

**Unclassified**

**NEA/CNRA/R(2011)12**

Organisation de Coopération et de Développement Économiques  
Organisation for Economic Co-operation and Development

**30-Nov-2011**

**English text only**

**NUCLEAR ENERGY AGENCY  
COMMITTEE ON NUCLEAR REGULATORY ACTIVITIES**

**PROCEEDINGS OF THE FORUM ON THE FUKUSHIMA ACCIDENT:  
INSIGHTS AND APPROACHES**

**Hosted by the Nuclear Energy Agency of the OECD and the French Government, Chair of the G8.**

**Held on 8th June 2011 at the OECD Conference Centre, Paris, France**

**JT03312480**

**Document complet disponible sur OLIS dans son format d'origine  
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## FORUM OVERVIEW

The Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency (NEA) sponsored a Forum on Insights and Approaches as a result of the Fukushima Accident. The forum was held at the OECD Conference Centre in Paris, France on 8 June 2011. It was organised in conjunction with the 7 June 2011 Ministerial Meeting on Nuclear Safety hosted by the French government, in their role as the G8-G20 Chair for 2011. This Forum was the first international regulatory meeting with industry that focused exclusively on the Fukushima accident and the path forward.

### Objectives

The main objectives of the forum were to provide the opportunity to exchange information on emerging lessons learnt, safety implications and national activities in response to the Fukushima accident, and to define areas where international co-operation could be of benefit. Participants had the opportunity to meet with their counterparts from other countries and organisations to discuss current and future issues on this topic, to provide guidance to the NEA Committee on Nuclear Regulatory Activities (CNRA) and the Committee on the Safety of Nuclear Installations (CSNI) for future activities, and to provide input for the International Atomic Energy Agency (IAEA) Ministerial Conference on Fukushima, held on the week of 20 June 2011 in Vienna.

### Background

As a result of the Fukushima accident, the safety of all nuclear power plants worldwide has come under close scrutiny. Regulatory bodies and industry have been called upon to affirm the safety of its nuclear power plants, regardless of their type. During the 5th Review meeting of the Convention of Nuclear Safety this year in Vienna, it was clear that further collaborative discussions dedicated to the emerging lessons learnt would be beneficial in identifying ways to combine efforts internationally to improve understanding of the event and to move forward in an effective and efficient manner.

All countries with operating nuclear power plants have embarked on assessments of the plants in areas that were immediately evident from the Fukushima accident. Many of the reviews include an evaluation of the ability to withstand severe accident situations related, among others, to:

- external natural events,
- long term loss of electrical supply,
- long term loss of ultimate heat sink,
- combustible gas management,
- spent fuel pool cooling,
- severe accident management,
- emergency planning and preparedness, and
- crisis communication.

Additionally, the CNRA established a senior-level task group to exchange information on national activities and look at generic implications of the event. The task group will identify areas where an in-depth evaluation would be of benefit and can be undertaken by CNRA or CSNI working groups, or by new task groups to address gaps that are not within the scope of an existing working group.

### **Format**

The Forum sessions were divided into an Opening Session, two Discussion Sessions: Insights and Approaches, and a Concluding Session on international co-operation.

### **Opening Session**

The Forum was opened by Ms. Nathalie Kosciusko-Morizet, French Minister for Ecology, Sustainable Development, Transport and Housing the French Chair of the Ministerial Meeting on Nuclear Safety, who was the Chair of the Ministerial Forum on Nuclear Safety on 7 June. Ms. Kosciusko-Morizet discussed issues raised the previous day and conclusions from the discussions. Mr. Luis E. Echávarri, OECD/NEA Director-General next provided a framework for the Forum and a perspective of the current situation and the role of international co-operation.

### **Discussion Sessions**

There were two main discussion sessions,

- ❖ Insights, what are we learning from the accident? and
- ❖ Approaches, how are we reacting to the insights?

For each session, first there were presentations, followed by a panel and open discussion with the audience. In each session, there were mostly representatives from regulatory bodies, but also from industry to provide different perspectives on the discussion topic.

### **Moving Forward and International Co-operation Session**

As the capstone session of the Forum, panellists provided their vision and insights on the policy decisions and the path forward for the resolution of challenges. From this session, issues were identified for further CNRA and CSNI activities and, for input to the IAEA ministerial conference on Fukushima.

## FORUM PROGRAMME

### *Opening Session*

- Statement by the Chair of the Ministerial Forum on Nuclear Safety, Ms. Nathalie Kosciusko-Morizet, French Minister For Ecology, Sustainable Development, Transport And Housing.
- Welcome Address: Luis E. Echávarri, OECD/NEA Director-General.

### **Session 1: Insights: What Are We Learning?**

Session Chair: Mike Weightman, HM Chief Inspector, ONR, CNRA Chair, United Kingdom

### *Presentations*

- Koichiro Nakamura, Deputy Director-General For Nuclear Safety, NISA, Japan  
*TEPCO's Fukushima Nuclear Power Station Accident.*
- Terry Jamieson, Vice-President, CNSC, Canada  
*Review of Japan 2011 Nuclear Event: Implications for Canadian Nuclear Power Plants.*
- Jean-Christophe Niel, Director-General, ASN, France  
*First Lessons Learnt and Subsequent First Actions Taken in France.*
- Choul-Ho Yun, President, KINS, Korea  
*Fukushima Accident: Its Impact and Actions Taken in Korea.*
- Laurent Stricker, Chairman, WANO  
*WANO after Fukushima: Strengthening Global Nuclear Safety.*

### *Panel Discussion*

- S.S. Bajaj, Chairman, AERB, India.
- Hans Wanner, Director-General, ENSI, Switzerland.
- Edward D. Halpin, President and CEO, CNO and Chairman of the Board of Directors, STP Nuclear Operating Company, United States.
- Harri Tuomisto, Director Nuclear Oversight, Fortum Generation, Finland.

## **Session 2: Approaches: What Actions Are We Taking?**

Session Chair: André-Claude Lacoste, Chairman, ASN, France

### ***Presentations***

- Jukka Laaksonen, Director-General, STUK and Chairman, WENRA, Finland  
*Focused Safety Assessment of NPPs in the European Union, Aiming for Improved Protection against External Hazards.*
- Gregory B. Jaczko, Chairman, NRC, United States  
*US NRC Approach and Actions to Address the Fukushima Accident.*
- Nikolay Kutin, Chairman, Rostekhnadzor, Russia  
*Actions in the Russian Federation taking into Account Lessons Learnt from the Fukushima Accident.*
- Francisco Fernandez Moreno, Commissioner, CSN, Spain  
*Spanish Nuclear Safety Council Crisis Communication Management: The Fukushima Accident.*
- Takuya Hattori, President, JAIF, Japan  
*Fukushima Accident: Actions for the Future from Industry's Perspective.*

### ***Panel Discussion***

- Marta Ziaková, Chair, UJD, Slovak Republic.
- Boyce M. Mkhize, CEO, NNR, South Africa.
- Duncan Hawthorne, President and CEO, Bruce Power, Canada.
- Jean-Marc Miraucourt, Director Nuclear Engineering, EdF, France.

## **Session 3: Moving Forward and International Co-operation**

Session Chair: Gregory B. Jaczko, Chairman, NRC, United States.

### ***Panel Discussion***

- Luis E. Echávarri, Director-General, OECD/NEA.
- James E. Lyons, Director, Division Of Nuclear Installation Safety, IAEA.
- André-Claude Lacoste, Chairman, ASN, France.
- Koichiro Nakamura, Deputy Director-General for Nuclear Safety, NISA, Japan.
- Mike Weightman, HM Chief Inspector, ONR, CNRA Chair, United Kingdom.
- Nikolay Kutin, Chairman, Rostekhnadzor, Russia.



## FORUM SUMMARY

### Opening Session

The forum was opened by **Nathalie Kosciusko-Morizet**, French Minister for Ecology, Sustainable Development, Transport and Housing and Chair of the G8-NEA Ministerial Seminar on Nuclear Safety on 7 June. In presenting the conclusions of the previous day's Ministerial Seminar, she stressed the need to learn from the Japanese accident and to work collectively and co-operatively to prevent any future nuclear accident of this significance. She pointed out the need for all countries with nuclear power plants to carry out "stress tests" and the importance of these for collective learning and safety improvements. She emphasised the role of organisations such as the IAEA and the NEA in working with their member countries to advance the field of safety standards and safety principles. On the topic of nuclear crisis management, Ms. Kosciusko-Morizet called on strengthening regional and international co-operation regarding emergency intervention mechanisms. She underlined the need to harmonise approaches and procedures to facilitate effective co-operation among crisis management groups internationally.

**Luis Echávarri**, the Director-General of the NEA re-enforced the Minister's statements by stressing the importance of this Forum to begin to share the lessons being learned from the Fukushima Dai-ichi accident and to move forward together in implementing these lessons in each of the country's national nuclear safety programmes. He then turned to the NEA, its committees and working groups and highlighted the depth of expertise within the collective member countries to undertake the necessary technical reviews and studies which may come out of the Forum discussions and conclusions. He reminded participants of the importance of meetings such as this in facilitating the pragmatic and efficient advancing of the collective learning and stressed that the messages coming out of this Forum will be used to feed into the IAEA Ministerial Meeting scheduled for later in the month. He concluded by encouraging participants to take the opportunity of this Forum to clearly articulate a harmonized vision of the key issues that need to be addressed as we move forward together to assure the safe operation of nuclear power plants today, tomorrow and well into the future.

### Session 1: Insights: What Are We Learning?

This session comprised the Chair's opening address, five presentations and four panelist interventions:

**Mike Weightman**, CNRA Chairperson, opened the first session with a reflection on the tragedy of the earthquake, tsunami, and nuclear power plant accident and of the courage of the Japanese people. Having just led the IAEA mission to Japan that finished the week prior to the Forum, he recounted his experience on this mission and the noteworthy dedication of the workers at the Dai-ichi and Dai-ni plants. He noted that in all countries, the regulatory bodies have responded to their own government and public for assurance and expertise. In response, the CNRA established a senior-task group to help identify and co-ordinate the international activities that would result from the lessons learnt from the accident.

**Presenters:**

**Koichiro Nakamura**, Deputy Director General for Nuclear Safety, NISA, Japan, provided an overview of the Tohoku region earthquake and tsunami and the development of the accidents at the TEPCO Fukushima stations. He described the radiation monitoring and countermeasures taken to address the radioactive water. He followed with an update on the latest work and TEPCO's progress on the "road map" of planned recovery actions.

**Terry Jamieson**, Vice-President, CNSC, Canada, discussed the CNSC task force efforts to evaluate operational, technical and regulatory implications of the accident. He identified issues that would need to be assessed, such as the prolonged loss of heat sinks, verifying margins for design basis, beyond design basis and severe accidents. Severe accident management guidance would be reviewed to look at instrument performance, validation of the management strategies with the analysis, consideration of multi-unit conditions, and interfaces with provincial and municipal organisations. Mr. Jamieson also noted that a non-technical external review would be conducted to assess the adequacy of the CNSC's processes. He finished noting several early lessons learnt, including the need to prepare for cross-boundary events, pre-arrange for inter-utility co-operation and support, and exercise agency interfaces and stakeholder communication. He also noted some specifics for CANDUs that will include looking at venting, multi-unit events, implementation of hydrogen recombiners, and completion of severe accident management guidelines.

**Jean-Christophe Niel**, Director General, ASN, France, stressed the first lessons learnt including, the need to re-assess the regulatory authorities' response plan to deal with a long-term crisis (e.g., high human resource needs due to prolonged and extended shifts; need to balance on-going responsibilities with crisis management); to handle the large media interactions; to handle an international nuclear crisis; and also the adaptability of the regulatory authority to handle an unexpected situation. He identified changes that could enhance the response of the regulatory authorities, such as enhanced co-operation between regulatory authorities and international organisations, and the re-assessment of safety margins in the case of events challenging safety functions and leading to a severe accident. Mr. Niel followed with an overview of the ASN complementary assessment to the Western European Nuclear Regulator's Association (WENRA) stress test and the planned inspections, and the extensive consultation with stakeholders.

**Choul-Ho Yun**, President, KINS, Korea, noted as the closest neighbour to Japan, the accident had a significant impact on his country; in particular the public was very sensitive to the possibility of radiation risk. There was a huge media impact, including misinformation that KINS spent significant effort addressing in response to public concern. From 12 March to 31 May, KINS received over 8,000 calls, had 3.5 million hits on their website, and conducted over 150 interviews. The need for a pre-planned programme for crisis co-ordination and communication with stakeholders is clearly an important lesson learnt. KINS has taken action to strengthen co-operation with neighbouring countries, specifically Japan and China. From their special inspection, KINS has identified 50 improvement action items, including the re-evaluation of seismic capability and installation of mobile emergency generators and batteries. Mr. Yun identified that countermeasures against severe accidents; strengthening of regional networks and risk communication with stakeholders are challenges that will need to be addressed.

**Laurent Stricker**, Chairman, WANO, opened his presentation noting that although it is a difficult time for the nuclear industry, the demand for nuclear power continues. The World Association of Nuclear Operators (WANO) is using this challenging time to strengthen its role in international co-operation. WANO has identified several areas to enhance safety that could be co-ordinated by WANO, including better defined roles and responsibilities in an emergency; adding emergency preparedness as a core review area; and looking at fuel storage and design aspects.

**Panelists:**

**S.S. Bajaj**, Chairman, AERB, India, noted that when it comes to preparedness for rare events, a belief that it is not really going to happen results in lack of preparedness. He stated that it was clear that improvements were needed in mitigative measures for extensive power loss and loss of ultimate heat sink. He noted that Fukushima re-emphasized known issues such as hydrogen management and other severe accident management provisions. But there are also new lessons learnt such as preparedness for use of off-site resources when off-site conditions are also in crisis; and the evaluation of guidelines for beyond design basis external events. Mr. Bajaj stressed the importance of safety culture and the role of leadership and management. The challenge is how to strengthen institutional mechanisms that will ensure sustained safety culture in design and operating organisations and regulatory bodies.

**Hans Wanner**, Director General, ENSI, Switzerland, gave an overview of the Swiss response. He noted that while recognizing that we are still at an early stage of the event analysis, the process of drawing lessons from it does not need to wait and has indeed already started. He supported the IAEA Safety Standards, commonly developed according to the best practice and state of science and technology and proposed to strengthen the global system for nuclear safety based on the Convention on Nuclear Safety (CNS) and on review missions already provided by the IAEA, namely for the various assessments of the regulatory framework and activities.

**Edward D. Halpin**, President and CEO, CNO, and Chairman of the Board of Directors of the STP Nuclear Operating Company, USA, began by noting that the US nuclear power plants have evolved and improved over the course of operation, especially in response to large-scale events such as Three Mile Island (TMI), Chernobyl and the terrorist attacks on 11 September 2001. These events have resulted in the fortification of the safety of each nuclear power plant to deal with accident scenarios and beyond design basis challenges. The US industry has put together a well thought-out process that considers key stakeholder input, captures roles and responsibilities, and defines a decision making model to help guide our overall response. Mr. Halpin described the seven goals identified by US industry, including ensuring timelines for emergency response capability to ensure continued core cooling, containment integrity and spent fuel pool cooling are synchronized to preclude fission product barrier degradation following station blackout; ensuring severe accident response plans include potential for effects from multiple units; ensuring external events are considered using the latest hazards analyses and historical data. He concluded stating that it is imperative that we have a global plan that allows us to effectively combat the next major nuclear challenge so as to minimize any impact on our societies. We must spend the time to carefully develop roles and responsibilities, a strategic communication plan and in ensuring the right emergency support and response is available to rapidly mitigate the consequences of a severe accident.

**Harri Tuomisto**, Director Nuclear Oversight, Fortum Generation, Finland, noted that the significant lessons include paying more attention to proper management of extreme external hazards and ensuring that severe accidents can be mitigated properly, in case the prevention of external hazards or other events from escalating into a core melt is not successful. He strongly supported the WANO proposal to include relevant design issues to the WANO reviews and the IAEA's new initiative to introduce severe accident management review to the future Operational Safety Review Team (OSART) missions. Another lesson from Fukushima is that it is necessary to take some further steps to review the designs and upgrades, even though these steps could be difficult in practice. He encouraged the CSNI to consider setting up a respective Senior Expert Group to work on the topic of Management of External Hazards and Severe Accidents.

## **Session 1 Summary Remarks**

From the Session 1 discussions, three main focus areas to strengthen nuclear safety emerged. First, to strengthen preventive and mitigative measures, such as power supplies, external hazards, cooling capability; second to strengthen severe accident response, such as to verify or improve the effectiveness of severe accident management guidelines and procedures; and third, to strengthen emergency response, such as taking a practical assessment of response plan with local devastation, exercising the response plan with all stakeholders; improving source term modelling; review the current environmental monitoring, and improve communication and co-ordination of stakeholders. We also should take a holistic view for reviews, including looking at the impact on the whole site and surrounding area and the assessment of resource needs for long-term situations. These focus areas will be need to be addressed by both the regulatory authorities and industry. Additionally as regulators, we need to assess the scope and programmes of regulatory oversight; assess and strengthen if necessary, the independence of the safety authority; and strengthen our national and international communication, especially in a crisis situation. It is also clear that international co-operation is a key element moving forward to improve. We should look to establish or strengthen regional nuclear safety networks by both industry and safety authorities; strengthen nuclear safety guidelines; and enhance our assessments of each other organisation in the spirit of continuous improvement.

