

STRENGTHENING NUCLEAR SAFETY WORLDWIDE

Lessons learned from the Fukushima Daiichi Accident

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Introduction

History works in a discontinuous way, nuclear safety history works pretty much in the same way. Every nuclear incident carries its lessons; this is why Incident reporting and experience feedback processes are an essential part of a developed nuclear safety infrastructure. They allow a continuous strengthening of nuclear safety and security. Unfortunately, the most profound structural or cultural changes need exceptional events to make their way into our minds and into implementation in the Global nuclear safety and security framework. Those who do not learn from the past are condemned to repeat it

In 1979, the Three Miles Island NPP Accident attracted the attention of many a research centre on man-machine interface. Seven years later, back in 1986, the most significant developments in nuclear safety were the results of the Chernobyl accident. The lessons learnt embraced many subjects, including safety culture, safety infrastructure, health effects, remediation policies, Emergency Preparedness and Response... This is the time when the development of IAEA safety standards and services saw a strong acceleration to include these lessons, at the same time when three major conventions - the Notification and Assistance Conventions and the Convention on Nuclear Safety - were adopted. A decade later, the Department of Nuclear Safety was created inside the Agency.

The history of nuclear security saw a similar acceleration, following the terrorist attacks on 11th September 2001. The work to amend the Convention on the Physical Protection of Nuclear Material was promptly started, while the Agency strengthened its capabilities in nuclear security.

Today, nuclear energy is faced with the same challenges of understanding and learning the lessons from the accident at Fukushima Daiichi NPP. Indeed, after 25 years without serious nuclear accident, following a natural disaster of extraordinary magnitude that struck the East coast of Japan March 11, 2011, the Fukushima Daiichi Nuclear Power Plant was severely damaged. Today, the Japanese authorities, TEPCO employees and the nuclear industry are working together to gradually bring the damaged reactors into a stable and safe state.

At the same time, nuclear energy actors are going through a major test of their ability to assess their weaknesses, to draw and implement lessons from the accident, to advance nuclear safety, and to rebuild public and governments' confidence in the possibility to manage and develop the peaceful uses of nuclear energy in a responsible, sustainable and safe manner.

The accident in Fukushima

Although many lessons are still to be learned on the course and causes of the accident, three substantial reports are currently available, that have already allowed drawing preliminary lessons:

- a 160-page report prepared by the IAEA International Fact Finding Mission despatched to Japan from May 24 to June 2, 2011ⁱ
- a 400-page report prepared by the Government of Japan in June 2011ⁱⁱ
- a supplementary report of 700 pages prepared by the Government of Japan in September 2011ⁱⁱⁱ

In addition to these reports, an independent investigation commission was set up by the Japanese Government; it is expected to release its preliminary findings towards the end of the year.

Already the IAEA fact finding mission in May identified some of the weaknesses at the origin of the accident concerning the natural hazard design basis:

- the underestimation of the seismic hazard from the use of recent historical seismological data, contrary to the need to consider prehistorical and historical data, as well established in the international safety requirements for assessing the natural hazards at nuclear installations;
- though it recognized that Japan has a high level of expertise and experience regarding tsunami hazard and provides leadership in this topic worldwide, it mentioned that organizational issues may have prevented this expertise to be applied.

First lessons learned

Fukushima confirmed if necessary that nuclear accidents do not respect borders. The atmospheric releases were detected in both hemispheres, and ocean releases are the subject of various assessments. While no transboundary release of radiological safety significance for another State was identified, it demonstrated again that the primary responsibility of operators and States, enshrined in IAEA safety standards, must be backed by an international approach to safety. The International Atomic Energy Agency is the privileged place where this approach is implemented.

At the request of the Director General of the IAEA, the International Nuclear Safety Group (INSAG) has established a series of recommendations^{iv} to guide future actions related to the accident in Fukushima. These recommendations were made on the basis of the report of the IAEA International Fact Finding Mission, of the Ministerial Declaration adopted 20 June 2011 during the Ministerial Conference on Nuclear Safety organized by the IAEA in Vienna from 20 to 24 June, and of the content of the three working sessions of the Conference. INSAG identified nine issues as potential vulnerabilities highlighted by the accident, concerning : regulatory structure, chain of command, extreme events, severe accidents, loss of power, loss of cooling, accumulation of explosive gases, spent fuel storage pools and emergency situations management.

