LESSONS LEARNED FROM FUKUSHIMA NUCLEAR ACCIDENT
Institutional Aspects/Issues

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Working Experience

• **1. Operating nuclear power plant; 1975 – 1990**
  
  Working for the Power Reactor and Nuclear Fuel Development Corporation (PNC), Tsuruga and Tokyo, Japan
  
  – Construction, start-up tests, and operation of 165MWe NPP and Research and Development for advanced reactors, etc.

• **2. Safety and regulation; 1990 – 2006**
  
  Working for the Government of Japan (STA, MEXT), USNRC, and International Organizations (IAEA, EC, and OECD/NEA)
  
  Tokyo, Washington DC, Vienna, Brussels, and Paris

• **3. Non-nuclear field; 2006 – 2009**
  
  Working for the International Human Frontier Science Program, Strasbourg, France

• **Full-time job in JNES since 1 April 2011**
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• 1. Fukushima Dai-ichi Nuclear Power Station Accident Update

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This presentation is given in my personal capacity, not representing the JNES.
1. Fukushima Dai-ichi Nuclear Power Station Accident Update

- The Great East Japan Earthquake and Emergency Response Efforts
- Fukushima Dai-ichi NPS Accident
- Mid and Long-term Roadmap towards Decommissioning
- Mid and Long-term Energy Policies
Unprecedented challenge for Japan

The Great East Japan Earthquake

Earthquakes
Main shock
- Magnitude: 9.0 (Mar. 11th 2011)

Aftershocks
- Magnitude 7 or greater: 6 times
- Magnitude 6 or greater: 97 times
- Magnitude 5 or greater: 594 times
(As of Feb 28th 2012)

Casualties
- Dead: over 15,800
- Missing: over 3,200
- Injured: over 6,000 (As of Feb 21st 2012)

Evacuees
- Over 342,000 (As of Feb 9th 2012)

Enormous earthquake, tsunami and nuclear accident

Source: Ministry of Economy, Trade and Industry
National Policy Unit
Emergency response efforts
Example(2) Early Earthquake Detection system for Shinkansen

JR East introduced early earthquake detection system

Since the 2004 Mid-Niigata Pref. Earthquake, ¥50-60B has been invested in earthquake disaster prevention measures.
• Within the JR East area, earthquake measurement equipment has been improved and increased, and the time from early tremor detection to electric supply cut has been reduced from 3 to 2 seconds
  – Seismographs at 62 locations were upgraded to the latest models in 2005
  – New seismographs were installed at 28 coastal locations in 2006
  – 97 installed in 2010
• By 2009, all carriages of the Tohoku Shinkansen were fitted with an early earthquake detection system

Succeed in making an emergency stop without derailing

Seismograph at Oshika Peninsula detects standard value to stop the train

In 2 secs, the system automatically halts electric supply to overhead wiring & operates emergency braking
• 1 min 10 sec before biggest tremor hit
• deacceleration, emergency stop

All 27 trains stopped without derailment • no injuries or fatalities

Source: JR East; NHK; SankaiBiz; The Boston Consulting Group
National Policy Unit
Cause of the Accident and Damage at Fukushima Dai-ichi Nuclear Power Station

1. Loss of Off-site Power due to the Earthquake

- Tsunami (inundation height 14~15 m)
- Elevation: about 10 m
- Seawater level
- Seawater Pump
- Reactor Building
- Turbine Building
- About 25M
- About 44M
- Emergency Diesel Generators

Partly damaged

2. Loss of On-Site Cooling Function
Installing Support Structures at Bottom of SFP of Unit 4

- It has been confirmed that the seismic resistance is sufficient without any reinforcements.
- As a precautionary measure, support structures at the bottom of the pool has been installed in order to further improve the safety margin.