### ***Key messages:***

- Initial responsibility is with the operator for nuclear safety.
- There needs to be a strong, independent safety authority.
- Strengthen defence-in-depth for prevention and mitigation.
- Policy of transparency for the safety authority is necessary for public trust.
- Actions and lessons learnt will be a long process.
- Post-Fukushima action plans should involve the regulatory authority and industry.
- Strengthen networks and co-operation, both the regulatory authorities and industry.
- Continue international support to Japan for post-accident cleanup and assessment.

## **Session 2: Approaches: What Actions Are We Taking?**

This session comprised the Chair's opening address, five presentations and four panelist interventions:

**Andre-Claude Lacoste, Chairman ASN**, provided some introductory remarks stressing the importance of collective learning and the application of these lessons into the NEA member and associated countries' regulatory programmes. He also highlighted the important role that industry must play within these actions plans. He noted that within this session both senior regulators and industry executives would have an opportunity to discuss the approaches that are being taken to improve nuclear safety in the aftermath of the Japanese accident.

### ***Presenters:***

**Jukka Laaksonen, Director-General, STUK, Finland**, gave an overview on the European Commission (EC) directive and subsequent approach regarding the safety of nuclear power plants in the European Union (EU) countries. He outlined the breadth of the stress test requirements being applied noting that the emphasis should not be on whether or not the plants are safe but rather how do we make the plants safer. He described the key technical questions being asked by EU countries as part of their stress tests and concluded by highlighting that the EC directive will ensure a process of continuous assessment and verification of plant safety always towards the goal of improving overall plant safety.

**Gregory B. Jaczko, Chairman, NRC, USA,** reported on the NRC's actions following the Fukushima Dai-ichi accident. He stressed the Commission's approach of communicating with the licensees, the conduct of enhanced inspections and the issuing of technical bulletins as the principal near-term actions taken. He stressed the need to adopt a defence-in-depth posture with the three pillars of prevention, mitigation and emergency preparedness each being reviewed and addressed to enhance nuclear safety in the US. Finally, he stressed the importance of international collaboration as we move forward together.

**Nikolay Kutin, Chairman, Rostekhnadzor, Russia,** provided an overview of the lessons being learned and the actions being taken by the Russian regulator in the wake of the Japanese accident. He spoke of the broad implications of the accident to the Russian regulatory framework including the need to strengthen the requirements of the plant safety analysis, improve emergency preparedness and response capabilities and implement key mitigative measures for earlier plant designs. Going forward, Mr. Kutin stressed the need to perform more targeted inspections, to carry out further confirmatory assessments of plant design robustness and to introduce additional requirements for design safety phenomena such as electrical supplies, heat removal systems, reactor containment vessels and control and instrumentation under severe accident conditions.

**Francisco Fernandez Moreno, Commissioner, CSN, Spain,** stressed the importance of learning from this accident from the perspective of appropriate and effective crisis communication, both within the country and internationally. He highlighted the importance of well managed strategic communications at the time of an accident and noted the whole-of-government approach adopted by Spain and how this aided in ensuring reliable, consistent, accurate and timely information to all stakeholders.

**Takuya Hattori, President, JAIF, Japan,** touched on the sequence of events and consequences of the accident as currently understood. He framed the lessons learnt via the following categories: lack of imagination in safety analysis and assessment, the need for reconsideration of the robustness of design under severe accident conditions, the need to enhance crisis management and the need to improve crisis communication and transparency regionally, nationally and internationally. He outlined his proposal to establish an international nuclear emergency response team under the guidance of the IAEA which would be able to immediately assist operators and governmental authorities in the case of future accidents.

**Panelists:**

**Boyce Mkhize, CEO, NNR, South Africa,** spoke of the culture of safety and its role in strengthening operational safety worldwide. He described the on-going stress test for the South African NPPs, and the plans to implement any corrective actions for these analyses in a reasonable period of time. He stressed the importance of continued international co-operation going forward and his country's commitment to continually improve the safety of its NPPs.

**Jean-Marc Miraucourt, Director Nuclear Engineering, EdF, France** stressed the fact that the Japanese accident has reinforced the preeminent role that operators play in assuring the safety of their plants. He supported the in-depth review and analysis of the findings of the Fukushima Dai-ichi accident in order that all French plants have a sufficiently robust defence-in-depth approach to any and all credible severe accident phenomena. He concluded by reinforcing the concept of the symbiotic relationship between plant design and operational performance in assuring continuous safety improvement.

**Duncan Hawthorne, President and CEO Bruce Power, Canada** stressed the primary role of operator organisations, such as WANO and highlighted the differences between the Canadian industry-based task force approach and the WENRA approach previously discussed. In his remarks, he stressed the need to bring pragmatic improvements to the plants that improve nuclear safety without undue delays.

**Marta Ziaková, Chair, UJD, Slovak Republic** gave an overview of some of the key undertakings in the Slovak regulatory environment in the aftermath of the Japanese accident, stressing a structured reasoned response in undertaking high priority reviews and analysis, and implementing needed improvements. She supported the need to strengthen all countries' responses through collaborative efforts, such as this Forum and encouraged all participants to continue to share their lessons learned as we move forward together.

### **Session 2 Summary Remarks**

The Chair and speakers brought up a number of very important points along the thematic lines of “what actions are we taking” following the TEPCO Fukushima Dai-ichi accident. Firstly, speakers agreed on the importance of continuing to thoroughly review plant safety. Second, the importance of adopting a robust defence-in-depth approach to future nuclear power plant operations and their oversight was discussed. Within this broad area, the need to re-look at severe accident initiating events in a holistic and more conservative fashion was presented. Many spoke of the need to embark on a campaign of continuous safety improvement of the plants as we gain more information and operational experience. Through this all, the importance of strengthened international co-operation and harmonization of post-accident approaches was deemed imperative. On the topic of accident management, many of the speakers noted that the way in which crisis communications is managed and practiced should also be improved as all recognized the value of timely, accurate, rapidly and efficiently distributed messages during an accident. Finally, it was stressed by the speakers that safety resides with the operator and as such, organisations such as WANO must take a very active role in enhancing their own safety review and improvement programmes.

### **Session 3: Moving Forward and International Co-operation**

The keystone session of the Forum was chaired by **Mr. Jaczko** and included the following panel members: Mr. Lacoste, Mr. Weightman, Mr. Kutin, Mr. Nakamura, Mr. Echávarri and Mr. Lyons (IAEA). The purpose of this third session was to synthesize the major items raised by speakers during the Forum and arrive at some key concluding messages that participants and interested stakeholders could take away. Further, it was intended that these key messages would provide the foundation and high-level direction for future collaborative activities internationally amongst NEA member and associated countries, all with the goal of improving nuclear safety. Specifically, the speakers acknowledged that the key messages from the Forum would provide important input to the upcoming IAEA ministerial conference in Vienna.

All recognized that the NEA Fukushima Forum was an important piece of the international co-operative effort being undertaken to learn from, to share and to begin to implement the lessons being learned from the Fukushima Dai-ichi accident. All also agreed that this Forum was an important milestone in that it allowed the senior nuclear regulators, along with industry executives and senior representatives of the NEA and IAEA to discuss how to collaborate in the implementation of the lessons being learned from the Fukushima Dai-ichi accident.

Further, the participants agreed that the international community of nuclear regulators and operators must learn from Fukushima Dai-ichi, must undertake technical reviews to assess and ensure plant safety now and into the future and must be committed to further reducing the possibility of other such severe accidents in the future. This should not be done solely in the national context but rather organisations such as the NEA and IAEA must be tasked to advance the necessary knowledge in the safety of plant designs, severe accident management and analysis, emergency preparedness and response, crisis communication and all other associated areas necessary to ensure the long-term safety of nuclear plants in the world.

Finally, the speakers all reinforced that the prime responsibility for safety lies with the operators. As such, although the nuclear regulatory organisations must be proactive in their reviews and evaluations of what happened in Japan and what needs to be done to further strengthen the regulatory programmes around the world, industry organisations such as WANO must take a lead in driving towards higher safety levels for the plants. Industry peer review missions and other industry-led cooperative safety initiatives must be strengthened and made even more stringent in order to ensure the highest practical levels of plant safety worldwide.

The key messages agreed to by the Forum speakers are included on the following pages.





## KEY CONCLUDING MESSAGES

The NEA Fukushima Forum has been an important piece of the international effort being undertaken **to learn from, to share and to implement** the lessons learned as a result of the Fukushima accident.

It aimed at preparing future discussions at the international level, in particular the IAEA Ministerial Conference of June 20th, by providing recommendations on nuclear safety in light of the Fukushima event, as shared by the Regulatory authorities of the NEA and associated countries.

### **In terms of collective learning,**

- The Forum has highlighted the fact that a lot of in-depth review and analysis of plant safety has taken place to-date by the regulatory authorities of the NEA and associated countries following Fukushima. We invite all regulatory authorities responsible for the oversight of nuclear installations to launch similar reviews and analyses as soon as possible;
- There have been excellent discussions today on “what we are learning” and “what actions we are taking”. That being said, further follow-up actions will continue to be taken and the Forum has focused our attention, as regulatory authorities, on these key issues and priorities;
- In light of the Fukushima nuclear accident, and the fundamental basis for sustained high standards - continuous improvement, we remain committed to seek ways to make operating and new reactors even safer by learning from what has happened;
- It is important to note that the regulatory authorities are still learning from this accident and the on-going situation, as more information is gained from the Japanese authorities and international organisations. We have already started implementing the lessons learned and will continue to do so within our domestic regulatory systems on a continuous manner, since the completion of the overall assessment of this accident may take years;
- National experience feedback and practices provide valuable knowledge that needs to be shared both nationally and internationally. We are committed to enhancing our co-operation in a timely and transparent manner and we encourage the nuclear industry to do so as well;
- The ability of Regulatory authorities to provide comprehensive information in a transparent manner to the public and governmental institutions both nationally and internationally is a real challenge. We are committed to sharing our experience in order to improve our policies in that field and to identify areas for co-operation;
- This Forum highlighted the need for the proactive focus on safety culture by all parties: operators, regulatory authorities and international organisations.

**In terms of sharing of insights and approaches,**

- This Forum provided an excellent example of international co-operation in which the community of nuclear regulators comes together to share insights and approaches with the international community;
- The Forum allowed us to identify the priority areas that need to be addressed together as we move forward. We are committed to continuing to systematically advance the necessary knowledge needed for all plant designs and post-accident situations. Some of these priority areas include extreme external natural events and resilience to external shocks, including combined risks, plant design and the ability of safety systems to withstand severe accidents, emergency response and management capabilities, crisis communication, and site recovery plans and their implementation;
- During this forum several approaches were presented, all of these promoting continuous improvement of nuclear safety by carrying out targeted or comprehensive safety assessments of nuclear installations. These assessments address a range of issues in an independent and transparent manner;
- The need to improve communication and transparency, especially during a crisis, was identified as an important area on which to focus lesson learned efforts. Further, we need to reflect upon the adequacy and challenges of the current tools that we are using to communicate openly and transparently with the public on accident severity, including the INES scale, a tool developed by the NEA and IAEA;
- It is important to assure the international community that the regulatory authorities of the NEA and associated countries are sharing information and working together to ensure the continued safe operation of nuclear plants today and into the future, and that they will work towards improvement of their practices and of the international nuclear safety framework as required, in order to address lessons learned, improve them further, and avoid complacency.

**In terms of the implementation of lessons learned,**

- We will strive to harmonize the national approaches being considered by the NEA and associated countries to incorporate the lessons learned from the Fukushima accident;
- NEA framework provides an effective expert network able to work efficiently and to ensure coordination between the regulatory authorities of NEA and associated countries. According to the future priorities that we collectively agree to, we expect the NEA's Standing Technical Committees to carry out additional technical analyses following this Forum and to share the outcomes internationally;
- We are ready to use the NEA framework for the continued monitoring and follow-up of the activities coming from the Fukushima accident lessons learned, mindful that the IAEA is bringing countries together to address lessons learned and that duplication of effort should be avoided. This will ensure that the regulatory authorities of NEA and associated countries come together on a periodic basis to review how the lessons learned have been implemented and if needed, to propose additional work based on further knowledge gained from the accident;

- Further, the national and regional common approaches discussed at this Forum and all proposals expressed should be used as input to the discussions and as appropriate, to influence and upgrade the programme of work within other international bodies such as the IAEA, in the perspective of the Ministerial Conference on June 20<sup>th</sup>. In particular :
  - For the NEA and related activities such as Multinational Design Evaluation Programme (MDEP), these insights can influence the development of further best practices to assure the long-term safety of our plants.
  - Initiatives aimed at improving the implementation of the IAEA safety standards, and allowing an optimization of the IAEA instruments (i.e., Integrated Regulatory Review Service (IRRS) and OSART) should be strongly supported.
  - National, regional and international initiatives on safety objectives for new reactors should be considered as far as they can provide substantial improvements of nuclear safety for new builds in light of Fukushima;
- During this forum we also highlighted the need for an early response for the management of such accident situations and for the early and continuous release of reliable information. Possible routes such as regional/international resource pooling, have been already identified and should be developed within international bodies or organisations;
- A particular effort of coordination and consistency among all international bodies and organisations is also expected. That being said, we, as regulatory authorities from NEA and associated countries, are ready to share our work internationally and encourage the nuclear industry to do so;
- Regarding the nuclear industry, the regulatory authorities stress that operators of nuclear installations have the prime responsibility for nuclear safety, and have a key role to play in order to improve nuclear safety at the international level. Therefore, the regulatory authorities very much welcome the declaration from WANO and its members to commit themselves to such an improvement, notably through renewed peer review, enhanced international co-operation between operators and a more ambitious transparency policy;
- It is important to note that this Forum has been held soon after the G8 declaration in Deauville, which makes nuclear safety one of the main international priorities, and was articulated with a Ministerial meeting organized on June 7<sup>th</sup> by the French Government, currently chair of the G8-G20. Clearly, all countries at the highest levels of government are committed to ensuring the safe operation of nuclear plants well into the future;
- The regulatory authorities of NEA and associated countries are committed to continuing to work together internationally. We also believe that the current situation is a unique opportunity to enhance the international nuclear safety framework, and are ready to consider improvements of the legal international frame to increase the use of international tools and safety standards, recognizing that the prime responsibility for safety rests with the operator and the country in which it operates. Notably, they welcome the special meeting of contracting Parties to the Convention on Nuclear Safety, and encourage any improvements of the relevant international Conventions, as needed.



**APPENDIX:  
ORAL REMARKS AND PRESENTATIONS  
PANELISTS ORAL REMARKS**



## Session 1: Insights: What Are We Learning?

*S.S. Bajaj, AERB, India*

I thank NEA for giving the opportunity to present the Indian regulator's perspective on insights and learnings from Fukushima.

The Fukushima accident is no doubt an epochal event from the nuclear industry, and will be a stepping stone towards a quantum enhancement in safety of nuclear power plants world-wide, just as TMI and Chernobyl were before this.

In India, as a preliminary response in March, the Government ordered a thorough review of the safety of Indian nuclear power plants in the light of the Fukushima accident. The Utility (NPCIL) and the regulatory body (AERB) have set up formal investigations. While recognizing that it will be a while before all of the lessons are learnt, some immediate apparent enhancement measures have already been identified by the utility for implementations. These include additional measures for decay heat removal from the core and spent fuel pools: identifying independent water inventories / resources and power sources which can be used or hooked up to plant systems at pre-identified points. A roadmap for implementation of these measures has been prepared for individual plants.

Beyond this, based on information available so far, we can identify the following areas where we need to take action or investigate further; many of these areas are of course obvious; and investigations on many of these are already in progress:

- First, design bases external events: Are our current requirements and methods for specifying them adequate, or do they need to be revisited? Perhaps the requirements need to be spelt out more explicitly and prescriptively in some areas.
- Further, for external events of magnitude larger than design basis events, we need to provide preventive measures or cushion against such rare occurrence. Assessments have already been initiated for existing plants to understand the available margins beyond design basis flood and design basis earthquake, at which safety function can still be performed. It will help if we can also evolve guidelines for required margins or magnitudes to be considered for such beyond design basis external events.
- It is clear that we need to provide mitigation measure for extended periods of station blackout and loss of ultimate heat sink. As mentioned above, hook-up schemes using external mobile power packs and pumping systems are being worked out. While this is fine, we need to take up work on evolving elegant, robust options for such ultimate mitigation measures. Options should consider measures that avoid generation of large amounts of contaminated water. Air as ultimate cooling medium, wherever, feasible, would be an obvious advantage.
- For severe accident management provisions and guidelines, many learning points are already emerging from Fukushima. Many of these re-emphasize known issues, e.g., ensuring containment integrity, hydrogen management/ containment venting. Other learning points are new: preparedness for the use of outside off-site resources for managing crisis at the plant, when outside conditions themselves may be unfavourable.
- Post accident management of radioactive water and contamination is another issue.

Many organisational and procedural issues may require a re-look.

- For one, emergency operating procedures (EOPs) need to be revisited for their implementability under adverse conditions with alternative options.
- In the areas of emergency preparedness, feedback from the event will no doubt throw up several learnings. For one, it may be an opportunity to re-visit the intervention levels for emergency counter measures, to fine-tune or perhaps re-affirm them.
- The way we communicate to the public regarding radiological releases needs a thorough review. We need to evolve a language and units that convey better understanding, sense and perspective.
- Last but most important, as with almost any safety incident, the question of safety culture and role of leadership and management issues is paramount. When it comes to preparedness for rare events or severe accidents, a question of mind-set probably comes in: a belief that it is not really going to happen (complacency). The result is half-hearted preparedness.

The challenge is to determine can we strengthen institutional mechanism that will ensure sustained safety culture in design and operational organisations, and regulatory bodies.



*Hans Wanner, ENSI, Switzerland*

Stunned, we had to watch from afar as the earthquake disaster and the accident in Fukushima took its course. We want to express here again our deepest sympathy to the Japanese people.

