Current Status of Nuclear Power in Japan

The 2nd World Nuclear Energy Development Forum

April 28, 2017

Akio Takahashi
President
JAPAN ATOMIC INDUSTRIAL FORUM, INC
I. Current Status of NPPs in Japan

II. Current Status of Fukushima Daiichi NPS (1F)

III. Current Status of Areas Surrounding 1F

IV. Post-Fukushima Safety Enhancements

V. Challenges and Issues

VI. Final Message
I. Current Status of NPPs in Japan

Status of Restarted NPPs

Legend:
- ● Restarted Units
- ○ Units to be decommissioned

Source: Meeting of Federation of Electric Companies of Japan (FEPC), Nov. 22, 2016
I. Current Status of NPPs in Japan

Status of License Application for Restart

1. Assessment of application for permission for change in reactor installation license
   - Deliberation on earthquake & tsunamis (design-basis earthquake ground motion)
   - Deliberations on plant facilities
   - Draft Assessment Report by NRA
   - Public Comments

2. Review of application for approval of construction plan (Detailed Design)
   - Pre-operational Inspection
   - Public Comments

3. Review of application for approval of technical specifications
   - Local Consent (before restart)

*Revise as necessary

Preparation for Restart

As of Feb. 22, 2017

Source: FEPC
II. Current Status of Fukushima Daiichi NPS
Roadmap for Decommissioning

- Unit 1: Demolition of building covers, rubble removal, cover installation → Fuel Removal
- Unit 2: Demolition of upper buildings, cover installation → Fuel Removal
- Unit 3: Cover installation → Fuel Removal

Confirmation of status inside containment vessels, consideration of fuel debris removal methods, etc.

30 to 40 years needed to complete decommissioning

Source: Meeting of METI ‘s Team for Countermeasures for Decommissioning and Contaminated Water Treatment
II. Current Status of Fukushima Daiichi NPS

Installation of Unit 3 Fuel Removal Cover

Installation of fuel removal cover (conceptional drawing)

Fuel handling machine
Crane
Fuel removal cover

Measures taken against rainfall

Unit 3, Mar. 2011
Unit 3 Operating floor, Mar. 2016

Source: TEPCO HD

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II. Current Status of Fukushima Daiichi NPS
PCV Internal Investigation

**Purpose:** To obtain current situation inside the containment vessel and its surroundings to ensure smooth removal of fuel debris.

Bottom of Containment Vessel (Sectional View)
II. Current Status of Fukushima Daiichi NPS
Self-Propelled Investigation Device for Unit 1

Source: TEPCO HD
II. Current Status of Fukushima Daiichi NPS
Self-Propelled Investigation Device for Unit 2

When inserted into a guiding pipe:
- Rear camera
- Rear light
- Front camera w/ built-in lighting

When moving forward:
- Rare light direction
- Front camera direction

When investigating inside the pedestal:
- Rare light direction
- Front camera direction

Source: TEPCO HD
II. Current Status of Fukushima Daiichi NPS
On-Site Tanks for Contaminated Water Treatment
II. Current Status of Fukushima Daiichi NPS

Improving On-Site Working Environment

Areas not requiring full-face masks increases

Source: TEPCO HD
II. Current Status of Fukushima Daiichi NPS

Improving On-Site Working Environment

Paving work

Tank installation work

On-site workers working in standard working clothes

Source: TEPCO HD
II. Current Status of Fukushima Daiichi NPS
Sea Area Monitoring Status

The radioactive material concentration in the sea area by one-1,000,000th after the accident

Concentration Limit Specified by the Rule
- Cesium 137: 90Bq/L
- Cesium 134: 60Bq/L

Source: TEPCO HD
III. Current Status of Areas Surrounding 1F

Transition of Evacuation Zone

August 2013

Difficult-to-return zone
Restricted residential zone
Evacuation order to be lifted
Former evacuation zone

April 2017

Source: Meeting material for the 45th Nuclear Emergency Response Headquarters Meeting (http://www.kantei.go.jp/jp/singi/genshiryoku/dai45/siryou3.pdf)
III. Current Status of Areas Surrounding 1F
Changes in Radioactivity Level

Results of Airborne Radiation Monitoring
(Map of air dose rate 1m above ground surface)

Nov. 5, 2011
(8 months after accident)

Oct. 15, 2016
(5 years & 7 months after accident)

Significant Drop

Source: Nuclear Regulation Authority, Japan
III. Current Status of Areas Surrounding 1F Radiations Status in Fukushima Pref.