INSAG also formulated broad recommendations directed at the IAEA and the Member States on Safety Standards, Peer review services, International Emergency Preparedness and Response, International Conventions, International Safety Research, Remediation.

How to strengthen the global nuclear safety framework? the IAEA Action Plan on nuclear safety

Responding to the Ministerial Declaration, the IAEA prepared during the summer of 2011, in consultation with Member States, an action plan on nuclear safety which was approved by the Board of Governors and adopted by the General Conference on September 22, 2011. This plan consists of 12 key actions each focusing on: safety assessments in the light of the accident at TEPCO's Fukushima Daiichi Nuclear Power Station; IAEA peer reviews; emergency preparedness and response; national regulatory bodies; operating organizations; IAEA Safety Standards; international legal framework; Member States planning to embark on a nuclear power programme; capacity building; protection of people and the environment from ionizing radiation; communication and information dissemination; and research and development.

The legal framework

The question of strengthening the **international legal framework** was acutely raised during the fifth review meeting of States Parties to the Convention on Nuclear Safety (CNS), held in Vienna from 4 to 14 April 2011. Confronted directly with the consequences of the accident, the Parties agreed to hold an extraordinary meeting in August 2012. Strengthening the provisions of the CNS was the focus of the discussions; many delegations considering that priority should be given to a strengthening of implementation mechanisms of the CNS, while others favoured the legal approach of amending the Convention.

My experience in the long process of amending the Convention on the Physical Protection of Nuclear Material (CPPNM - the amendment process was launched around 1998, an amendment was adopted in July 2005, entry into force is foreseen in an optimistic perspective around 2015) convinced me ~hat a two-track approach: launching a carefully planned amendment process, supplemented by a variety of mechanisms and non-legally binding tools available to the international community is the right way forward to respond to the need for urgent actions to strengthen nuclear safety, without foregoing the longer term, more potent tools of a strengthened international legal regime.

One of the lessons learnt from the Fukushima accident which has been widely mentioned, is that the **effective independence** of the national regulatory authorities must be ensured. Indeed, a number of reflections have been voiced during the Ministerial conference and during the CNS review meeting, on defining criteria for the effective independence of the national regulatory authorities, and on the possibility to include these in an amended Convention. I have myself asked the International Nuclear Safety Group (INSAG), to revisit its report INSAG-17 published in 2003 under the title: "Independence in regulatory decision making", and see whether it needs sharpening or not in the light of recent lessons. In a concrete way, since the accident, the Republic of Korea strengthened the independence of its regulatory infrastructure, Japan is planning for increased independence of its safety authority, and the European Union is considering strengthening the provisions of the Nuclear Safety Directive in that direction.

In the field of international legal instruments, the issue of **international liability instruments** in case of nuclear accident has been also raised, since non-participation of Japan to any such instruments was probably one of the limiting factors to recourse to assistance.

The evaluation of the safety of nuclear power plants

In the immediate aftermath of the accident at TEPCO's Fukushima Daiichi Nuclear Power Station, many Member States launched **complementary safety assessments of the safety vulnerabilities of nuclear power plants** in the light of lessons learned to date from the accident (commonly but improperly called "stress tests"). This action in itself encapsulates most of the issues encountered as a result of the accident in Fukushima: urgency, transparency, harmonization, independence and international oversight.

This is clearly an urgent action expected by the public and by governments in order to provide a realistic assessment of the safety of existing facilities, and a clear vision of improvements needed in the short term.

At the same time, the question of harmonization of these reviews from one State to another is clearly needed: every Nation hoping that its neighbours (in the Global understanding of a mixed, flat world) will address this issue with the same seriousness as its own, and expecting to be informed in a transparent way of the assessments performed. To eliminate any risk of complacency, the independence of regulators in charge of the review of the analysis performed by the operators is, as always, a strongly formulated requirement, and finally a final review by peers at international level is an added guarantee of impartiality of the process.