The analysis of this complex and still on-going event is not an easy task. The approach we have chosen in Switzerland is quite standard. It is divided in three steps and starts with the collection of the available information. The second step is the search for the contributing factors which led to the accident. And the third step is then the check of the applicability of the identified contributing factors to the situation in Switzerland. At the end of this step a series of country specific lessons learnt is issued. Here we may identify lessons for the utilities, for the regulators, for the nuclear emergency organisation or for the legislative power. Lessons may also be learnt regarding the international community and cooperation.

What are we learning?

*Site Hazards and Plant Design*

The most obvious lesson learnt from Fukushima is that the Tsunami hazard for the site was underestimated. Of course, the design of a nuclear power plant must match the site specific hazards; and these must be well understood. I am convinced that updating the site hazard profiles should be a continuous process with follow-ups, for example in the frame of the periodic safety reviews.

Considering the design of a nuclear power plant, it is important to consider common cause failures due to area events, to enforce a high degree of redundancy, physical separation and diversity, to make sure that appropriate instrumentation is available for monitoring the actual conditions in the reactor, but also in the fuel pool, and to address the special case of a prolonged station blackout.

ENSI has ordered the Swiss nuclear utilities to update the hazard profiles for earthquake and flooding, and to carry out a comprehensive re-evaluation of the plant design. The scope of these re-evaluations includes the spent fuel pools.

*Crisis management*

Further, we are learning that the emergency organisation and crisis management at a national level should be reviewed in the light of extensive infrastructural damage and long repair times. In addition, the strategies for the protection of the population should be reassessed in view of an accident of prolonged duration.

ENSI has ordered the Swiss utilities to put in place, by 1 June 2011, an external, flood-proof storage facility for emergency equipment such as diesel generators, pumps etc. The equipment can be transported by helicopter. In addition, the Swiss government has established a process to examine and review the protection measures for the Swiss population in emergency cases due to extreme events.

*Legal and regulatory framework*

What we are also learning is that the role of the regulator as an independent supervisor cannot be stressed enough. There should be provisions de facto and de jure which allow an independent regulatory judgment and an effective enforcement.

In addition, I want to emphasize that safety is not a state; safety is a process. It is the process of continuous improvement. This is important. Specific legal provisions – as we have them in Switzerland – which

require such safety improvements based on operational feedback or state-of-the-art considerations, are very helpful and strengthen the regulator's role and enforcement capabilities in this respect.

### Conclusions

While recognizing that we are still at an early stage of the event analysis, the process of drawing lessons from it does not need to wait and has indeed already started. Switzerland has taken several concrete actions to improve nuclear safety as a result of first lessons learnt from the events in Japan, and there may be more as the analysis progresses.

All countries should have a vital interest that the IAEA Safety Standards, commonly developed according to the best practice and state of science and technology, are implemented worldwide and enforced by the national supervisory authorities. In order to support the States, I propose to strengthen the global system for nuclear safety based on the Convention on Nuclear Safety (CNS) and on review missions already provided by the IAEA, namely for the assessment of the regulatory framework and activities (e.g., IRRS), of nuclear power plants design (e.g., Integrated Safety Review) and of nuclear power plants operation (e.g., OSART).

*Edward Halpin, STP Nuclear Operating Company, United States*

The leadership of the U.S. commercial nuclear industry is dedicated to gaining a deep understanding of the events at the Fukushima Daiichi nuclear station and to taking the necessary actions to improve safety and emergency response preparedness. More importantly, we want to reaffirm to our Japanese counterparts that they have our commitment to help in whatever way possible.

There is a need to act in a deliberate manner that is balanced and proactive. Recognizing this, we will take action based on a preliminary understanding of the events. Having a thorough knowledge of the investigated root causes, both technically and organisationally, is essential in helping to establish long-term corrective actions. We recognize that establishing a root cause will take time, especially considering the extraordinary and significantly challenging conditions the Japanese team is heroically working through to stabilize the Fukushima station.

Separately, the Nuclear Regulatory Commission (NRC) is conducting an independent assessment and will be taking action to ensure its regulations reflect the lessons learned from the Fukushima accidents. The industry's response will focus on ensuring that we remain informed of each other's respective activities, so that new regulatory requirements are implemented in the most efficient and effective manner.

In response to the panel discussion question, "What have we learned?" I would offer:

1. The actions the U.S. industry has put in place since Three Mile Island (TMI), Chernobyl and the terrorist attacks on September 11<sup>th</sup>, 2001, have fortified each nuclear power plant to deal with accident scenarios and beyond design basis challenges. A small sample of some of these actions include:
  - a. Design change modifications that incorporated the lessons of TMI;
  - b. The formation and charter of the Institute of Nuclear Power Operations (INPO) and its strong focus on excellence through constant evaluation as well as accountability through the use of an assessment grade;
  - c. Significant Accident Management Guidelines (SAMG's), training and equipment to combat beyond design basis accidents;
  - d. Changes in security strategies, staffing and protocol along with additional equipment and training to combat large area fires and explosions.
2. The established margin our Industry has put in place to preserve safety is being carefully reviewed in light of the Fukushima reactor accident. Improvements will be made, as necessary, in a controlled and deliberate manner.
3. Having a well coordinated, collaborative response is essential in order to be effective. The U. S. Industry has put together a well thought through process that considers key stakeholder input, captures roles and responsibilities, and defines a decision making model to help guide our overall response. Our goals as an Industry include the following:
  - a. The nuclear workforce remains focused on safety and operational excellence at all plants and maintains the appropriate sensitivity to their important emergency response roles particularly in light of the increased work that the response to the Fukushima event will represent;

- b. Timelines for emergency response capability to ensure continued core cooling, containment integrity and spent fuel pool cooling are synchronized to preclude fission product barrier degradation following station blackout;
- c. The U.S. nuclear industry is capable of responding effectively to any significant event in the U.S. with the response being scalable to support an international event, as appropriate;
- d. Severe accident management guidelines, large area fire and explosion response strategies, and external event response plans are effectively integrated to ensure stations are capable of a symptom-based response to events that could impact multiple units at a single site;
- e. Margins for protection from external events are sufficient based on the latest hazards analyses and historical data;
- f. Spent fuel pool cooling and makeup functions are adequate during periods of high heat load in the spent fuel pool during extended station blackout conditions;
- g. Primary containment protective strategies can effectively manage and mitigate post-accident conditions including pressure and elevated hydrogen concentrations.

4. Our global response to this unfortunate event must be aligned, broad and sweeping. It is imperative then that we commit to having a global plan that allows us to effectively combat the next major nuclear challenge so as to minimize any impact on our societies. We must spend the time to carefully develop roles and responsibilities, a strategic communication plan and in ensuring the right emergency support and response is available to rapidly mitigate the consequences of a severe accident. This is an opportunity to demonstrate to the world the incredibly high standards our community lives by each and every day by having a unified, well crafted world-wide plan that puts safety first and protects the health and safety of the general public.

***Harri Tuomisto, Fortum Generation, Finland***

In general terms, the significant lesson is: pay more attention to proper management of extreme external hazards.

During the emergency conditions, the key elements are to ensure availability of :

- emergency power supply,
- ultimate heat sink,
- operational staff.

The concept of defence-in-depth remains the essential basis of nuclear safety. However, the management of external hazards should be explicitly introduced into functional levels of the defence-in-depth concept. It could be done, for example, by following the proposal of WENRA and adding it to new level 3B that defines management of design extension conditions.

Equally important is to ensure that severe accidents can be mitigated properly in case that the prevention of external hazards or other events from escalating into a core melt is not successful. Unfortunately there are only a few countries that have provided deterministically sound and probabilistically consistent approach to managing severe accidents of the existing plants.

I strongly support the WANO proposal to include relevant design issues to the WANO reviews and the IAEA's new initiative to introduce severe accident management review to the future OSART missions. Both WANO and IAEA have made very good work in reviewing and supporting the operational safety of the all the world's nuclear power plants. But a lesson from Fukushima is that it is necessary to take some steps further to review the designs and upgradings, even though these steps could be difficult in practice.

Concerning new plants, I can provide some general conclusions from recent market surveys:

- currently available reactor concepts for implementation will survive,
- plant concept with passive safety features may become more attractive,
- harmonization of safety requirements is even more important,
- the industry interest in small and medium size reactors and later in Generation IV systems may increase.

Final remark: Senior Group of Experts on Severe Accident Management was formed by CSNI twenty years ago. This group provided significant reports and on the status and prospects of severe accident management to the community. The group consisted of selected members from regulatory authorities, industry and technical support organisations. Based on that experience, I would encourage the CSNI to consider setting up a respective Senior Expert Group to work on the topic of Management of External Hazards and Severe Accidents.



## **Session 2: Approaches: What Actions Are We Taking?**

*Marta Ziaková, UJD, Slovak Republic*

Nuclear power plants in the Slovak Republic

- There are 3 units in decommission, 4 units in operation and 2 under construction,
- 4 operating nuclear reactors produce approximately 50% of the Slovak electricity,
- All units are WWER 440 type 213,
- There is one license holder for units in operation and units under construction – Slovenske elektrarne, a.s.

Initial response after Fukushima event

- Operator – WANO Significant Operating Experience Report (SOER) 11-2 – all tasks were fulfilled and operator sent report as it was required.
- UJD SR (nuclear regulator) – based on recent periodic safety reviews which were conducted in 2008 for Bohunice site and in 2010 for Mochovce site the first immediate review has been conducted to assess if the plants are able to cope with the severe extreme hazards. Conclusion – no immediate action is required.

Medium term activities

- Slovakia takes part in the “stress tests” (targeted safety review) based on the agreement between European Commission and operators and regulators in the European Union.
- Based on the action plan resulted from periodic safety reviews all nuclear power plants continue with the implementation of the measures which will help the plants to cope with the severe accidents (e.g. ex-vessel cooling, hydrogen management, additional diesel-generators, tanks and pumps for cooling of the reactor coolant, spent fuel pools, containment,...).
- Based on the results of the stress tests to prepare action plan for implementation of additional corrective measures if it is required.

Conclusions

- Improved international cooperation (both operators and regulators) and help in the upgrading and harmonisation of nuclear power plants safety round the world.
- It is necessary to use lessons learnt from Fukushima event today but also in the future for further upgrading of nuclear power plants safety and ability of the plants and countries properly react in the case of emergencies.





**Boyce Mkhize, NNR, South Africa**

The Culture of Safety

- Safety culture in the nuclear industry raised today in an attempt to imagine what would have happened, had Fukushima not occurred?
- Have we been robust enough before Fukushima and will we be robust enough post-Fukushima?

The Culture of Safety

- Without doubt Fukushima has placed an urgent call for us to re-engineer our processes placing safety as a paramount **institutional objective**.
- No lasting or substantive changes can be made without successfully remaking an organisational culture.

The Culture of Safety

- Organisational culture is expressed through values, beliefs, attitudes, behaviours, language, customs, goals, policies and operations.
- A safety culture is what emerges as a result of an organisational effort to move all cultural elements towards the goal of safety including its members, systems and work activities.

RSA Initial Response

- Coordinate communication efforts within South Africa between the Regulator and Operators.
- Overall message to the public was about instilling calm and calling for understanding of the differences in context between RSA and Japan in terms, inter alia, of design basis of Nuclear Power Reactors, environmental consideration, seismic activities etc.

RSA Initial Response

- Set up a Task Team on Fukushima.
- Called for high level assessment of Operators' preparedness in terms of design and beyond design basis for accidents similar to Fukushima.
- Got initial comfort in terms of design basis e.g., nuclear power plant's ability to withstand earthquakes and severe flooding.

RSA Initial Response

- .... Hydrogen re-combiners not requiring electrical power supply, diesel air intakes location, steam driven cooling pumps & water supplies & RSA not prone to earthquakes and tsunami.

Medium to Long Term Actions:

- Issued a call to all Operators to conduct a comprehensive reassessment with respect to external events due by November 2011.
- External events reassessment on design basis and risk analysis to form a basis for modifications, measures and technical features to be implemented to improve safety based on re-assessment.

Areas for review include:

- 1) Provision taken on design basis concerning flooding, earthquake or other extreme natural phenomena and combinations of external events.
- 2) Robustness of facility design to maintain safety functions beyond design basis hazards.
- 3) Consequential loss of safety functions such as prolonged total loss of electrical power supply and prolonged loss of ultimate heat sink.
- 4) Identification of potential cliff edge effects in assessment of external events and safety functions and potential measures or design features to mitigate these effects.
- 5) Accident management.
- 6) Emergency management responses.
- 7) Safety considerations for operation of multi units.
- 8) Safety of other fissile material and facilities e.g., spent fuel, etc.

Submission Due: November 2011.

Task Team to review safety reassessment submissions, monitor implementation of corrective measures and modifications required to improve safety.

International Co-operation:

- Participation in Multilateral and Bilateral structures.
- Approach informed largely by IAEA, WENRA and other Regulatory Authorities internationally.

**Conclusion:**

There is undoubtedly a need for a renewed focus on international collaboration and a need to:

- i. institutionalize a culture of safety,
- ii. implement corrective actions based on lessons learnt from Fukushima; and
- iii. continually improve and maintain nuclear safety.

***Duncan Hawthorne, Bruce Power, Canada***

## Canada's Nuclear Fleet:

- 7 nuclear stations, producing approximately 15% of Canada's electricity.
- Largest nuclear facilities are in Ontario, where 50% of electricity is generated from nuclear.
  - Bruce Power Site: Largest facility in North America, two 4-Unit CANDU Stations. Anticipate will be fully refurbished.
  - Darlington Site: home of one 4-unit CANDU Station. Anticipate will be fully refurbished.
  - Pickering Site: home of two 4-unit CANDU Station. Will be in operation until 2020.

## Work Completed To-date:

- WANO SOER 11-2
  - Table top and field walk downs completed at both Bruce A & B.
  - Areas for improvement identified and high level summaries submitted to WANO London Office.
  - Canadian Industry Team formed with twice weekly video conference calls (all domestic nuclear power plants) – participation has increased to include Romania, CRNL-AECL, Argentina, Korea, China and India

## Current Activities:

- CNSC Directive
  - Builds upon work completed through WANO SOER.
  - Industry Team formed to support development of CNSC Fukushima Task Force terms of reference (“White Paper”).
- Objective of task force is to review submissions provided by Utilities and report to Commission.
- Task Force nearly completion of white paper development
- Key Differences between Canadian Approach and WENRA Stress Test
  - Risk/Hazard based assessment methodology is being proposed by the industry.
  - Keeps the potential scenarios limited to “credible events”.
  - Focus on practical meaningful improvements to our plants.

## Public Outreach:

- An immediate public outreach effort is underway to engage with the public and interested stakeholders:
  - Open house
  - Briefing sessions
  - Stakeholder engagement
  - Information on the website
  - Updated materials on emergency preparedness
- As an operator, communicating to the public the actions we are taking in response to the events in Japan is critical.



*Jean-Marc Miraucourt, EdF, France*

Continuous improvement in the safety of French nuclear power plants is based in particular on the consideration of all lessons learned from global events. For this reason, lessons from the Fukushima accident should have as significant an impact as those drawn from the Three Mile Island accident in 1979 and Chernobyl in 1986, which gave rise to major action plans to improve the safety of EdF reactors.

First of all, the accident of Fukushima reinforces the fact that the operator is the unique responsible for the safety of its installations. It is our responsibility, as an operator, to avoid especially any situation with a high and long-term contamination of territories involving heavy constraints on the populations.

From the beginning, EdF has been performing periodic safety reviews (PSR), taking benefit from national and international operating feedback. This process is now imposed by the French law. Regarding the natural hazards, they were taken into account at the initial stage of design, and they are taken into account all along the operating life of the plants, through the PSR's, which result in a continuous improvement of the safety. The standardization of our fleet makes it possible a retrofit of all reactors in operation at the same level of safety, whatever the age of these reactors,

Within this frame, the lessons from Fukushima will be deeply studied: we will examine the robustness of the successive lines of defense in depth, and seek beyond these lines, it means beyond the design basis, if some cliff-edge effect could occur and lead to a Fukushima-type event. The action plan will deal with prevention, mitigation and emergency preparedness. It will likely lead to a reinforcement of our crisis organisation, with additional material and human means on a national basis, able to be rapidly on site and aimed at coping with a crisis involving all reactors of a same site.

Last but not least, all these actions and programs rely on an architect-engineering-operating industrial scheme: this continuous improvement of the safety, which requires a complete mastery of both design and operation of the plants, is achieved through the integration, inside EdF, of strong R&D, engineering and operating skills and covering the whole life-cycle of the plants, it means design, construction and commissioning, operation and dismantling.



### Session 3: Moving Forward and International Co-operation

*Gregory Jaczko, NRC, United States*

It is time to close this forum but before I turn it over to Luis I wanted to highlight some of the key points that I have heard today.