Changes in Air Dose Level

**Fukushima City**

* 0.04 uSv/h before 3.11

<table>
<thead>
<tr>
<th>Year</th>
<th>Fukushima</th>
<th>Aizuwakamatsu</th>
<th>Iwaki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 3.11</td>
<td>0.04</td>
<td>0.04-0.05</td>
<td>0.05-0.06</td>
</tr>
<tr>
<td>Apr. 2011</td>
<td>2.74</td>
<td>0.24</td>
<td>0.66</td>
</tr>
<tr>
<td>Sep. 2011</td>
<td>1.04</td>
<td>0.13</td>
<td>0.18</td>
</tr>
<tr>
<td>Mar. 2012</td>
<td>0.63</td>
<td>0.10</td>
<td>0.17</td>
</tr>
<tr>
<td>Sep. 2012</td>
<td>0.69</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Mar. 2013</td>
<td>0.46</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>Sep. 2013</td>
<td>0.33</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>Dec. 2016</td>
<td>0.17</td>
<td>0.06</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Unit: u Sv/h

III. Current Status of Areas Surrounding 1F
Changes in Hirono Town

Hirono Station (east side)

Elevated disaster prevention green area (10.7m higher than original ground level)


Photo credit: Hirono Town

Photo by JAIF
III. Current Status of Areas Surrounding 1F

Changes in Okuma Town

TEPCO Housing Units for single staff

Fukushima Meal Supply Center

Photo by JAIF
III. Current Status of Areas Surrounding 1F
Changes in Tomioka Town

Front of Tomioka Station after tsunami

Station square to be completed in 2017 spring

Public restoration housing (ready for move-in in April 2017)

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III. Current Status of Areas Surrounding 1F

Changes in Naraha Town

View from Tenjinmisaki (2012.11)

Scene of Naraha (2012.11)

Public restoration housing
(move-in began in Nov. 2016)

View from Tenjinmisaki (2017.02)

Photo by JAIF
IV. Post-Fukushima Safety Enhancements

Comparison between Past and New Regulatory Requirements

The New Regulatory Requirements tighten measures to prevent or deal with severe accidents and acts of terrorism.

**<Previous Regulatory Requirements>**

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

**<New Regulatory Requirements>**

- Response to intentional aircraft crashes
- Measures to suppress radioactive materials dispersion
- Measures to prevent containment vessel failure
- Measures to prevent core damage (postulate multiple failures)
- Consideration of internal flooding (newly introduced)
- Consideration of natural phenomena in addition to earthquakes and tsunamis—volcanic eruptions, tornadoes and forest fires

Seismic/tsunami resistance

* SSC: Structure, Systems and Components

Source: Nuclear Regulation Authority, Japan
IV. Post-Fukushima Safety Enhancements

Improved Safety Measures

- External power supply enhancement
- Water supply vehicle
- Portable pump
- Wheel loader (for removing debris)
- Portable power supply vehicle
- Filter vent (PWR: to be used 5 yrs later)
- Specific safety facilities (to be used 5 yrs later)
  - Emergency control room
  - Power, water supplies, etc.
- Use of fire resistant cables and multiplexing piping
- Watertight door against flooding
- Investigation of active faults
- Seawall against tsunamis
- Setting of standard for tsunamis

Implemented on July 8, 2013

Source: Chubu EPC
IV. Post-Fukushima Safety Enhancements

Tsunami Countermeasures by Hamaoka NPS (Chubu EPC)

Tsunami protection wall (22m)
Cement-mixed soil embankment

Source: Chubu EPC
### IV. Post-Fukushima Safety Enhancements

**Voluntary Measures for Safety Enhancement**

<table>
<thead>
<tr>
<th>Voluntary Measures</th>
<th>How to achieve?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving methods of risk assessment &amp; decision-making</td>
<td>Base on appropriate combinations of assessment results, engineering judgments, etc.</td>
</tr>
<tr>
<td>Identifying areas for improvement</td>
<td>Through peer reviews and responses</td>
</tr>
<tr>
<td>Conducting further discussions on safety enhancement</td>
<td>Base on peer review results</td>
</tr>
<tr>
<td>Improving abilities to respond to emergencies</td>
<td>Through operation of the <em>Mihama Nuclear Emergency Assistance Center</em></td>
</tr>
<tr>
<td>Establishing a system of cooperation</td>
<td>Through collaboration among nuclear operators</td>
</tr>
</tbody>
</table>