The latest condition of the upper floor of Unit 4 (Mar. 5, 2012) (source: TEPCO)
Primary Targets of Mid-to-Long-Term Roadmap towards the Decommissioning of Fukushima Daiichi NPP

The Mid-to-Long-Term Roadmap defines the term of decommissioning into the three phases, and details major schedule of on-site works and R&D projects

- Phase 1: From the completion of Step 2 to the commencement of fuel removal from the Spent Fuel Pools
  (Target: Accomplish in 2 years)
- Phase 2: From the end of Phase 1 to the commencement of fuel debris removal
  (Target: Accomplish in 10 years)
- Phase 3: From the end of Phase 2 to the end of the Decommissioning
  (Target: Accomplish within 30 to 40 years)

For more information:
Progress of discussions to review Energy Policy including Nuclear Energy Policy

Energy and Environment Council
“Green Growth Strategy (Draft)”

Advisory Committee for Natural Resources and Energy
“New Basic Energy Plan (Draft)”

Japan Atomic Energy Commission
“New Nuclear Energy Policy Framework (Draft)”

Central Environment Council
“New Global Warming Countermeasures (Draft)”

This summer (2012)
Energy and Environment Council
Finalization of the “Innovative Strategy for Energy and the Environment”
2. Institutional Issues on Nuclear Safety and Regulation in Japan

- **Responsibility for Safety?** - TEPCO, Utilities in Japan?
  - Commitment, Competencies, Transparency?
  - Safety Culture in organizations?
  - Lessons learned from international experience and best practice?

- **Role of Government?**
  - Independent Regulatory Body in Japan?
  - Technical and managerial competency?
  - Lessons learned from International experience and International Safety Standards?
3. Investigations into the Accident by the Committee/Commission in Japan

• 3-1 Government Investigation Committee
  Established by the Cabinet decision on 24 May 2011, Chaired by Prof. Yotaro HATAMURA and nine members.

• 3-2 Fukushima Nuclear Accident Independent National Diet Investigation Commission (NAIIC)
  Established by the National Diet in January 2012, chaired by Prof. Kiyoshi KUROKAWA and nine members.

3-1. Government Investigation Committee’s Investigation and Report

• The Committee inspected the accident site including the Fukushima Dai-ichi and Dai-ni NPSs, and interviewed many individuals concerned, including the mayors and residents of relevant municipalities. The number of interviewees reached 772 in total.

• Public hearings with high-level experts from overseas (USA, France, Sweden, China, and Korea) were held on 23 February 2012.

• The Final Report was published on 23 July 2012 and submitted to Prime Minister Yoshihiko NODA on the same day.

The English version of the Final Report will be uploaded on the website (http://icanps.go.jp/eng/).
3-2. National Diet Investigation Commission (NAIIC)’s Investigation and Report

- A number of the Commission meetings have been held since January 2011 by hearing of witnesses, requesting for information, taking field survey included more than 900 hours of hearing and interviews with 1,167 people.

- Former Prime Minister, Ministers, Chairman and President of TEPCO, National Regulators of nuclear installations, and also high-level experts from overseas were included as witnesses in the Commission meetings.

- The report was submitted to the National Diet on 5 July 2012.

Executive Summary in English (88 p.) : http://www.naiic.jp/en
3-2-1. NAIIC’s Conclusions

In order to prevent future disasters, fundamental reforms must take place. These reforms must cover both the structure of the electric power industry and the structure of the related government and regulatory agencies as well as the operation processes. They must cover both normal and emergency situations.

A “manmade” disaster:

The TEPCO Fukushima Nuclear Power Plant accident was the result of collusion between the government, the regulators and TEPCO, and the lack of governance by said parties. They effectively betrayed the nation’s right to be safe from nuclear accidents. Therefore, we conclude that the accident was clearly “manmade.” We believe that the root causes were the organizational and regulatory systems that supported faulty rationales for decisions and actions, rather than issues relating to the competency of any specific individual. 

Extracted from the Executive Summary with English (P. 16) : http://www.naiic.jp/en
3-2-2. Was the accident preventable?

- The Commission has verified that on March 11, 2011, the structure of the Fukushima Daiichi Nuclear Plant was not capable of withstanding the effects of the earthquake and the tsunami. Nor was the Fukushima Daiichi Nuclear Plant prepared to respond to a severe accident. In spite of the fact that TEPCO and the regulators were aware of the risk from such natural disasters, neither had taken steps to put preventive measures in place. It was this lack of preparation that led to the severity of this accident.