- We heard several participants talk about the need for a strong independent regulator and actions that are necessary for National regulators and international organisations to take to achieve high levels of safety. It was pointed out that operators are critical in this process and we must all work together to learn from and implement measures in response to this event.
- It also was mentioned that it has been a long time since any of us (regulators, operators, or international organisations) have experienced a large accident such as this. There may have been some complacency, lack of imagination or opinions that this type of accident could not happen. This event serves as a sober reminder that we must never stop questioning or evaluating safety.
- We also heard that this is not just an issue for boiling water reactors (BWR) impacted by an earthquake and Tsunami. As we move forward we need to consider a broad range of natural hazards and the cross-cutting issues for all nuclear power plant designs, non-reactor aspects of plants, such as spent fuel pools, and other non-power reactor facilities. We need to look for ways to apply these lessons learned more broadly.
- Communication and transparency have also been a major focus today. We all need to consider improvements in how we communicate. This includes internal and external communications with the public, with other nations, with our neighbours, and with international organisations.
- There is also a need to strongly support initiatives to improve the implementation of IAEA guidance and international instruments, and conventions on nuclear safety.
- There was universal agreement that we have to continue to incorporate new information through rigorous assessments of operating and new nuclear power plants. There will not be a replacement for thorough national assessments based on domestic challenges. At the same time we must all work together to communicate and share information internationally to learn from the unique insights we will gain from situations in each of our countries.
- As we have discussed today, this is going to be long process. For the foreseeable future we will continue to learn and continue to make enhancements. We cannot afford to wait too long to take actions.
- As a result of this event we have discussed the changes, present and future, to the nuclear landscape. However, energy demands worldwide remain, so it is vital that we get it right.

Finally I want to end with a quote I heard today...Safety is a continuous process not a state of being, it requires eternal vigilance and a passion for learning and improvement.





## PRESENTATION MATERIAL

### Session 1: Insights: What Are We Learning?

- Koichiro Nakamura, Deputy Director-General For Nuclear Safety, NISA, Japan  
*TEPCO's Fukushima Nuclear Power Station Accident.*
- Terry Jamieson, Vice-President, CNSC, Canada  
*Review of Japan 2011 Nuclear Event: Implications for Canadian Nuclear Power Plants.*
- Jean-Christophe Niel, Director-General, ASN, France  
*First Lessons Learnt and Subsequent First Actions Taken in France.*
- Choul-Ho Yun, President, KINS, Korea  
*Fukushima Accident: Its Impact and Actions Taken in Korea.*
- Laurent Stricker, Chairman, WANO  
*WANO after Fukushima: Strengthening Global Nuclear Safety.*

### Session 2: Approaches: What Actions Are We Taking?

- Jukka Laaksonen, Director-General, STUK and Chairman, WENRA, Finland  
*Focused Safety Assessment of NPPs in the European Union, Aiming for Improved Protection against External Hazards.*
- Gregory B. Jaczko, Chairman, NRC, United States  
*US NRC Approach and Actions to Address the Fukushima Accident.*
- Nikolay Kutin, Chairman, Rostekhnadzor, Russia  
*Actions in the Russian Federation taking into Account Lessons Learnt from the Fukushima Accident.*
- Francisco Fernandez Moreno, Commissioner, CSN, Spain  
*Spanish Nuclear Safety Council Crisis Communication Management: The Fukushima Accident.*
- Takuya Hattori, President, JAIF, Japan  
*Fukushima Accident: Actions for the Future from Industry's Perspective.*



**Session 1: Insights: What Are We Learning?**

*Koichiro Nakamura, NISA, Japan*

(For Forum on the Fukushima Accident: Insight and Approaches)

# **TEPCO's Fukushima Dai-ichi NPS Accident**

**June 2011**

**Report of Japanese Government  
to the IAEA Ministerial Conference on Nuclear Safety  
- The Accident at TEPCO's Fukushima Nuclear Power Station -  
by Nuclear Emergency Response Headquarters of GOJ**


Framework of the report includes;


- Occurrence and development of the accident in Fukushima Nuclear Power Stations
- Response to Nuclear emergency
- Discharge of Radioactive Material to the Environment
- Cooperation with the international community
- Efforts to Restore the Accident in the Future
- Lessons learned from the Accident so far

1

### Tohoku Region – Off the Pacific Ocean Earthquake and Tsunami

- Occurred 14:46 March 11, 2011
- Magnitude: 9.0 Mw
- Epicenter location: 38° 6"N and 142° 51"E, and 24km in depth
- It is said that the height of tsunami attacked Fukushima NPP was more than 14m





Source: Fire and Disaster Management Agency

- East coast of northern area in the main island of Japan is seriously damaged
- As of May 9, 14,737 people are dead and 9,992 people are missing according to the Fire and Disaster Management Agency

2


### Occurrence and development of the accidents in Fukushima NPS (1/2)

**March 11, 14:46, The earthquake occurred**

- 11 reactors under operation were automatically shut down
  - Onagawa 1,2,3
  - Fukushima Dai-ichi 1,2,3
  - Fukushima Dai-ni 1,2,3,4
  - Tokai Dai-ni
- 3 reactors under periodic inspection
  - Fukushima Dai-ichi 4,5,6

**Around 1 hour later, after tsunami hit the NPSs above**

- Following reactors went to cold shut down
  - Onagawa 1,2,3 : External power and sea water pumps were alive
  - Fukushima Dai-ichi 5,6: Emergency DG was alive
  - Fukushima Dai-ni 1,2,3,4: External power was alive
  - Tokai Dai-ni: Emergency DG was alive
- The problems came with Fukushima Dai-ichi 1,2,3 and 4.



*Location of the Nuclear Installations*

<ul style="list-style-type: none"> <li>Onagawa                             <ul style="list-style-type: none"> <li>Unit1: 524 MW, 1984-</li> <li>Unit2: 825 MW, 1995-</li> <li>Unit3: 825 MW, 2002-</li> </ul> </li> <li>Fukushima I                             <ul style="list-style-type: none"> <li>Unit1: 460 MW, 1971-</li> <li>Unit2: 784 MW, 1974-</li> <li>Unit3: 784 MW, 1976-</li> <li>Unit4: 784 MW, 1978-</li> <li>Unit5: 784 MW, 1978-</li> <li>Unit6: 1,100 MW, 1979-</li> </ul> </li> <li>Fukushima II                             <ul style="list-style-type: none"> <li>Unit1: 1,100 MW, 1982-</li> <li>Unit2: 1,100 MW, 1984-</li> <li>Unit3: 1,100 MW, 1985-</li> <li>Unit4: 1,100 MW, 1987-</li> </ul> </li> <li>Tokai II (1,100 MW, 1978-)</li> </ul>
--

3

### Occurrence and development of the accidents in Fukushima NPS(2/ 2)

- Unit1 -3 automatically shut down by the earthquake. External power supply lost, but Emergency DGs started up as planned.
- Emergency DGs except 1 DG stopped by tsunami. Station blackout except unit6 and the core cooling function was lost.
- The loss of water injection to the reactors caused exposure of the nuclear fuels
- Hydrogen was generated, and it was discharged into the R/B, and presumably hydrogen explosion at unit 1-4.

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### Response to Nuclear Emergency (1/ 2)

March 11<sup>th</sup>

- Set up of the NISA Emergency Preparedness Headquarters (Tokyo) immediately after the earthquake
- Establishment of Government Nuclear Emergency Response Headquarters and On-site Emergency Response Headquarters

March 15<sup>th</sup>

- Establishment of Integrated Headquarters for the response to the incident at the Fukushima Dai-ichi NPS (later, renamed as Government-TEPCO Integrated response office)
- Local nuclear emergency response headquarters moved to Fukushima prefectural office from the Off-site center designated by the Basic Plan for Emergency Preparedness

Response to Nuclear Emergency (2/2)	
March 11 <sup>th</sup>	<ul style="list-style-type: none"> <li>● Residents within 3km radius from Unit1 shall evacuate by the PM Directive.</li> </ul>
March 12 <sup>th</sup>	<ul style="list-style-type: none"> <li>● Residents within 20km radius from Unit1 shall evacuate by the PM Directive.</li> </ul>
March 15 <sup>th</sup>	<ul style="list-style-type: none"> <li>● The sheltering stay was enlarged to the area from 20km to 30km from the NPS.</li> </ul>
April 21 <sup>st</sup>	<ul style="list-style-type: none"> <li>● The PM instructed to prohibit the access to the area within 20km radius or to order to leave the area.</li> </ul>
April 22 <sup>nd</sup>	<ul style="list-style-type: none"> <li>● The PM issued the following instruction to the Governor of Fukushima pref, and relevant heads of towns;                             <ul style="list-style-type: none"> <li>-- to establish <u>Deliberate Evacuation</u> as well as <u>Evacuation-Prepared Area</u></li> </ul> </li> </ul>

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Radioactive materials discharge to the atmosphere			
	Assumed amount of the discharge from Fukushima Dai-ichi		
	NISA's estimation(April)	NISA's re-estimation (May)	NSC's estimation <sup>*2</sup>
<sup>131</sup> I	1.3*10 <sup>17</sup> Bq	1.6*10 <sup>17</sup> Bq	1.5*10 <sup>17</sup> Bq
<sup>137</sup> Cs	6.1*10 <sup>15</sup> Bq	1.5*10 <sup>16</sup> Bq	1.2*10 <sup>16</sup> Bq

\*1: Estimation by NISA is based on the numerical analysis of accident transient  
 \*2: NSC calculated backward of monitoring data to estimate the amount of discharge

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### Radioactive material discharge to seawater (1/2)

**(1) Outflow from Unit 2**

- On April 2nd, the outflow from the crack with a length of around 20 cm in the concrete portion of the lateral surface of the pit into the sea was confirmed.
- ➡ On April 6, the outflow was confirmed to stop

Amount of spilled water: 520 tons  
Quantity of radioactivity : 4700 teraBq

**Countermeasures**

- Drilled a hole into the pit and injected water glass (sodium silicate) into the pit.

**(2) Water leakage from Unit 3**

- On May 11<sup>th</sup>, TEPCO found some water was flowing into the pit through cable conduit at Unit 3.
- ➡ On the same day, the outflow was confirmed to stop

Amount of spilled water: 250 tons  
Quantity of radioactivity : 20 teraBq

**Countermeasures**

- Inserting fabrics and filling concrete inside pit
- Reconfirmation of other leakage possibilities.
- Strengthening the monitoring

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### (Ref.) Radioactive water and counter measures

**Intentional discharge of radioactive water**  
from sub-drain of Unit 5&6

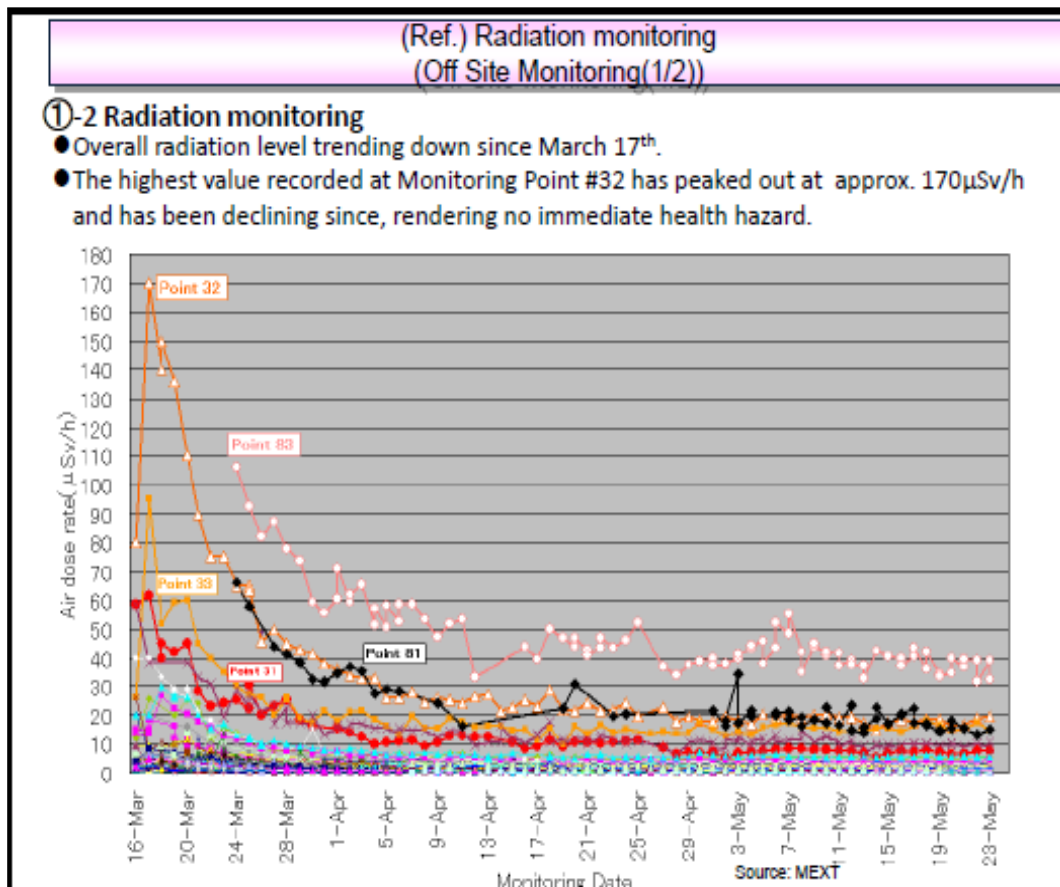
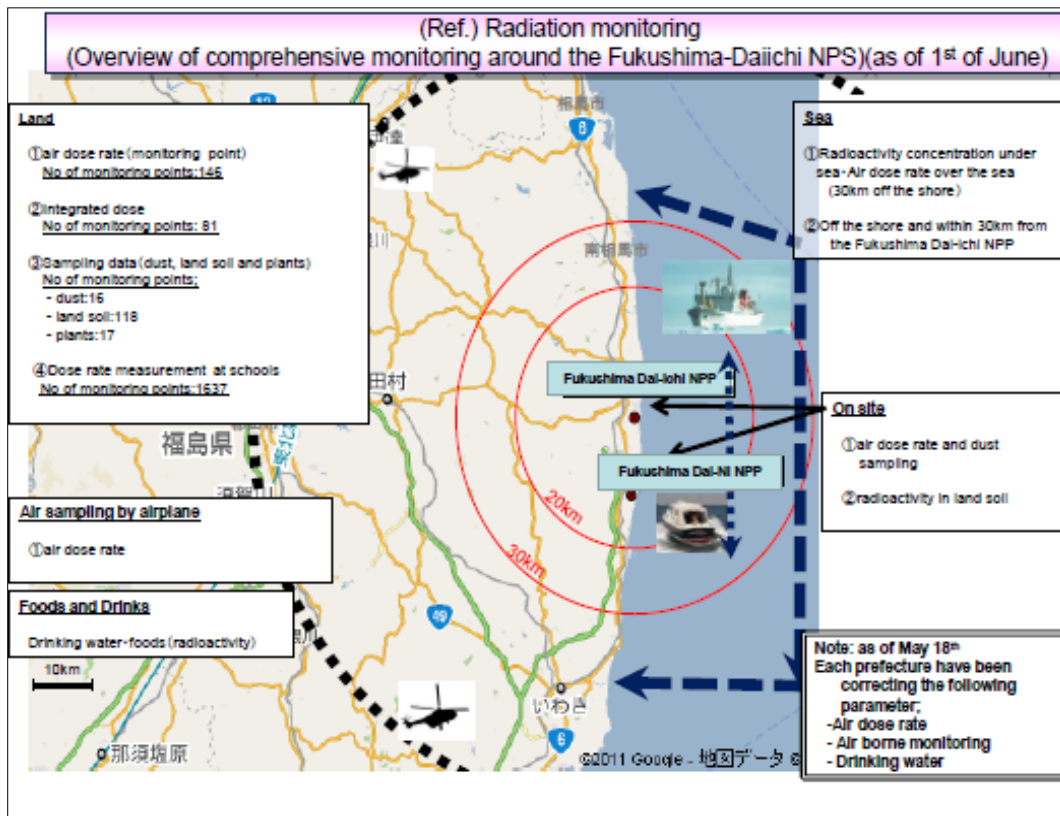
**Leakage of Highly radioactive water**