Source: FEPC
## V. Challenges and Issues

### COP21 Commitment

**Future Energy Mix of Japan**

<table>
<thead>
<tr>
<th>Energy Mix</th>
<th>2010</th>
<th>2013</th>
<th>- - - -</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>29%</td>
<td>1%</td>
<td>- - - -</td>
<td>20 to 22%</td>
</tr>
<tr>
<td>Renewable</td>
<td>10%</td>
<td>11%</td>
<td></td>
<td>22 to 24%</td>
</tr>
<tr>
<td>Thermal</td>
<td>61%</td>
<td>88%</td>
<td></td>
<td>56%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CO2 emissions</th>
<th>2010</th>
<th>2013</th>
<th>- - - -</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>total</td>
<td>1.304Gt</td>
<td>1.408Gt</td>
<td>- - - -</td>
<td>1.042Gt</td>
</tr>
<tr>
<td>CO2kg/kwh</td>
<td>0.350</td>
<td>0.570</td>
<td></td>
<td>0.370</td>
</tr>
</tbody>
</table>

Complied by JAIF
V. Challenges and Issues

Life Extension & Decommissioning

Electricity Generation (TWh)

Year

- Nuclear in Energy Mix: 20%~22%

- 40 years
- 60 years

Complied by JAIF
## V. Challenges and Issues
### Life Extension & Decommissioning

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Commercial Operation</th>
<th>Reactor Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Tokai-1</td>
<td>1966.07</td>
<td>GCR</td>
</tr>
<tr>
<td>2 Hamaoka-1</td>
<td>1976.03</td>
<td>BWR</td>
</tr>
<tr>
<td>3 Hamaoka-2</td>
<td>1978.11</td>
<td>BWR</td>
</tr>
<tr>
<td>4 Fukushima Daiichi-1</td>
<td>1971.03</td>
<td>BWR (BWR-3)</td>
</tr>
<tr>
<td>5 Fukushima Daiichi-2</td>
<td>1974.07</td>
<td>BWR (BWR-4)</td>
</tr>
<tr>
<td>6 Fukushima Daiichi-3</td>
<td>1976.03</td>
<td>BWR (BWR-4)</td>
</tr>
<tr>
<td>7 Fukushima Daiichi-4</td>
<td>1978.10</td>
<td>BWR (BWR-4)</td>
</tr>
<tr>
<td>8 Fukushima Daiichi-5</td>
<td>1978.04</td>
<td>BWR (BWR-4)</td>
</tr>
<tr>
<td>9 Fukushima Daiichi-6</td>
<td>1979.10</td>
<td>BWR (BWR-5)</td>
</tr>
<tr>
<td>10 Tsuruga-1</td>
<td>1970.03</td>
<td>BWR (BWR-5)</td>
</tr>
<tr>
<td>11 Mihama-1</td>
<td>1970.11</td>
<td>PWR W(2 loop)</td>
</tr>
<tr>
<td>12 Mihama-2</td>
<td>1972.07</td>
<td>PWR M(2 loop)</td>
</tr>
<tr>
<td>13 Genkai-1</td>
<td>1975.10</td>
<td>PWR M(2 loop)</td>
</tr>
<tr>
<td>14 Shimane-1</td>
<td>1974.03</td>
<td>BWR (BWR-3)</td>
</tr>
<tr>
<td>15 Ikata-1</td>
<td>1977.09</td>
<td>PWR M(2 loop)</td>
</tr>
</tbody>
</table>
V. Challenges and Issues
Efforts to Improve Public Understanding

Public Poll on Nuclear Power

**Period:** Dec. 22-24, 2016
**Target:** Adults aged 18-69
**Area covered:** Japan nationwide (major metropolitan cities)
**Sample size:** 3,800
**Method:** Internet survey

<table>
<thead>
<tr>
<th>Regarding Use of Nuclear Power</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous poll (overall)</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>This poll (overall)</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>Male 10s-20s</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>30s</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>40s</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>50s</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>60s</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>Female 10s-20s</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>30s</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>40s</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>50s</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
<tr>
<td>60s</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
<td>![Graph]</td>
</tr>
</tbody>
</table>