- The lack of tsunami countermeasures
- Countermeasures not up to international standards

Extracted from the Executive Summary with English (P. 26) : http://www.naiic.jp/en
3-2-3. Organizational issues in accident prevention and response

- The Commission found a number of organizational issues regarding preventive measures prior to the accident, the causes of the accident and the crisis management response after the accident. We investigated the entire chain of events in order to discover what went wrong with the organizations and systems involved. We also examined the relationship between TEPCO and the regulatory agencies with a view to reform in the future.

- The “regulatory capture” of Japan's nuclear industry
- TEPCO’s organizational issues
- Organizational issues concerning regulatory bodies

Extracted from the Executive Summary with English (P.42) : http://www.naiic.jp/en
4. Specific Topics and Comments

• 4-1. The End of Japanese Illusions: “Public Myth of Absolute Safety”
  – Chained to the so-called “Public Myth of Absolute Safety”

• 4-2. The Potential for Extended Loss of Power?
  – Japan, USA, and Europe

• 4-3. Lack of Safety Culture and Transparency?
4-1. The End of Japanese Illusions

• “TOKYO – March 11. 2011, was a transformational moment for the Japanese people. It not only shattered the public myth of absolute safety that had been nurtured by the Japanese nuclear-power industry and its proponents. It also destroyed Japan’s self-image as a “safe and secure nation” that grew out of the country’s pacifism since World War II.”

• “Any drills for a nuclear were meticulously designed to avoid giving any impression that an accident could possibly progress to the severity of a meltdown and municipalities were discouraged from taking action to anticipate the compounded risks that would be involved in the event of an earthquake, for example.”

Chained to the so-called “Public Myth of Absolute Safety”

- Incentives for the “Public Myth of Absolute Safety”
  - Promotion of nuclear energy
  - Relationship with municipal population, etc.
  - Lawsuits against existing nuclear installations

- Chained to inadequacy
  - Inadequate provisions/countermeasures for serious nuclear accidents such as “Severe Accident”
  - Insufficient nuclear emergency preparedness and excises/drills
  - No regulatory requirements for Severe Accidents
  - No “back-fit”
4-2. The Potential for Extended Loss of Power?

- **JAPAN**: “Japan’s Nuclear Safety Commission stipulated in its safety guidelines for LWR that “the potential for extended loss of power need not be considered”. June 1993

- **USA**: “Shortly after September/11 2001, the USNRC passed new regulations to deal with a possible terrorist attack on a nuclear plant. These included comprehensive guidelines and strategies “to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities,” the so-called B.5.b.”

Source: “The End of Japanese Illusions” by Yoichi FUNABASHI, Published on 11 March 2012

The New York Times, The Opinion Papers
IAEA Safety Review Mission to Chernobyl NPP
Ukraine, March 1994
4-2. The Potential for Extended Loss of Power?

European Countries;

• The biggest risk that tsunami pose to nuclear plants the destruction of their power supplies. Without electricity, a reactor cannot be cooled and a meltdown can result. This is exactly what happened at Fukushima. A similar event might have been triggered in France in December 1999, when the Blayais nuclear power plant was flooded.

• Recognizing this risk, European states examined their nuclear plant designs for vulnerabilities. They then equipped their plants with more emergency electricity supplies and protected them to better withstand a whole range of hard-to-predict extreme hazards.

TO OUR READERS

Winter 1999: A powerful storm named Lothar sweeps through the southwest of France, causing significant flooding at Le Blayais NPP, including some safety-related buildings. Summer 2007: The strongest earthquake ever to affect an NPP occurs near Kashiwazaki-Kariwa, the world’s largest nuclear power plant, located in western Japan. Though the reactors and their safety-related equipment perform satisfactorily, the quake damages non-safety-related equipment, and four of the seven units are still shut down. Summer 2007: An unprecedented heat wave hits several parts of Russia, lighting violent forest fires. Working day and night, the fire squadrons succeed in containing the fire only four kilometres away from the Novovoronezh NPP. The situation was never out of control in any of these three cases, and yet...