**Intentional discharge of radioactive water**  
from radiation Waste treatment building

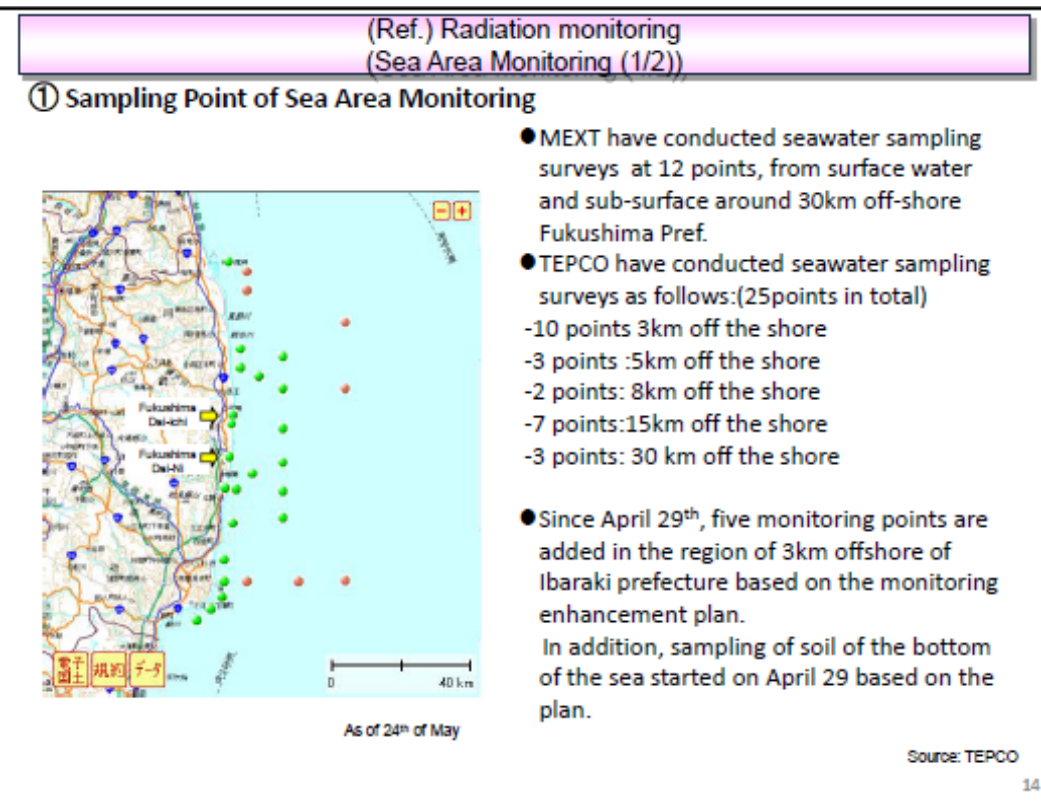
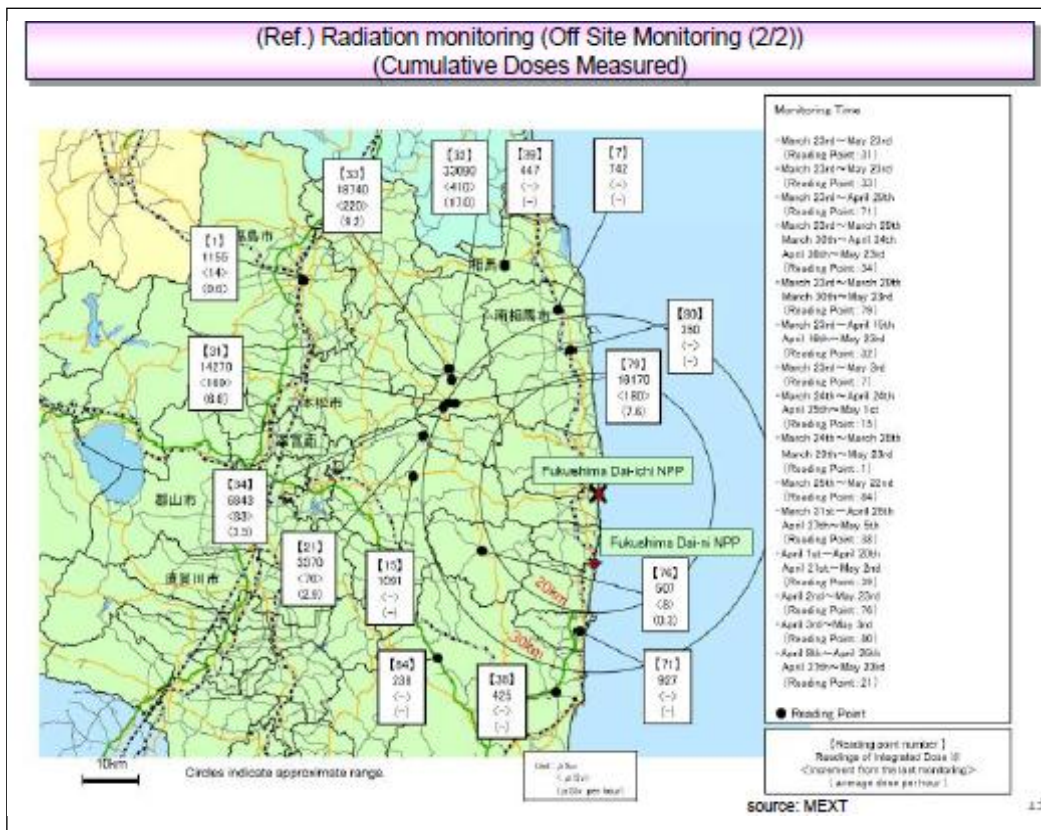
- Large-sized Sandbags (finished on Apr. 17)
- Silt fence (Finished on Apr. 14)
- Steel plate insulation (Finished on Apr. 15)
- Sandbags containing Zeolite (in operation)
- Sheet Pile (under planning)
- Sliding timber weir (under planning)

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Status of Radiation exposure
<p><b>(Residents)</b></p> <ul style="list-style-type: none"><li>● Fukushima Prefecture has started the screening from 13 March.</li><li>● Up until May 31st, the screening was done to 195,354 people.</li><li>● All 1,149 children who went through thyroid gland exposure evaluation received the results lower than the screening level.</li></ul> <p><b>(Workers)</b></p> <ul style="list-style-type: none"><li>● To date a total of 30 people have registered exposure dose above 100mSv.</li><li>● The internal exposure measurement of the radiation workers has been delayed. The exposure dose of a certain number of workers could exceed 250mSv.</li></ul>

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Cooperation with international communities
<ul style="list-style-type: none"><li>● A lot of valuable advices of experts from the US, France, Russia, The Republic of Korea, China and the UK as well as IAEA, and OECD/NEA</li><li>● Japan also received supports including materials required for taking measures against nuclear accidents.</li></ul>

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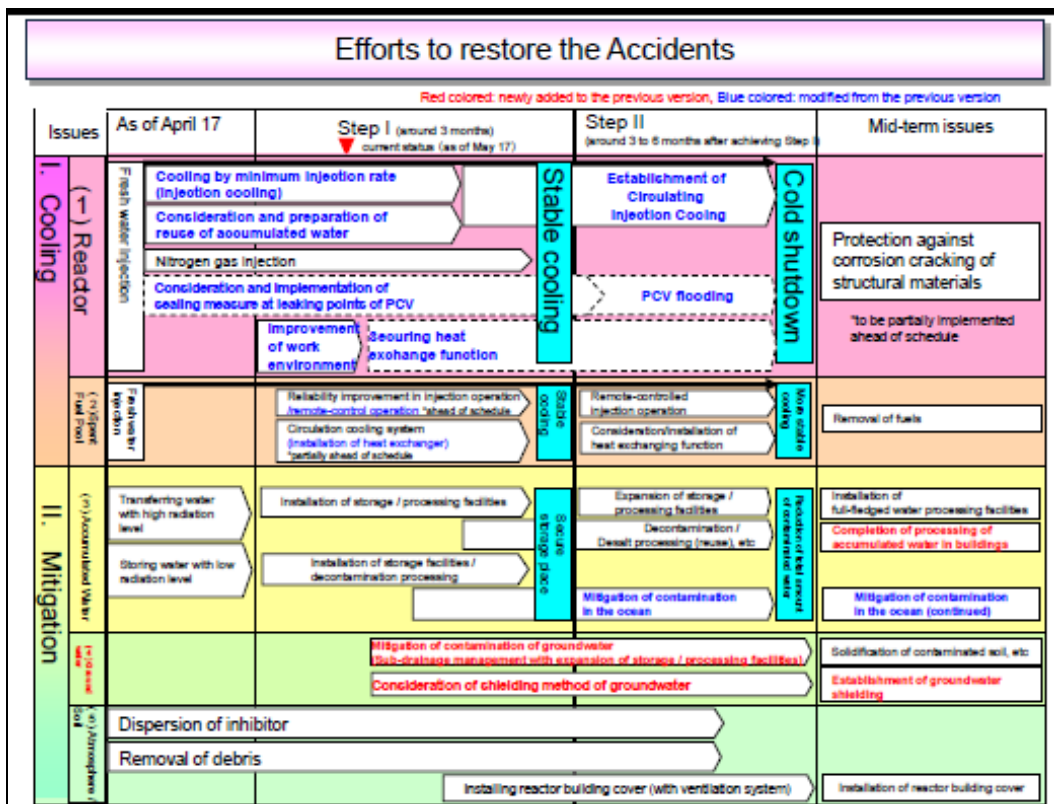
## Communication regarding the accident

### Information Provision to the international community

- ENAC Website
- IEC (IAEA)
- Foreign Media Briefing
- Briefings for Diplomatic Representatives in Tokyo
- English information on the Web


We are also sharing the information with international communities through international conferences and meetings in IAEA, OECD/NEA etc.

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**Responses in other NPS (1/2)**

- NISA instructed each electric utilities to implement emergency safety measures drawn from the 2011 Accident at Fukushima Dai-ichi and Dai-ni NPS(March 30<sup>th</sup>)



- Based on the report from each electric utilities, NISA has confirmed that emergency safety measures had been appropriately implemented.

(1) Short-term Measures

- Measures against Loss of All AC Power Supply were confirmed.
- ➡ ● Securing Power Supply in Case of Emergency through confirming the power cars, etc.
- Securing Heat Removal Function in Case of Emergency through confirming the pump trucks, etc.
- Implementation of Checks for Machines and Equipment as well as Drills

- Measures against Inundation of Buildings will be implemented till the end of May.

- ➡ Planning measures against inundation so that machines and equipment mentioned above will not be impacted by tsunami.

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**Responses in other NPS (2/2)**

(2) Mid- to long-term Measures

- Measures to Improve Reliability by Speeding Up the Cold Shutdown will be implemented.
- ➡ ● Securing Back-up Equipment for Seawater Pump Motors, etc.  
[implementation within about 1 year]
- Establishment of Air-Cooling Type Emergency Generators  
[implementation within about 1-2 years]
- Measures to Protect Against Tsunami will be implemented.
- ➡ Building Tide Embankments, Building Seawalls around Buildings, Increasing Water Tightness Around Buildings  
[implementation within 2 to 3 years]

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### Lessons learnt so far from the accidents(1/2)

- Strengthening preventive measures against a severe accident
  - Strengthening measures against earthquakes and tsunamis
  - Secure power supply
  - Secure robust cooling functions of a reactor and a PCV etc.
- Enhancement of response measures against severe accidents
  - Enhancement of prevention measures of hydrogen explosion
  - Enhancement of containment venting system
  - Improvement of accident response environment etc.

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### Lessons learnt so far from the accidents(2/2)

- Enhancement of nuclear emergency response
  - Response to combined emergency of both large-scale natural disaster and prolonged nuclear accident
  - Reinforcement of environment monitoring
  - Establishment of clear division of labor between relevant central and local organizations etc.
- Reinforcement of safety infrastructure
  - Reinforcement of safety regulatory bodies
  - Establishment and reinforcement of legal structure, criteria and guidelines
  - Human resources for nuclear safety and emergency preparedness and response etc.
- **Raise awareness of safety culture**

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• ***Thank you very much!***

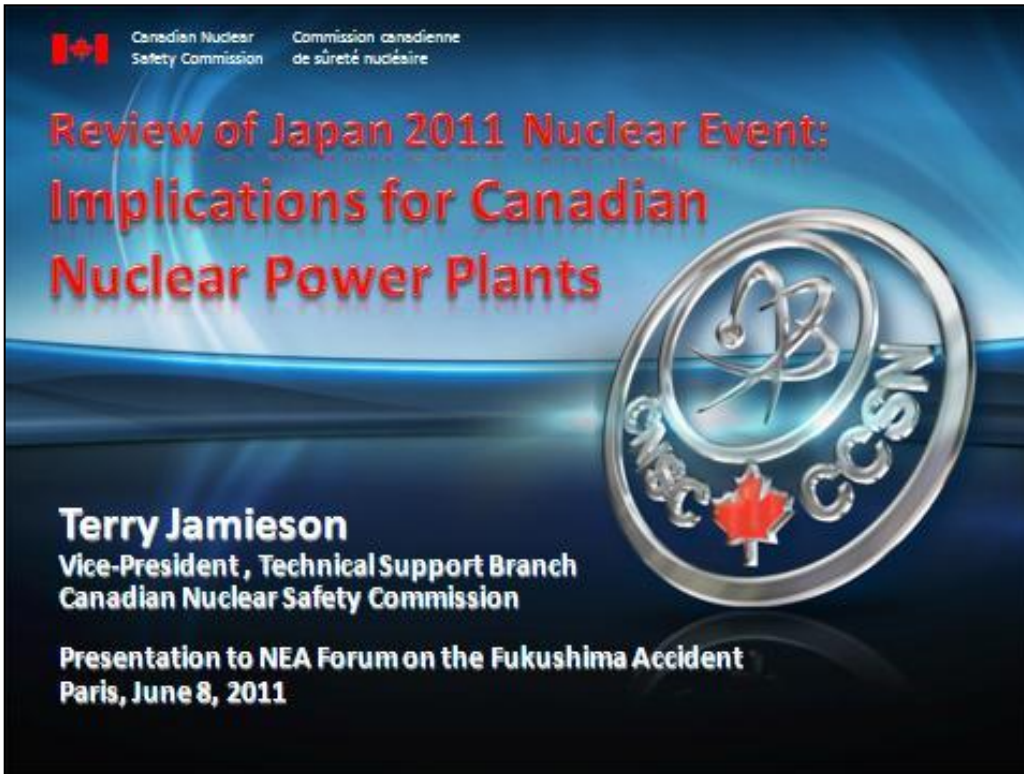
(Reference)

The access to the report:

[http://www.kantei.go.jp/foreign/kan/topics/201106/iaea\\_houkokusho\\_e.html](http://www.kantei.go.jp/foreign/kan/topics/201106/iaea_houkokusho_e.html)




*Terry Jamieson, CNSC, Canada*



**Canadian Nuclear Safety Commission** / **Commission canadienne de sûreté nucléaire**

# Review of Japan 2011 Nuclear Event: Implications for Canadian Nuclear Power Plants



**Terry Jamieson**  
Vice-President, Technical Support Branch  
Canadian Nuclear Safety Commission

Presentation to NEA Forum on the Fukushima Accident  
Paris, June 8, 2011



## Presentation Outline

- ✦ What we have done to date
  - How are we learning?
- ✦ Initial lessons learned
  - Domestic
  - International
- ✦ Path forward

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## CNSC Initial Response to Fukushima

**Domestic:**

- Activate Emergency Operations Centre and staff Nuclear Emergency Organization
- Create a Japan Executive Team (senior CNSC executives)
- 24-7 operation with Technical, External Liaison, Communications and Logistics teams
- Worked closely with other federal and provincial governments

**Internationally:**

- Established links with USA, UK, FRA regulators
  - Daily teleconferences
  - Information exchange and validation
- IAEA
  - CNSC access to IAEA secure emergency info web site
  - Canadian mission at IAEA in Vienna (VPERM)
- Two Canadian experts to Vienna to support IAEA
  - CNSC
  - AECL

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## How We Are Learning

- 12(2) Request to Industry
- CNSC Task Force
- External Review of Process

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## CNSC's Request Under 12(2)

- ◆ Address CNSC's request for information as committed in the initial response to the 12(2) letter:
  - *“review initial lessons learned from the earthquake in Japan and re-examine the safety cases of nuclear power plants, in particular the underlying defence-in-depth concept, with focus on:*
    - external hazards such as seismic, flooding, fire and extreme weather events;
    - measures for prevention and mitigation of severe accidents;
    - emergency preparedness; and
  - *report on implementation plans for short-term and long-term measures to address any significant gaps”*
- ◆ Report on implementation plans should:
  - provide a plan and schedule for completion of short-term and long-term measures
  - identify measures that have already been put in place
  - identify any previously planned activities that have been accelerated as part of the lessons learned

## CNSC's Request Under 12(2)

- ◆ Review initial lessons learned, with focus on:
  - External hazards such as seismic, flooding, fire and extreme weather events
  - Measures for prevention and mitigation of severe accidents
  - Emergency preparedness
- ◆ Report on implementation plans for short and long term to address any significant gaps

## CNSC's Request Under 12(2): Licensees' Responses

### ✦ Licensees' responses to date:

- provided requisite initial response, identifying proposed plans and schedule to meet CNSC's request
- concluded that overall safety case remains strong
  - but continue to identify potential improvements
- accelerated implementation, especially in severe accident management and emergency preparedness

## CNSC's Task Force: Mandate

- ✦ Evaluate operational, technical and regulatory implications of the Japan 2011 events
- ✦ Focus on plant, spent-fuel pool and site behaviour, taking into account:
  - external hazards and common mode events that could impact Canadian NPPs
  - accident progression where different levels of protection are assumed failed
  - severe accident management
  - off-site emergency response
  - regulatory requirements

## CNSC's Task Force: Outputs

- ✦ Identification of potential design and operational measures to minimize risk associated with severe accidents (likelihood and consequences)
- ✦ Priorities for implementation of risk control measures
- ✦ Recommendations for potential changes to CNSC's regulatory requirements

## Risk Assessment

- ✦ An extended stress test
- ✦ Focus on consequences
- ✦ External events:
  - Will include man-made events
  - No random combinations: must be consequential or directly related
- ✦ DBAs/BDBAs/Severe Accidents:
  - Verify margins to core/severe core/containment damage
  - Cliff-edge effects and preventive measures



## Risk Assessment: Severe Accident Scenarios

- ❖ Prolonged Loss of Heat Sinks:
  - loss of electrical power, service water, etc.
  - other consequential failures (e.g. LOCA)
- ❖ Progressive failure of back-up supplies, for example:
  - loss of electrical power (up to station blackout)
  - loss of service water
- ❖ Containment bypass
- ❖ Multi-unit events

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## Severe Accident Management (SAMG)

- ❖ Prompt completion of station-specific SAMGs:
  - Identify what equipment can be used for severe accident mitigation and where it is located
  - Identify what can and cannot be done (equipment survivability, capability, accessibility) based on experience and judgment
  - Develop Enabling Instructions, etc.
  - Consider multi-unit conditions, where necessary
- ❖ Consider Regulatory Guide G-306: *Severe Accident Management Programs for Nuclear Reactors*

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## Severe Accident Management (cont'd)

### ✦ Station-specific SAMGs:

- Assessment of station's instrumentation performance under severe accident conditions
- Safety analyses to validate selected strategies for severe accident management and support: SAMG entry criteria, Identification of challenges (e.g. to containment), Estimation of timing of challenges, Identification of system requirements to mitigate challenges, etc.
- Identification and evaluation of possible design modifications for accident mitigation
- Interface with Provincial and Municipal Emergency Management Organizations

## Severe Accident Management (cont'd)

### ✦ Off-Site Support for SAMGs:

- Provision of external supplies and mobile devices, including:
  - water, fuel, power, people
- Inter-utility cooperation and support

## External Review

- ✦ Review team members to be chosen from outside the nuclear industry
- ✦ To review adequacy of CNSC's processes and confirm that they were followed
- ✦ Not a technical review

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## Initial Lessons Learned - CANDU/Domestic

- ✦ Some CANDU Specifics
  - Venting
  - Multi-unit events
  - Implementation of hydrogen recombiners
  - Completion of severe accident management guidelines
- ✦ Emergency Management in Canada
  - Exercising agency interfaces
  - Communicating with stakeholders
    - The Internet Age
  - Personnel
  - Source term modelling

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## Initial Lessons Learned-International

- International Events
  - Domestic plans and international events
  - Preparing for cross-boundary events
- Generic Technical Observations
  - Off-site support for SAMGs
  - Inter-utility cooperation and support
  - Formalizing support arrangements

## Path Forward

- Completion of the task force report
- Validation of our findings:
  - External review panel
  - IRRS
  - CNS Extraordinary Review Meeting
- Implementation: short/medium/long term

## Concluding Remarks

- ✦ Detailed and in-depth program
- ✦ Our licensees have completed all required short-term actions
- ✦ Canadian facilities are safe
- ✦ Potential improvements areas noted
- ✦ Independent reviews
- ✦ Canada looks forward to learning with our partners

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**We Will Never  
Compromise  
Safety...**

**...It's In Our DNA!**







*Jean-Christophe Niel, ASN, France*



**First lessons learnt and subsequent first actions taken in France**

*Forum on the Fukushima Accident: Insights and Approaches*

Jean-Christophe NIEL  
ASN Director General

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**Content**

- **Crisis Management In France**
- **ASN actions: Complementary Assessment**
- **ASN actions: Inspections**
- **Consultation Process**
- **Summary**

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## Content

- **Crisis Management In France**
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## Crisis Management in France ASN responsibilities

- **In an emergency situation, ASN's responsibilities, with the support of IRSN, are :**
  - to ensure that adequate and relevant actions are undertaken by the licensee;
  - to advise the Government about emergency measures;
  - to inform the media and the public;
  - to act as competent authority within the framework of the international conventions.