Within the Secretariat, we have developed a methodology for the evaluation of safety margins of nuclear power plants, based on existing experience. This will allow us to respond to requests for assisting our Member States in their own assessment, and possibly to organise international peer reviews.

IAEA Safety Standards

The **IAEA safety standards** are grounded in our Statute. Along the years we have developed a consistent set of more than a hundred safety standards, established through a rigorous process. They form today the recognised benchmark for achieving a high level of safety. A review of their continued relevance in the light of the accident has been promptly launched in the frame of the Nuclear Safety Action Plan. However, the first findings of the IAEA fact finding mission in May tend to show that they provide a robust basis. For example the mission identified the following findings related to the design basis of the plant, and covered by the IAEA Safety Standards:

- “the underestimation of the seismic hazard from the use of recent historical seismological data, contrary to the need to consider prehistorical and historical data, as well established in the international safety requirements for assessing the natural hazards at nuclear installations”;
- “...Japan has a high level of expertise and experience regarding tsunami hazard and provides leadership in this topic worldwide, [however the mission] mentioned that organizational issues may have prevented this expertise to be applied”.

It shows that the key worth of even the best safety standards is in their implementation.

The IAEA peer review missions

To further facilitate their implementation, we provide an external view, in an incentive approach to continuous improvement, through **peer review missions** which address regulatory effectiveness,

operational safety, design safety, and emergency preparedness and response. These peer reviews are at the heart of the Action Plan. Their clear foundation in the IAEA Safety Standards strengthens *de facto*, if not *de jure*, the essence of these standards as the international reference.

During the consultations on the way to strengthen peer reviews, Member States' views ranged from a desire to make these missions compulsory, periodic and automatic, to a clear preference to keep them voluntary. The formulation finally accepted by all is: "*Member States [are] strongly encouraged to voluntarily host IAEA peer reviews...*". Indeed, the real challenge is not to include peer reviews in a legally binding instrument, but to create a living process, through the incentives provided by transparency and the pressure it creates, but also through demonstration of the enhanced benefits for all of international peer reviews.

Good news came from a recent workshop on lessons learned from past IRRS missions organised jointly by the IAEA and the USNRC in Washington DC in October, where senior regulators from 22 Member States expressed their strong support for the IAEA peer reviews. There was a general recognition that these peer reviews provide national nuclear regulators with an objective view of their strengths and weaknesses and contribute to the continuous strengthening of nuclear safety.

Emergency preparedness and response

In the area of **emergency preparedness and response**, the IAEA works primarily within the two conventions adopted in the aftermath of the Chernobyl accident: the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

To ensure its responsibilities under these Conventions, an "Incident and Emergency Centre - IEC" was created in the Department of Nuclear Safety and Security. The IEC serves as a focal point for receiving information from the State where an emergency occurred, offers the Agency's "good offices", and transmits the assistance proposals received from Member States, through the Response and Assistance Network (RANET).

Today, actions have been launched *inter alia* to widen the rapid response capabilities provided through RANET, to expand the participation of Member States to the Network, and in parallel to expand the participation to the Joint Radiation Emergency Management Plan of the International Organizations.

Communication

The accident at Fukushima Daiichi NPP was the first in our era of global, instant **communication**. In 1986, the first pictures of the Chernobyl accident were available to the international community a number of days after the accident, and I remember my demarche as a French diplomat in Moscow at the beginning of May 1986 to buy photographs of Chernobyl NPP from the TASS Agency. In 2011, the public could see live on their TV the hydrogen explosions at Fukushima Daiichi NPP, and every piece of information was immediately disseminated and commented on myriads of internet fora. It revealed a need and a hunger for clear and understandable information about the accident.

This calls in turn for an enhanced role of the IAEA in receiving more timely information, in increasing its capability to federate real-time safety analysis. It also points to the need for

hannonization of approaches in a number of criteria to avoid a cacophony of expert advice (event classification, evacuation criteria, product contamination, remediation strategies...).

