion of emergency preparedness measures and appropriate risk management and reduction.
In order to continuously manage power station risks, it is necessary to utilize risk information to identify areas that need reinforcement in plant equipment and administration, and implement effective measures in a timely fashion.

⇒ The Strategic Plan for RIDM Introduction has been compiled to introduce decision-making based on risk information (Risk-Informed Decision-Making: RIDM) to plant management.

**Self-regulated management system for safety improvement**

- **(1)** Performance, monitoring and evaluation
- **(2)** Risk assessment
- **(3)** Decision-making
- **(4)** Corrective Action Program (CAP)
- **(5)** Configuration management

**Note** Corrective Action Program (CAP): A mechanism for identifying and resolving issues at nuclear licensees, encompassing processes from assessing the issues’ relevance to safety, defining priority order for response and managing the progress through to full resolution.

**Note** Configuration management: Initiative for maintaining consistence in three elements, i.e. design requirements, physical facility configuration and facility configuration information.
### Issues concerning the management system with RIDM

#### (1) Performance monitoring and evaluation
- Operation, maintenance and management capabilities for system performance monitoring, equipment reliability diagnostic technology, etc.
- Organizational and individual performance improvement program

#### (2) Risk assessment
- Plant-specific PRA that eliminates serviceability as much as possible

#### (3) Decision-making and implementation
- Management that can choose and carry out total optimization solutions taking into consideration uncertainty associated with risk assessment

#### (4) CAP
- Process of ensuring to collect data on irregular statuses at low threshold from all workers
- Screening process in line with risk importance

#### (5) Configuration management
- Sufficient ability to manage plant design so that it is not left entirely to manufacturers
- System for controlling facility configuration management information

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**For all the functions, it is important to develop technological foundation / processes and foster human resources.**

**Importance of leadership, organizational safety culture and organization-wide initiatives**

- Accurately understand plant performance, and **enhance the technological and organizational capability for identifying issues**.
- Everyone involved in plant safety must use a common set of risk-based assessment criteria to correctly identify issues, **make swift decision-making in the order of priority based on comprehensive knowledge and implement improvement measures.**
- Use PRA to quantify risks, and **build positive relationship with society and regulatory authorities, using risks as the common language.**
In light of the results of risk analysis and assessment, it is important for management to make decisions based on integrated judgment so as to implement necessary safety measures.
Example of risk communication (Chubu Electric Power Company)

Carry out active dialog activities to **foster mutual understanding** with the people of local communities. residents.

⇒ **Explain risks** rather than appealing safety.

**Opinion exchange sessions**
Plan and organize opinion exchange sessions with local community associations, women’s organizations, etc., and participate in opinion exchange sessions organized by local governments.

**Informal forums for women**
Under themes of strong interest among women (e.g. aromatherapy, yoga), provide energy-related information to initiate exchange of opinions.

**Door-to-door dialog**
Make door-to-door house calls in Omaezaki City, where a nuclear power station is located, as well as its surrounding three cities.

**Information caravan**
Set up a booth outside shopping centers and other places that attracts people, so as to initiate dialogs.

**Plant tour**
Plant tour for the residents of Omaezaki City and 11 surrounding municipalities who apply

It is important to use risk information for providing the overall picture of nuclear plants’ risks and risk reduction activities (accidents’ impact and probability, multi-layered accident prevention measures, accident mitigation measures, etc.) in plain language.
The NRRC has been set up within the CRIEPI to centrally undertake R&D on the mechanism of natural external events that do not occur very frequently but could deal substantial damage, the method of evaluating such events and advancement of PRA.

**Research examples at the NRRC**

- **Internal fires:** Advancing PRA through the compilation of PRA guide, international research, testing, etc.
- **Internal flooding:** Compiling PRA guide, developing flooding simulation tools, etc.
- **Tsunami:** Using the Hamaoka Unit 4 as a model for developing tsunami PRA, and advancing PRA through assessment
- **Severe accidents:** Expanding knowledge on the progression of accidents and the integrity of PCV, etc.
- **Other external events:** Establishing a risk assessment method for tornadoes and volcanoes

**3D fluid analysis on the behaviors of tsunami running up to a power station**  
**Impact force assessment of tsunami debris**

Incorporate the findings of research (external hazard, fragility, human reliability, equipment reliability, etc.) to licensees’ risk assessment as they become available to faithfully identify plant behaviors and reduce the uncertainty of risk assessment.

Identify uncertainty and plant vulnerability as accurately as possible to make integrated judgment and decisions for enhancing plant safety and resilience.
To achieve plant operation, it is important to ensure that licensees’ safety improvement initiatives are carried out “autonomously and continuously.” Licensees must assume primary responsibility in pursuing safety improvement and enhancement of emergency preparedness measures, and managing risks appropriately (risk management).

Quantification of risks through probabilistic risk assessment (PRA) is important for risk management. Introduce risk-informed decision-making (RIDM) as an essential process.

Licensees’ capabilities must be increased as the premise of RIDM introduction. Under strong leadership, licensees must promote necessary initiatives to attain the To-Be status of nuclear business administration.

Promote R&D, continue making efforts to advance risk assessment technology and actively utilize advanced risk assessment to enhance plant safety and resilience.

Through self-regulated initiatives for plant management, enhance plant performance to improve plants’ safety and capacity factor so as to achieve S+3E, thereby contributing to the Japanese economy.
Strategic Plan for RIDM Introduction

Phase 1 (up to 2020 or until the restart of plant operation)

- Advancing self-regulated plant management, using risk information
  ⇒ Draw up specific initiatives and compile them into an action plan.

Phase 2 (from 2020 or after the restart of plant operation)

- Continuously improving self-regulated plant management, and expanding the scope of RIDM use
  ⇒ Expand the scope of RIDM use for day-to-day plant operation, maintenance and management
  ⇒ Enhance necessary functions, such as PRA, to expand their scope of application to the mechanism of safety improvement management, incorporating RIDM, similar to in-service maintenance in the United States in the future.