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## Crisis Management in France ASN & the Fukushima accident

- An important crisis: a severe nuclear accident in a major natural disaster
- Extremely weak radiological consequences in France foreseen and measured, strong mediatic pressure
- Necessity to adapt the objectives of the ASN emergency center
- From 11 march to early April 2011, ASN emergency triggered on a 24/24h basis to:
  - get information
  - analyze this information
  - advice the Government:
    - French citizens in Japan
    - Importation of goods
    - Impact of radioactive plume on french territories
  - inform the media and the public

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## Crisis Management in France Key facts

- 24/24h ASN emergency center during one month,
- Up to 20 people in the center; more than 200 of ASN staff (on 450) participated
- Daily phone conferences with IRSN, French Embassy in Japan, French institutions, foreign counterparts, etc.
- Numerous meetings with government, parliament,...
- 18 press conferences / 28 press releases
- Local and national communications
- Devoted website
- Hotline for the public
- Reinforced monitoring of the environment

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## Crisis Management in France First lessons learnt

- **Facing a long term crisis**
  - Need for important human resources due to shifts
  - Ensuring the management of ASN on on-going activities
  - Need to ensure coordination between ASN, IRSN and other stakeholders
  - Rethinking the configuration and the organization of the ASN Emergency Center
  - Importance of anticipating post-accidental measures

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## Crisis Management in France First lessons learnt

- **Facing a major media crisis**
  - Need for a large number of trained staff,
  - Need for available background information on foreign nuclear installations
  - Need for a specific organization
- **Facing an international nuclear crisis**
  - Need for an enhanced coordination between regulatory authorities at European (EC...) and international (IAEA, NEA...) levels


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## Crisis Management in France First lessons learnt

- **Facing an unexpected situation:**
  - Extreme external hazard
  - Severe accident
  - Several plants
  - Devastated surroundings
- Reassessment of safety margins in the case of events challenging safety functions and leading to severe accidents
- Evaluation of the nuclear installation response facing “beyond design basis situations” (weak point and cliff-edged effect identification)
- Identification and implementation of improvements.

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## Content

- Crisis Management In France
- **ASN actions: Complementary Assessment**
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## ASN actions: Complementary Assessment

### A necessary experience feedback

- After major accidents (TMI, Tchernobyl, Fukushima) experience feedback has to be drawn
- Long process (10 years)
- Need to start now: the complementary safety assessment (CSA)
- *“A targeted evaluation of safety margins with regards to the Fukushima events”*: weak point and cliff-edged effect
- All facilities

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## ASN actions: Complementary Assessment

### A necessary experience feedback

- **5 Issues :**
  - Flooding hazards,
  - Seismic hazards,
  - Total loss of electricity supply risks,
  - Total loss of heat sink risks,
  - Operating management of accidental situations.
- Complementary safety assessment of existing dispositions implemented by Licensees (under the ASN control)
- Examination for each installations if improvements / modifications are necessary
- An answer to the French Prime Minister

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## ASN actions: Complementary Assessment European Stress Tests

- Review of the safety of the 143 EU nuclear plants, on the basis of a comprehensive and transparent risk and safety assessment (“stress tests”)
- Based notably on WENRA proposal, ENSREG and the EC developed the stress test scope and modalities in the light of lessons learned from the accident in Japan
- Conducted by Regulatory Bodies and through peer reviews
- Outcome/subsequent measures should be made public
- Assessment of initial findings by the end of 2011

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## ASN actions: Complementary Assessment Consistency between the two approaches

FRANCE		EUROPE
15 Sept. 2011	Licensee reports <i>(on the basis of existing safety studies &amp; specific engineering studies)</i> + French Complementary requests	15 August 2011 Progress report
		31 Oct. 2011 Final report
15 Nov. 2011	National reports + French Complementary Assessment	15 Sept. 2011 Progress report
Early Dec. 2011	ASN's Resolutions	9 Dec. 2011 - European Council Meeting Initial findings
	all nuclear facilities organizational and human factor, specific attention given to	31 Dec. 2011 Final report

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## Content

- Crisis Management In France
- ASN actions: Complementary Assessment
- **ASN actions: Inspections**
- Consultation Process
- Summary

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## ASN actions: inspections

- All the nuclear facilities inspected before november 2011
- **5 Issues :**
  - Protection against
    - flooding hazards,
    - seismic hazards,
    - total loss of electricity supply risks,
    - total loss of heat sink risks,
  - Operating management of accidental situations.




## Content

- Crisis Management In France
- ASN actions: Complementary Assessment
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## Consultation Process Stakeholder involvement

*National level: High Committee for Transparency and Information on Nuclear security (HCTISN)*

- *Local level: Local information committee (~ 1 per major nuclear installation) (CLI)*

- HCTISN consultation on ASN decision on Complementary Safety Assessment and on the ASN resolution
- HCTISN/CLIs members can participate in ASN inspections as observers
- HCTISN / CLIs information during the CSA
- Foreign counterparts attend to standing group meeting

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## Content

- Crisis Management In France
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- **Summary**

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## Summary

- Experience feedback necessary
- First step of a long process (10 years)
- Manifold:
  - **Crisis management**
  - **Complementary Safety Assessment**
    - Ensuring maximum consistency between national and European approaches
    - Focused as a first priority on safety issues raised by the Fukushima accident, which have to be urgently investigated
- Including extensive consultation with stakeholders

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*Choul-Ho Yun, KINS, Korea*

*Fukushima Forum, 8 June 2011, Paris, France*

# **Fukushima Accident: Its Impact and Actions taken in Korea**

**Choul-Ho Yun**  
**Korea Institute of Nuclear Safety**

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## 1. Introduction

- In Korea, as the closest neighbor country to Japan, **increasing concerns about nuclear safety** overshadowed the entire society.
- Under this circumstance, regulatory body had to deal with media request and public concern every day and night to calm down the surge of worries toward nuclear safety.



## Status of Nuclear Power in Korea and Region



	Operating	Const.	Planning
Korea	21	7	2
Japan	54	2	12
China	14	26	26
Taiwan	6	2	-



## 2. Impact of Fukushima Accident on Korea

- ❑ **Uprising negative public opinions on the nuclear energy**
  - ❖ Strong concerns about the nuclear safety
  - ❖ Sensitive reactions on the radiation risks
- ❑ **Mass media effect**
  - ❖ Hourly flash news on the Fukushima thickening the confusion and anxiety
  - ❖ Reasonable explanation overshadowed by exaggerated radiation risks
- ❑ **Revitalization of Anti-nuclear movement**

## 3. Actions taken after Fukushima Accident

- ❑ **Activation of Emergency Response Team**
- ❑ **Crisis communication with public**
  - ❖ Operation of Media Service Center & Call Center 24/7
  - ❖ Press Releases, Press Conferences, Interviews, e-mails, etc.
  - ❖ Daily Information Updates on the Web-Portals on the safety information
- ❑ **Strengthening Environmental Radiation Monitoring and public release**
- ❑ **Special Safety Inspection on Nuclear Facilities**



## Environmental Radiation Monitoring

### □ Strengthening the environmental radiation monitoring using 70 monitoring posts

#### ❖ 1<sup>st</sup> Stage Monitoring (March 11 ~)

- Dose Rate: 15 → 5 min
- Air Borne Dust: Monthly → weekly
- Continuous Air Current Analysis

#### ❖ 2<sup>nd</sup> Stage Monitoring (March 28 ~)

- Air Borne Dust: weekly → daily
- Sample Analysis for the Rain
- Sample Analysis\* for the Sea water & Marine life, Soil, etc.

## Radiation Monitoring Results

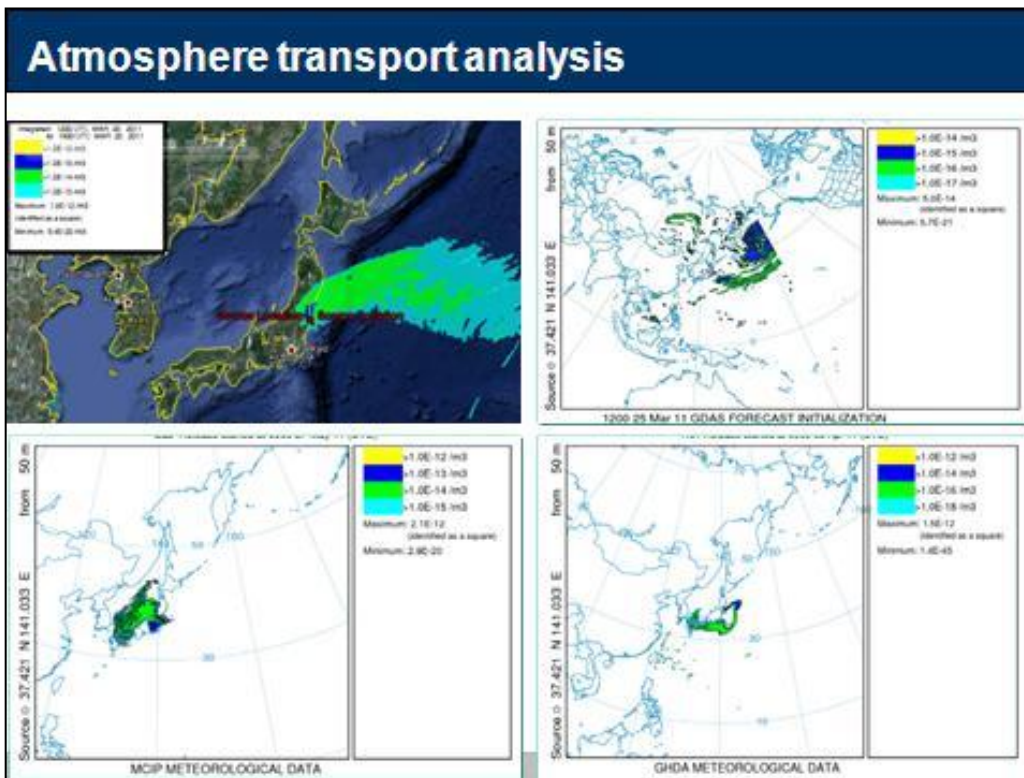
### □ Radiation Monitoring Results

- ❖ I-131, Cs-134, and Cs-137 were detected in both airborne and rain in Korea after Fukushima accident.
- ❖ Public were very sensitive to the fact that the radioactive materials were detected in Korea

Sample	Isotopes	Date	Max. Value	Rel. Exposure Dose to 1 mSv/year
airborne	I-131	6 April	3.12 mBq/m <sup>3</sup>	1/3323
	Cs-134	7 April	1.19 mBq/m <sup>3</sup>	1/3195
	Cs-137	7 April	1.25 mBq/m <sup>3</sup>	1/1548
rain	I-131	7 April	2.81 Bq/L	1/22*
	Cs-134	11 April	1.67 Bq/L	1/43*
	Cs-137	11 April	2.02 Bq/L	1/52*

\* Assume that adult drinks 2 liters water everyday for 1 year.





## Special Safety Inspection

- Special Safety Inspection for Nuclear Facilities on 21 operating NPPs and 1 research reactor considering an unlikely worst case scenario;**
  - ❖ An extreme natural disaster (earthquake + tsunami) hit the NPPs;
  - ❖ Loss of Emergency D/G and external power
  - ❖ Severe accident is to take place.
  
- The objective of this special safety inspection is to provide a firm answer to the public;**
  - ❖ how well the NPPs are designed against natural disasters;
  - ❖ how well they can mitigate the severe accident;
  - ❖ how much effective the emergency response system are in place.

## Special Safety Inspection

### □ Inspection Areas

- ❖ Structural Integrity (Seismic & Tsunami Resistance)
- ❖ Reliability of Electrical Power and Cooling Systems
- ❖ Response to Severe Accidents
- ❖ Effectiveness of SAMG
- ❖ Emergency preparedness and medical treatment

### □ As inspection results, **50 safety improvement items** were selected to avoid nuclear disaster like Fukushima at any case;

- ❖ Minimize the impact of extreme natural disaster;
- ❖ Make available emergency power and ultimate heat sink at any case;
- ❖ Eliminate the likelihood of severe accident and avoid hydrogen explosion

## Inspection results

### □ Major Findings:

- ❖ Sufficient safety margin exists for all units against maximum potential earthquake and maximum potential sea levels
- ❖ To cope with loss of offsite-power, 2 EDGs per unit + Alternative AC
- ❖ Severe accident management guidelines had been prepared for all units
- ❖ Multiple sources of water for emergency cooling of spent fuel pit
- ❖ Appropriate emergency measures, including organization, facilities, protective action guidelines

## Inspection Results

### ❑ Major Improvement Items:

- ❖ Reevaluation of seismic capability of safe shutdown system such as shutdown cooling system, residual heat removal (RHR), etc. and strengthening system to a level of new reactor's design earthquake (0.3g).
- ❖ To install water-proof door and water-proof drain pump in relevant facilities to prevent flooding of emergency power systems and major safety system
- ❖ To cope with a flooding, a car equipped with mobile emergency generator and battery will be deployed in a safe place
- ❖ To cope with the loss of cooling for spent fuel pool, a countermeasure includes supplying makeup water using fire engine
- ❖ To install passive hydrogen removal equipment to prevent hydrogen gas explosion
- ❖ To be equipped with venting/depressurization device to cope with pressure buildup in containment during severe accident
- ❖ To modify the 'radiological emergency plan' for an emergency response organization to be set up considering multiple emergency, and to have declaration criteria considering magnitude of tsunami

## Future Actions

- ❑ Korean Licensees should submit the detailed action plans by coming August.
- ❑ The details of the Korea's action items will be modified and updated in consideration of internationally agreed post-Fukushima actions.
- ❑ Internationally cooperated research & developments are strong required including severe accident, spent fuel, and emergency preparedness.