A typical communication issue was highlighted on the occasion of the classification by Japan of the accident in the INES scale (International Nuclear Event Scale). Japan filed a preliminary accident classification on March 18 at level five of the scale (“accident with wider consequences”) then issued a new classification as level 7 on April 12 (“major accident”), the maximum level, equivalent to that of the Chernobyl disaster, after the Japanese experts had assessed the amount of releases of radioactivity into the atmosphere. In the meantime, the opinions of international experts had been reported in the media, some holding that the accident was indeed a major accident to ranking at level 7, others arguing that the accident should be classified at level 6. Obviously, the objective of providing the public with simple information, prompt and easy to understand, comparable to the magnitude of an earthquake, was widely missed. We have launched a review of the implementation of the INES scale to avoid such a repetition.

Transparency and Action Plan

In proposing to make a more systematic use by Member States of peer review missions, providing the **widest transparency** to the results of these evaluations, the Action Plan will play a decisive role towards harmonization of safety practices. It will also demonstrate, to the benefit of the international community, the adequacy of measures taken at national level to ensure the highest level of nuclear safety. Its effective implementation will strengthen nuclear safety worldwide. This is the necessary first step to rebuild trust between States and with the Public.

Safety and security

As current Head of a nuclear **safety and security** department, it would be inappropriate for me to avoid the issue of the relationship between safety and security in the light of the Fukushima accident. Yes, a nuclear accident could be the result of a malicious act, an act of terrorism. Yes, it is legitimate to consider the lessons of the accident in Fukushima in terms of improvements that could be made to the protection of nuclear facilities against such acts. But transparency, which I have just praised, is not easily available in the field of nuclear security.

Nevertheless security has not been overlooked so far. It was addressed in the IAEA's contribution to the study launched by the UN Secretary General in preparation to the High Level Meeting organised in New York. Nuclear security in light of lessons learned from the Fukushima accident was also present in the Agenda of the Senior Regulators' Meeting during the 55th IAEA General Conference.

Conclusion

I have addressed only a small part of the lessons already learned and to be learned from the Fukushima Daiichi NPP accident. IAEA Member States recognized that the process will be a 1rmg one, but most actors of nuclear energy have acted promptly to draw these lessons, and to strengthen nuclear safety. The IAEA nuclear safety action plan will serve as the thread on this path. Last September, Director General Amano decided to create in my Department a Nuclear Safety Action

Team to ensure proper coordination among all stakeholders and to oversee the prompt implementation of the Action Plan. This is not a Plan only for the 2000 or so employees of the IAEA. As explicated in the Action Plan, stakeholders include, amongst others, governments, relevant international organizations and associations, regulatory bodies, operating organizations, nuclear industry, radioactive waste management organizations, technical support and safety organizations, research organizations, education and training institutions and other relevant bodies.

One of the key tasks of the Action Team will be to gather from all Member States information and actions performed, to allow analysing these actions, drawing lessons, and above all, disseminating to all stakeholders the results and the lessons of the NSAP.

By adopting the Action Plan on Nuclear Safety on 22 September, the IAEA General Conference took a historical step. This is the first time in the life of the Agency that 151 Member States gather in a comprehensive program all nuclear safety tools to strengthen the global nuclear safety framework at the national, regional and international levels. The implementation of all these tools opens a new period in the quest for a continuous strengthening of nuclear safety worldwide. The IAEA, its 151 Member States, are at the heart of this work.

ⁱ IAEA international fact finding expert mission of the Fukushima Dai-ichi accident following the Great East Japan earthquake and tsunami - Tokyo, Fukushima Dai-ichi NPP, Fukushima Dai-ni NPP and Tokai Dai-ni NPP, Japan - 24 May - 2 June 2011

ⁱⁱ Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety - The Accident at TEPCO's Fukushima Nuclear Power Stations - June 2011 Nuclear Emergency Response Headquarters Government of Japan

ⁱⁱⁱ Additional Report of the Japanese Government to the IAEA - The Accident at TEPCO's Fukushima Nuclear Power Stations - (Second Report) September 2011 Nuclear Emergency Response Headquarters Government of Japan

^{iv} Communication from the INSAG Chairman dated 26 July 2011