This issue of the EUROSAFE Tribune, devoted to external hazards, bears witness to the increasing awareness of the uncertainty associated with phenomena such as floods, earthquakes, tsunamis, extreme heat, dust- and sandstorms, and airplane crashes. It provides an overview of the lessons learned from each event and of the knowledge gained from ongoing studies aimed at making nuclear facilities less vulnerable to external hazards at each stage of the lifecycle, from design through siting, construction and operation. We invite you to draw your own conclusions on these issues, and we wish you pleasant reading.

Jacques Repussard and Heinz Liemersdorf
4-3. Lack of Safety Culture and Transparency?

• “Japanese electricity companies, including TEPCO, have also been unwilling to cooperate with the IAEA’s other safety-review program, the Operational Safety Review Team (OSART) since its induction in the 1980s”.

• “It was revealed in 2002 that TEPCO falsified 29 cases of safety-repair records regarding cracks found at several of its nuclear reactors in the late 1980s and 1990s”.

• “The culture of secrecy and technical loftiness within the Japanese nuclear community was consequently enhanced through such events, allowing the industry to minimize the disclosure of detailed information about its operation, and to develop its own safety assurance practices which were not in accordance with global standards”.

Extracted from www.eastasiaforum.org/2012/03/26
Reform of Nuclear Regulatory Organisations
(source: National Report of Japan to IAEA July 2012)

- **Independence**: Separate nuclear regulation function and nuclear promotion function and establish the “Nuclear Regulation Authority (NRA)”, as an independent commission body affiliated to the MOE. Chairman and Commissioners are appointed by the Prime Minister after the approval of the National Diet.
- **Integration**: Integrate nuclear regulation functions, namely, nuclear safety, security, safeguards, radiation monitoring and radioisotopes regulation, into the NRA.
- **Crisis Management**: Establish “Nuclear Emergency Preparedness Commission (NEPC)” in a cabinet and implement nuclear emergency prevention measures in close cooperation with relevant organisations.

**Current Organisations**

- Cabinet Office
  - Atomic Energy Commission (AEC)
    - Nuclear Security Policy
  - Nuclear Safety Commission (NSC)
    - Nuclear and Industrial Safety Agency (NISA)
      - Nuclear Power Plants Regulation, etc.

- Ministry of Economy, Trade and Industry (METI)
  - Agency for Natural Resources and Energy (ANRE)

- Ministry of Education, Culture, Sports, Science and Technology (MEXT)
  - Research Reactors Regulation
  - Safeguards
  - Radiation Monitoring
  - Radioisotopes Regulation, etc.

- JAEQ
  - Nuclear Research, etc.

- NIRS
  - Radiation Research, etc.

- Double Checking

**New Organisation**

- Ministry of the Environment (MOE)
  - Nuclear Regulation Authority (NRA)
    - Commission: Chairman and 4 Commissioners
      - Secretariat
        - Merged into the NRA after necessary legal arrangements

- JNSES
- JAEQA
- NIRS

**Independent Administrative Agencies**
- JNSES: Japan Nuclear Energy Safety Organisation
- JAEQA: Japan Atomic Energy Agency
- NIRS: National Institute of Radiological Sciences

* Transferred by 1st April 2013
“Trust is a fragile commodity. Government organizations and their relations with the public they serve can be strengthened by trust – or paralysed by a lack of it.

Responsible openness is the key to building and maintaining trust in regulatory programs.”

Key Points to be discussed

• How safe is safe enough?
• Improving versus Maintaining Safety?
• Symptoms of Safety Culture Deterioration in Organizations
• Investing in Trust and Confidence
• Stakeholders Involvement in Decision Making Process
5. Summary

- Learn from Crises to Avert Catastrophe
- Learning Culture – Learning Globally
- Investing in Trust and Confidence

*Hoping for the best, but should prepare for the worst.*