## 4. Crisis Communication with Public

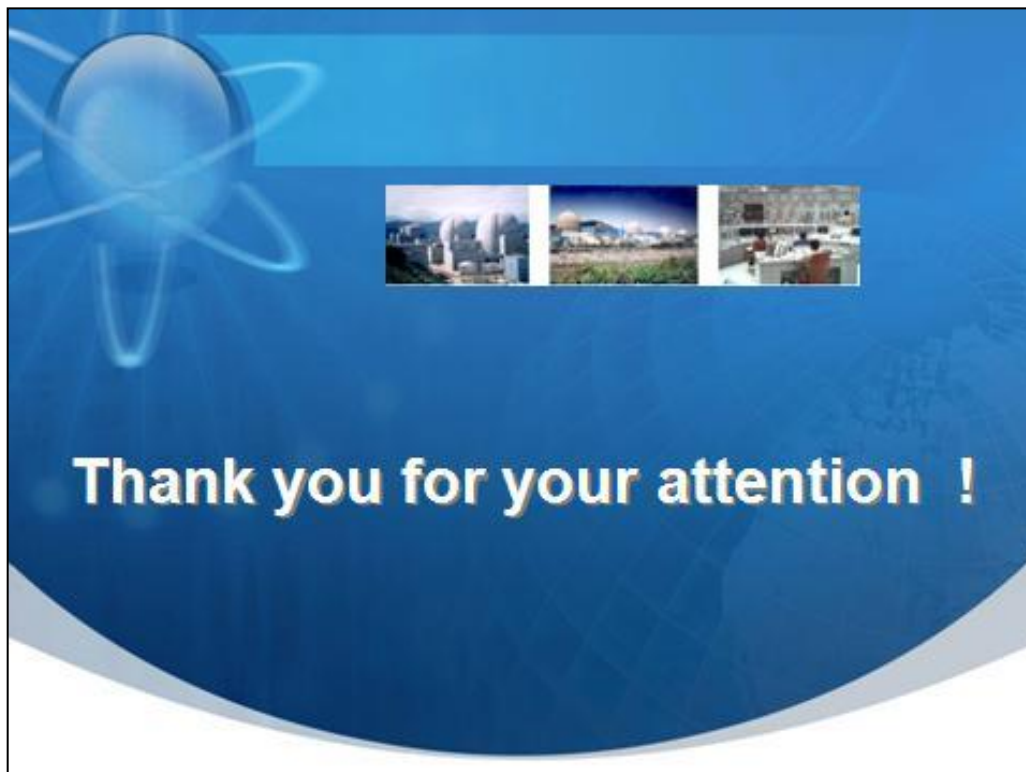
- ❑ Activities dedicated to deal with high demand of media requests and public concern;
  - ❖ Received 8,600 calls (12 March~31 May)
  - ❖ Number of hits of the website
    - 3,595,860 visits (12 March~31 May)
    - Peak (4~10 April): Radioactive Rain Effect
    - Normally 8,845 visits per year
  - ❖ 152 Interviews / 9 Press Releases
  - ❖ 104 Press Releases / 200 Media Visits
- ❑ Q&A activities to deal with rumors in the internet and to correct them in order to prevent the public from misunderstanding of the situation

## International Cooperation

- ❑ Participation in IAEA Activities:
  - ❖ Fukushima Accident Coordination Team- Fukushima Radiological Assessment Team (4-15 April)
  - ❖ Fact finding Mission (24 May-1 June)
- ❑ Strengthening Cooperation with Japan
  - ❖ Support to Emergency team to Sendai (18-23 March / 1 expert)
  - ❖ Korea-Japan Expert Meeting (12-13 April / 7 experts)
  - ❖ Expert Dispatch to Japan [JNES] (18 May- / 1 expert)
  - ❖ Technical support to Korea Embassy (20 March- / 3 experts)
- ❑ Korea-Japan-China Summit
  - ❖ Tri-lateral cooperation for nuclear safety was highly emphasized
  - ❖ Top Regulators' Meeting (TOR) is newly recognized as a practical and tangible cooperation framework for three countries.

## 5. Concluding Remarks


- ❑ Immediately after Fukushima accident occurred, Korean RB has taken actions in response to public concerns
  - ❖ Emergency Response Team was set up;
  - ❖ Environmental radiation monitoring was strengthened;
  - ❖ Safety information released to the public through various channels;
  - ❖ A special safety inspection was conducted for nuclear facilities
- ❑ Those prompt regulatory actions are very important to reduce the uprising public concerns.
- ❑ Effective skill of crisis communication with public and also international community should be more developed.
- ❑ The international cooperation for obtaining lessons learned from Fukushima accident should be more emphasized.





*Laurent Stricker, WANO*

**World Association of Nuclear Operators**



**AFTER FUKUSHIMA:**  
**“Strengthening  
Global Nuclear Safety”**

**NEA Forum OECD Centre, Paris – June, 8 2011**

***Introduction***

**Difficult time for Nuclear Industry**





## *March 11, Earthquake and Tsunami*



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## *Nuclear Landscape*

Pause in Nuclear development

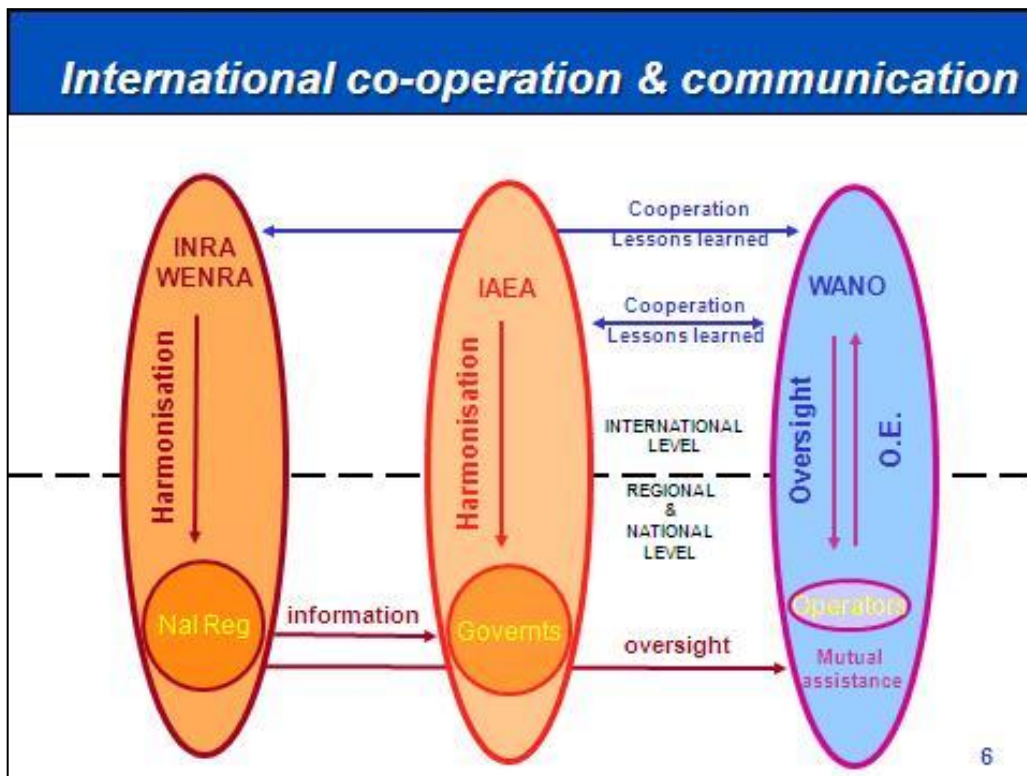
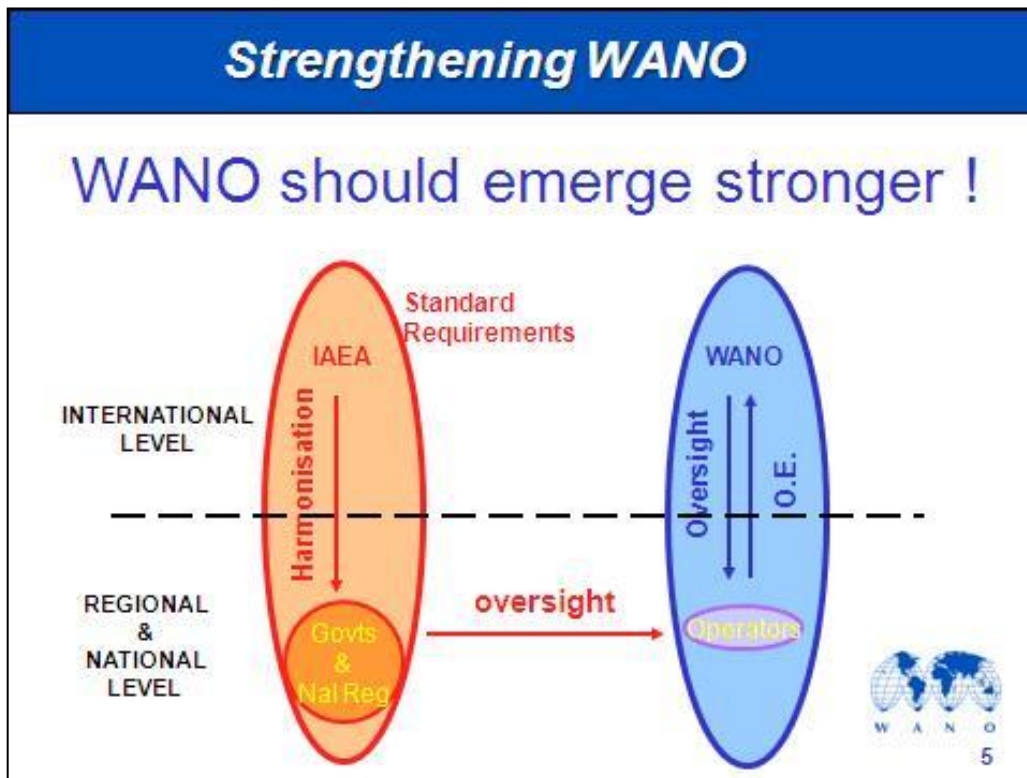
**but**

**Energy demand worldwide  
remains !**



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## ***What does Nuclear Safety mean ?***

**The three Safety Functions**

- Control of reactivity / stored energy**
- Core Cooling / decay heat removal**
- Containment / radiation & radioactive waste**



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## ***Safety functions in Nuclear accidents***

**Reactivity**

~~**Cooling**~~

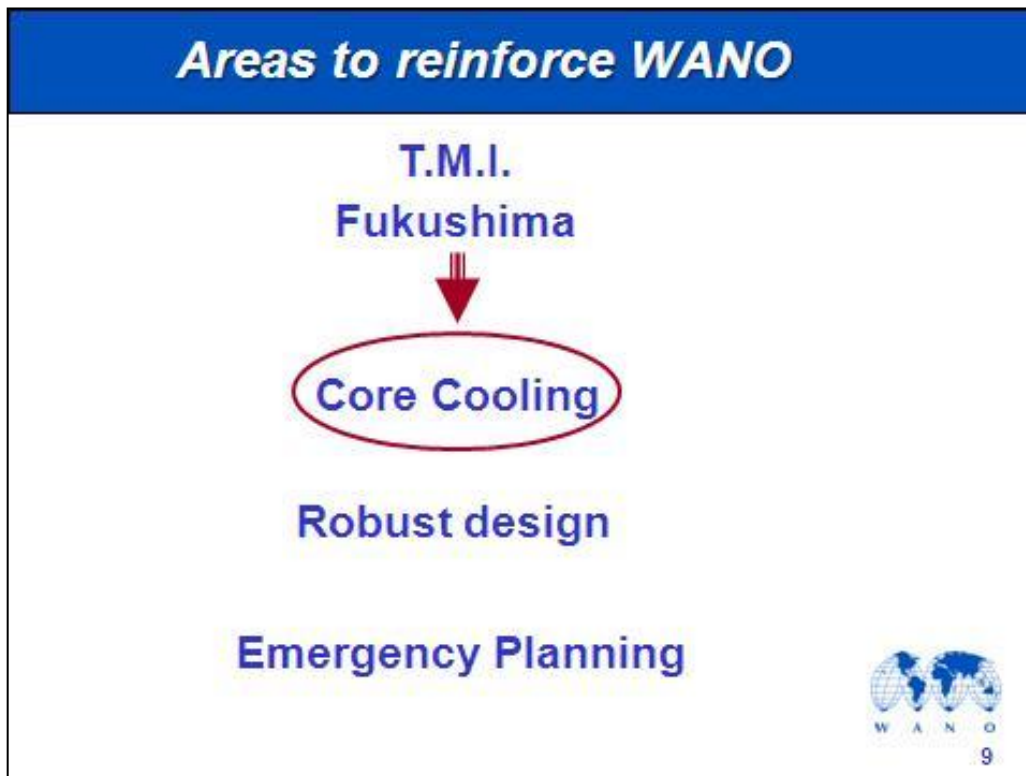
**Containment**





**T.M.I.  
Fukushima**



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- What did WANO do since March 11 ?**
- Within the first days after the earthquake and tsunami, WANO:
  - Sent members daily situation updates
  - Provided additional resources to WANO TC
  - Provided TEPCO information on available member equipment & supplies
  - WANO / INPO issued SOER (17/03/11)
  - WANO issued Press Releases
  - WANO asked TEPCO & IAEA to participate in their fact-finding mission.
- 
- 
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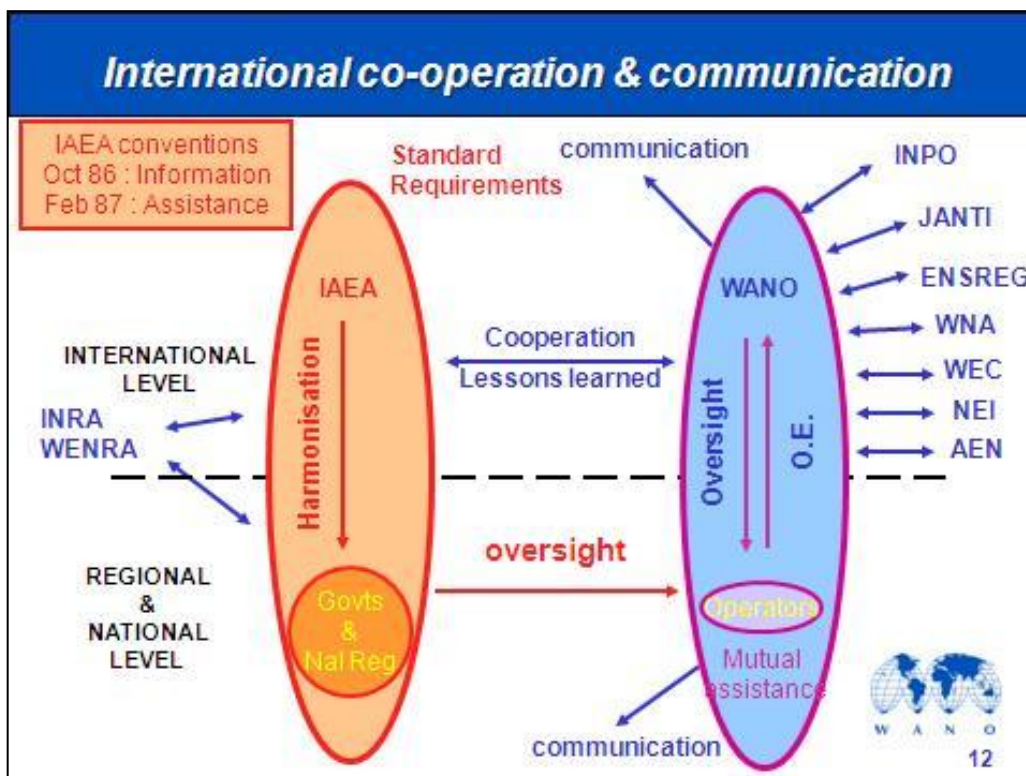
## WANO possible changes

**WANO will:**

- **Better define the roles and responsibilities in an emergency**
- **Add emergency preparedness as a core review area**
- **Look at fuel storage including fuel pools and dry cask storage**
- **Look at some aspects of Design**



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### ***Additional thoughts***

Risk of loss of trust by the public

Risk of loss of trust by nuclear workers

Risk of over-confidence of some operators



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### ***WANO's conclusion***

The Nuclear landscape will be different

→ WANO must change

Credible regulator / Strong WANO

Guard against Complacency

Emergency Preparedness &

Managing Decay Heat

WANO members trust and


shared obligations



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**WANO's conclusion**

**WANO  
stronger  
and  
more effective**



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**World Association of Nuclear Operators**



**W A N O**

<http://www.wano.info>

**Session 2: Approaches: What Actions Are We Taking?**

*Jukka Laaksonen, STUK, Finland*

3.


NEA Forum on the Fukushima Accident  
Paris, 8 June, 2011

**Focused Safety Assessment of NPP's in the EU**  
Aiming for Improved Protection Against External Hazards

Jukka Laaksonen  
Director General, STUK  
Chairman, WENRA

SÄTEILYTURVAKESKUS • STRÅLSÄKERHETSCENTRALEN  
RADIATION AND NUCLEAR SAFETY AUTHORITY

J. LAAKSONEN  
8 June 2011



**EU Council for Energy, on 21<sup>st</sup> March**

*"Implementing and **continuously improving high standards for nuclear safety is our priority**"*


*"need for an effective response, even though we don't have yet full analysis of the situation in Japan"*

*"response would take the form of a comprehensive risk and safety assessment (so-called stress-test) of nuclear plants in Europe"*

*"the scope and modalities should be developed making full use of the expertise available, notably from WENRA"*

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RADIATION AND NUCLEAR SAFETY AUTHORITY

J. LAAKSONEN  
8 June 2011





## European Council of March 24th and 25th

*“safety of all EU NPP’s should be reviewed, on the basis of a comprehensive and transparent risk assessment (stress tests)”*

*“ENSREG and the Commission to develop the scope and modalities of these tests, making full use of the expertise available, notably from WENRA”*

*“assessments will be conducted by independent national authorities and through peer review”*

*“outcome and any necessary subsequent measures that will be taken should be shared with the Commission and within ENSREG and should be made public; the European Council will assess initial findings by the end of 2011, on the basis of a report from the Commission”*

## WENRA’s policy

WENRA task group prepared the proposal for “stress tests” in the spirit of a policy statement which was signed in December 2005 by all of the WENRA member states:

*“We, the heads of the national Nuclear Safety Authorities, members of WENRA, commit ourselves to a continuous improvement of nuclear safety in our respective countries.”*



## What do we mean by “stress tests”?

We define a “stress test” as a **targeted reassessment of the safety margins** of NPPs in the light of the events which occurred in Fukushima.

Reassessment will be **based on the existing safety studies and engineering judgment** to evaluate the behavior of a nuclear power plant when facing a set of challenging situations.

The results **may indicate a need for additional safety provisions**, being technical or organisational.

It remains a **national responsibility to take any appropriate measures** resulting from the reassessment.

## Some remarks on “stress tests” (1)

- For WENRA this is **not a political process**: the main aim is not to convince the public that nuclear power plants are safe.

- In this process the industry and regulators must have an **objective of enhancing nuclear safety**.

- The process is not Fukushima specific but has wider safety perspective.

- We must recognize that today the external hazards are the main source of nuclear power plant risk if we do not address them properly.

- Each site has its own specific hazards that must be identified and adequately protected against.