Conducted by JAIF
### V. Challenges and Issues
#### Dispelling Unfounded Fears and Rumors

**Reference Values for Cesium Concentration in Foods**

<table>
<thead>
<tr>
<th></th>
<th>Japan (2012.4-)</th>
<th>Codex Alimentarius Commission※</th>
<th>EU (Products distributed within the EU)</th>
<th>U.S.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drinking water</strong></td>
<td>10</td>
<td>1000</td>
<td>1000</td>
<td>1200</td>
</tr>
<tr>
<td><strong>Milk</strong></td>
<td>50</td>
<td>1000</td>
<td>1000</td>
<td>1200</td>
</tr>
<tr>
<td><strong>General food</strong></td>
<td>100</td>
<td>1000</td>
<td>1250</td>
<td>1200</td>
</tr>
<tr>
<td><strong>Baby food</strong></td>
<td>50</td>
<td>1000</td>
<td>400</td>
<td>1200</td>
</tr>
</tbody>
</table>

Note: As seen in the next slide, the assumptions for calculating reference values vary; thus the reference values can be quite different and are not directly comparable.

※ An intergovernmental organization issuing international food standards (Codex Standards), established in 1963 by the Food and Agriculture Organization and the World Health Organization (WHO) of the United Nations.

Source: Basic Information on Radiation Risk, Cabinet Office, Et Al. (February 2016)
## V. Challenges and Issues

Dispelling Unfounded Fears and Rumors

### Reference Values for Cesium Concentration in Foods

#### Assumptions in calculations of reference values

<table>
<thead>
<tr>
<th>Country</th>
<th>Standard Limit</th>
<th>Assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Japan</strong></td>
<td>Upper limit of additional effective dose by food ingestion at 1 mSv/year</td>
<td><strong>50% of general foods</strong> are contaminated at levels equivalent to the reference value. Given that marketed milk and baby food are mostly domestically produced, the effective dose from them is half the reference value for general foods.</td>
</tr>
<tr>
<td><strong>Codex Alimentarius Commission</strong></td>
<td>Based on the Operational Intervention Level of 1 mSv/year (below which no need for special measures)</td>
<td><strong>10% of all foods</strong> come from radioactively contaminated areas.</td>
</tr>
<tr>
<td><strong>EU</strong></td>
<td>Additional exposure dose of not more than 1 mSv/year</td>
<td><strong>10% of all foods</strong> for human consumption in a lifetime are contaminated at levels equivalent to regulation values.</td>
</tr>
<tr>
<td><strong>U.S.A.</strong></td>
<td>Effective dose of 5 mSv/year</td>
<td><strong>30% of all food intake</strong> is radioactively contaminated.</td>
</tr>
</tbody>
</table>

Source: Basic Information on Radiation Risk, Cabinet Office, Et Al. (February 2016)
V. Challenges and Issues

Dispelling Unfounded Fears and Rumors

Efforts to Ensure Safety of Food in Fukushima

Monitoring of Fukushima Food Products

- Fukushima Prefecture conducts repeated inspections on all local food products in each stage of production, distribution and consumption, in order to ensure their safety.

- Only primary products certified to be safe through multiple inspections in each stage are shipped out to the market.

<table>
<thead>
<tr>
<th>Food Types</th>
<th># of Inspected Cases</th>
<th>Cases Exceeding Standard Limits</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown rice (2006 grown)</td>
<td>8,600,000</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Fruits &amp; vegetables</td>
<td>2,998</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Livestock</td>
<td>2,496</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Cultivated mushrooms</td>
<td>562</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Marine fish &amp; shellfish</td>
<td>4,908</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Farm-raised fish</td>
<td>66</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Edible wild plants &amp; mushrooms</td>
<td>1,031</td>
<td>2</td>
<td>0.19%</td>
</tr>
<tr>
<td>Freshwater fish</td>
<td>502</td>
<td>4</td>
<td>0.80%</td>
</tr>
</tbody>
</table>

No single case exceeding inspection standard limits!

Data collected between 2016.4.1-10.31 (Brown rice: 2016.8.24-10.31)

VI. Final Message

「知己知彼,百战百胜」

（孙子兵法）

To know one’s own strength and the enemy’s is the sure way to victory.

(The Art of War by Sun Tzu)
Thank you very much for your attention.

Akio Takahashi

www.jaif.or.jp/en/