## Some remarks on “stress tests” (2)

- The question we must make is not “are our plants safe enough”.
- The right question is “how can we make our plants more safe”.
- The measures to be taken need not be very costly but they need to be effective in enhancing the safety.
- We must do this exercise in a transparent manner and present the end results for open discussion.

## Implementation of “stress tests”

The licensee has the prime responsibility for safety. Hence, it is up to the licensees to perform the reassessments and to send the results and related documentation to their national regulator.

The regulator performs a review of the licensees' submissions and produces a review report which should be published.

*“stress tests” specifications as written and agreed in the ENSREG meeting do not provide unambiguous guidance for report contents and format; provision of harmonized reports needs interaction between national regulators and licensees*

Interactions between European regulators will be necessary, optimum way for conducting peer reviews still remains to be planned and agreed.

## Schedule of WENRA for “stress tests”

Requirements sent to the licensees by June 1.

National reporting schedule:

	Progress report	Final report
Licensee report	<b>August 15</b>	<b>October 31</b>
National report	<b>September 15</b>	<b>December 31</b>

Peer review process starts in the fall 2011, completed by end of April 2012.

The European Commission, with the support of ENSREG, will present a progress report to the EU Council meeting in December 2011.

A consolidated report to the EU Council meeting in June 2012.

## Main issues for reassessment

- Initiating events
  - Earthquake
  - Flooding
  - (Other extreme external conditions challenging the specific site, as decided in each country)
- Consequential loss of safety functions
  - Loss of electrical power
  - Loss of the ultimate heat sink
  - Combination of both
- Severe accident management issues



## Examples of questions in stress tests (1)

- Were the internal and external threats properly taken into account in the design? Should we take different positions in light of today's knowledge and experience?
  - Are the assumptions valid and conservative enough, are the safety margins adequate?
  - Have coincident events / threats been properly considered?
  - Has potential damage to external infrastructure (traffic routes, information transfer) been adequately considered?

## Examples of questions in stress tests (2)

- Has adequate account been taken on all existing possibilities/resources to provide power to the plant and to transfer decay heat from hot and cold reactor core, containment, and spent fuel pool to ultimate heat sink?
  - Are the all available resources kept in continuous readiness by means of regular maintenance and testing?
  - Do operators get adequate training and retraining to use all existing resources?
  - Do operators have written procedures for using these resources?

## Examples of questions in stress tests (3)

- What are the potential means to improve reliability of power supply in exceptional accident conditions?
  - Possibilities to reduce risk of common cause failures in permanently installed onsite power sources (location in leak tight bunkers, diversity in general, diverse means for cooling diesels)?
  - Need and possibilities to extend the independent operating time of AC power sources (fuel supply) and DC batteries (recharging possibilities)?
  - Possibilities for fast provision of reliable dedicated offsite power (e.g. hydro power)?
  - Possibilities to utilize transportable power sources?

## Examples of questions in stress tests (4)

- What are the potential means to improve reliability of decay heat transfer to the ultimate heat sink in exceptional accident conditions?
  - Possibilities to install new systems that do not need electrical power (passive systems, pumps with direct diesel drive)?
  - Possibilities to provide diverse ultimate heat sink (water, air)?
  - Possibilities to increase amount of stored clean water onsite?
  - Possibilities to bring clean water from offsite?

## Examples of questions in stress tests (5)

- Is connection of external power and water supplies to the plant systems ensured with compatible systems?
- What kind of plant modifications could improve fast and easy connection of external systems?

## Examples of questions in stress tests (6)

- Are diverse systems actually diverse in all details?
  - need for water cooling of components in systems that transfer heat to atmosphere as an ultimate heat sink?
  - need for DC power to monitor / control performance of passive systems?
  - could auxiliary systems of diverse equipment be identical and fail when exposed to same damaging environmental conditions (extreme cold, heat)?

## Examples of questions in stress tests (7)

- Is it possible to provide adequate number of competent personnel for each safety critical task, if the accident situation lasts long and concerns more than one plant unit?

## Examples of questions in stress tests (8)

- Is the plant protected against phenomena that could possibly threaten the containment integrity in connection with a severe accident that leads to core meltdown. Among these phenomena are
  - core meltdown in high pressure,
  - hydrogen burn / explosion,
  - molten core penetration,
  - increase of pressure due to steam or non-condensable gases,
  - high temperature.




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## Examples of questions in stress tests (9)

- The question on adequate demonstration of severe accident mitigation needs to be considered more thoroughly in a later stage when Fukushima accident has been finally terminated and adequate information on actual phenomena is available:
  - protection from hydrogen explosion when relieving pressure from nitrogen filled containment
  - keeping the molten core inside the vessel for extended time
- The stress test results are expected soon — emphasis must be in severe accident prevention that does not need time consuming research.

SÄKERHETSKOMMISSIONEN FÖR STRÅLSÄKERHETSCENTRALEN | J. GERRITSEN  
 RADIATION AND NUCLEAR SAFETY AUTHORITY | 9 June 2011




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## Conclusions

The response to be taken in all European countries after Fukushima accident is in line with the policy statement adopted by the national regulators in 2005, and the principle that has been incorporated in 2009 in the European Council Directive setting up a Community framework for nuclear safety:

*“Member States shall ensure that the national framework in place requires licence holders, under the supervision of the competent regulatory authority, to regularly assess, verify and continuously improve, as far as reasonably achievable, the safety of their nuclear installations in a systematic and verifiable manner.”*

SÄKERHETSKOMMISSIONEN FÖR STRÅLSÄKERHETSCENTRALEN | J. GERRITSEN  
 RADIATION AND NUCLEAR SAFETY AUTHORITY | 9 June 2011





Gregory Jaczko, USNRC, United States



## **U.S. NRC Approach and Actions in Response to the Fukushima Accident**

**June 8, 2011**

### **U.S. NRC Actions to Date**

- **Communicating with licensees**
  - Providing information so that licensees can take proactive actions
- **Enhanced inspections**
  - Issued Temporary instructions (TI) to focus on Fukushima-related issues
- **Issued Bulletin**
  - Mitigating strategies



## **Task Force**

- **Systematic and methodical review**
  - Near-term, 90-day review
  - Longer-term review
- **Defense-in-depth approach**
  - Prevention
  - Mitigation
  - Emergency preparedness (EP)



## **Prevention**

- **Design basis events**
  - Seismic, flooding, and other external events
  - Broader focus than seismic/tsunami hazards
- **Beyond design basis events**
  - Survivability of alternating current (AC) power
  - Emergency AC power and distribution
  - Alternative AC sources in the event normal sources are lost



## **Mitigation**

- **Mitigation Goals**
  - Preventing core damage and containment failure
  - Preventing spent fuel damage and mitigating releases
- **Cross-cutting considerations**
  - Emergency operating procedures and guidelines



## **Emergency Preparedness**

- **Considerations from Fukushima**
  - Infrastructure damage
  - Multi-unit events
  - Long-term station blackout
- **National approach**
  - Shared responsibility with other federal agencies, state and local authorities, and private sector licensees



## **International Cooperation**

- **Fukushima-related efforts**
  - Coordinating events and efforts to maximize effectiveness
  - Open exchange of information
- **Broader Efforts**
  - Multilateral activities
  - Bilateral activities




## **Next Steps**

- **Follow-up activities**
  - Evaluate inspection findings
  - Bulletin on mitigating strategies
- **Near-term review**
  - June 15, 2011 – 60-day status briefing
  - July 19, 2011 – 90-day final briefing
  - Final task force report
- **Long-term review**





*Nikolay Kutin, Rostechndor, Russian Federation*




Federal Environmental, Industrial and Nuclear Supervision Service

**Actions to Be Taken in the Russian Federation  
after Fukushima-1 Accident**

Nikolay Kutin,  
Head of Federal Environmental, Industrial and Nuclear  
Supervision Service

Paris, June 6-8, 2010

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**GENERALIZED LESSONS LEARNT FOLLOWING THE  
ACCIDENT (1):**

- Safety analysis shall be as representative as possible:
  - input data used for analysis are to be complete and current;
  - all possible site specific combinations of initiating events are to be considered;

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**GENERALIZED LESSONS LEARNT FOLLOWING THE ACCIDENT (2)**

- Technical emergency measures and means shall:
  - be diverse;
  - cover all possible initiating events of accidents in their combinations;
  - exhibit unconditional availability.
- For the earliest NPP units, compensatory measures shall be developed and implemented.

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**GENERALIZED LESSONS LEARNT FOLLOWING THE ACCIDENT (3)**

- The effectiveness of implementation of organizational emergency measures, including transport routes, emergency communication, shall to be checked:
  - adequacy of emergency measures;
  - protection of emergency measures from external impacts.
- Rules of interaction between the operator, regulator and other public organizations in case of accident shall be in place.

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**GENERALIZED LESSONS LEARNT FOLLOWING THE ACCIDENT (4)**

- Regulatory requirements shall consider all new knowledge. The sad lesson of Fukushima is to be fully taken into account in the course of safety regulation.
- Safety culture may lack now and then. The priority of safety must be realized at all levels – from the government to workers.

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**ACTIONS TO BE TAKEN CONSIDERING LESSONS LEARNT (1)**

- Carry out target inspections of NPP protection from extreme external impacts;
- Perform extraordinary emergency drills of the personnel according to scenarios of accident caused by external impacts;
- Analyze mutual influence units of a multi-unit NPP (radiation accident, flooding, fire safety, chemical equipment accident, impact of missiles, etc.);

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**ACTIONS TO BE TAKEN CONSIDERING LESSONS LEARNT (2)**

- Clarify initial data used for analysis of NPP protection against accidents on hydraulic structures (dike of cooling water ponds on NPP site, dam in NPP area);
- Confirm if seismic micro-zoning results for individual NPP sites are valid;

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**ACTIONS TO BE TAKEN CONSIDERING LESSONS LEARNT (3)**

- Develop and introduce, as necessary, additional engineering solutions aimed to increase reliability of:
  - power supply (e.g., by means of mobile diesel-generators),
  - reactor heat removal (e.g., by means of portable pump units),
  - heat removal from spent fuel pools (e.g., by means of alternate cooling systems).

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**ACTIONS TO BE TAKEN CONSIDERING LESSONS LEARNT (4)**

- Review emergency documentation on severe accident management, including emergency actions under shutdown reactor;
- Fully implement programmes ensuring of C&I systems operating under severe accident conditions;
- Analyze reasonability of reactor vessel external cooling under severe accidents conditions.

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**THANK YOU FOR ATTENTION**

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Francisco Fernandez Moreno, CSN, Spain

**CSN** CONSEJO DE SEGURIDAD NUCLEAR www.csn.es

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## Spanish Nuclear Safety Council Crisis Communication Management: The Fukushima Accident

June 8, 2011



NEXT 

**CSN** CONSEJO DE SEGURIDAD NUCLEAR www.csn.es

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### Tracking of the accident by the CSN



- Tracking of the accident from the CSN Emergency Response Room

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- Activation of the level 1 ("limited response") of the Emergency Response Organisation (ERO)

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- Information and advice for the Spanish Government

---

- Information for public opinion and stakeholders

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- Environmental radiological surveillance programme for the monitoring of radioactivity in Spain in the wake of the Fukushima accident.

INDEX PREVIOUS  NEXT 



**CSN** CONSEJO DE SEGURIDAD NUCLEAR www.csn.es

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### Tracking of the accident by the CSN







INDEX PREVIOUS NEXT

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### Response of the Spanish Government



- Setting up of a Tracking Unit to monitor the situation in Japan.

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- Interministerial coordination.

---

- Implementation of a protocol for action by persons arriving from Japan.

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- Control and surveillance of goods.

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**CSN** CONSEJO DE SEGURIDAD NUCLEAR [www.csn.es](http://www.csn.es)

## Response of the Spanish Government



INDEX PREVIOUS NEXT

**CSN** CONSEJO DE SEGURIDAD NUCLEAR [www.csn.es](http://www.csn.es)

## Communication and information actions



- Periodic information via communiqués.
- Attention to the media. More than 860 responses to queries.
- Attention to direct queries from the members of the public. More than 640 consultations.
- Special area set aside on the website. Permanent information via the Twitter channel.
- Informative blocks with answers to frequently asked questions.
- Direct contacts with stakeholders and the Advisory Committee.

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Takuya Hattori, JAIF, Japan




## **Fukushima Accident: Actions for the Future *from Industry's Perspective***

**Forum on the Fukushima Accident  
OECD/NEA Paris, France  
June 8, 2011  
Takuya HATTORI  
Japan Atomic Industrial Forum Inc.**



## **What happened after the Earthquake on March 11?**

- **3 operating units automatically shut down, another 3 units were under annual outage at Fukushima Daiichi NPS**
- **~1hr after the earthquake, Tsunami reached to Fukushima site**
- **Long-term SBO**
- **Long-term loss of UHS**



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## Consequences of Accident

- **Multi-unit events simultaneously**
- **Core damage and containment failure**
- **R/B failure by H<sub>2</sub> explosion**
- **Heat up of SFP water in R/B**
- **Accumulation of radioactive effluent**




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## Consequences of Accident (cont'd)

- **Release of radioactive material into the environment**
  - **0.3~0.6x10<sup>18</sup> Bq I-131 eq**
  - **~1/10 of the case of Chernobyl accident (5.2x10<sup>18</sup> Bq I-131 eq)**
- **Radiation dose of workers (as of May 31)**
  - **Emergency exposure dose limit : 250mSv**
  - **over 100mSv : 30 workers**  
( internal exposure dose of 2 workers is under evaluation )


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## Current Challenges

**At the station :**

- **Core and SFP cooling**
- **Control of high contaminated water effluent**
- **Prevention of additional H<sub>2</sub> explosion**
- **Minimizing release of additional radioactive material into environment**



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## Current Challenges (Cont'd)

**Outside site boundary :**

- **Evacuation of local residents ;**
  - \* **Restricted Area (20km)**
  - \* **Deliberate Evacuation Area**
  - \* **Prepared Area in case of Emergency**
- **Contamination of air, soil, vegetables, groundwater, grass, sea water, and so on**
- **Ingestion control ;**

I-131	300 Bq/kg in water
	2000 Bq/kg in food
Cs	200 Bq/kg in water
	500 Bq/kg in food



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## JAIF

# Consideration of beyond Design Basis natural phenomena

- **Design Basis Tsunami**
  - original licensing application
    - \* height **+3.1m** above sea water  
(based on Chile tsunami in 1960)
    - \* elevation of ground level **+10m**
  - revised licensing application (2002)
    - \* height **+5.7m** above sea water
- **Tsunami on March 11, 2011**
  - **+14~15m** height

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## JAIF

# Consideration for Emergency Preparedness

- **Before March 11 :**
  - AM by utility's voluntary action to cope with B-DBE incl. SBO (1992~)**
- **After March 11 :**
  - On Mar.30, METI ordered all utilities to take necessary action to cope with SBO**

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## Lessons learned

- **Lack of imagination**
- **Robustness of design**
- **Crisis management**
- **Communication/transparency**
- **Nuclear Security**  
(to be discussed separately)

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## Lessons learned (cont'd)

- **Out of hypothesis ?**
- **Lack of imagination**  
Because of long term **safety operation record** after Chernobyl accident,
  - we fell down in a pit that to follow the **strict regulatory requirement is a synonym for to keep high level of safety**
  - we have stopped stretching our **imagination on nuclear safety prudently**

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## Lessons learned (cont'd)

- To maintain or restore core cooling, containment and SFP cooling capability, **Robustness of design** under the circumstance of B-DBE should be re-evaluated
  - reliability of **offsite power**
  - reliability of **emergency AC power**
  - reliability of **ultimate heat sink**

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## Lessons learned (cont'd)

- To enhance **Crisis management** capability, effectiveness of SAM should be reviewed ;
  - **SAM procedure and operational aids**
    - \* **instrumentation and tool for SAM**
    - \* **tracking of plant behavior**
    - \* **simulation of plant behavior**
  - **decision making and command & control**
  - **training and exercise on SAM**

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## Lessons learned (cont'd)

- To improve **Communication/transparency**, methodology (tool and procedure) should be reviewed ;
  - Information for **local residents**
  - Information for **general public**
  - Information sharing with **international community**
  - **Communication between MCR,TSC and EOF**

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## Toward the Future

- **World energy demand increase would be inevitable.**
- **For sustainable future, we have to challenge to realize low carbon society.**
- **Nuclear power have played an important role for energy supply assurance and reduction of CO<sub>2</sub> emission.**
- **There is no silver bullet to realize low carbon society, but there would be no solution without nuclear.**

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## Toward the Future (cont'd)

- For the **responsible development of nuclear power**, it is crucial to share the **lessons learned from Fukushima accident** as agreed in **G8 summit**
  - Enhancement of **nuclear safety**
  - Reassurance of **public confidence**
  - Strengthen **international cooperation**
  - Enhancement of **nuclear security**

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## International Cooperation

- The **Conventions after Chernobyl accident** should be re-evaluated ;
- My proposal is to establish the **regional International Nuclear Emergency Response Team (INERT)** under the guidance of **IAEA**
  - **Major function of INERT**
    - preparation of **tools/equipments/systems for SAM**
    - **tracking/simulation of plant behavior**
    - **radiation monitoring/exposure prediction**

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***Thank you for your attention***

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**Acronym List**

- **AC - alternating current**
- **AM - accident management**
- **B-DBE - beyond design basis event**
- **EOF - emergency offsite facility**
- **MCR - main control room**
- **METI - Ministry of Economy, Trade and Industry**
- **SAM - severe accident management**
- **SBO - station blackout**
- **SFP - spent fuel pool**
- **TSC - technical support center**
- **UHS - ultimate heat sink**

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