

## DELIBERATION OF POST 3.11 FAST REACTOR R&D STRATEGY IN JAPAN

Shunsuke Kondo, Dr.  
Chairman  
Japan Atomic Energy Commission

Good afternoon, Ladies and Gentlemen.

It is a pleasure for me to be invited to participate in this conference because this conference represents the continuation of cooperation among people around the world who want to realize sustainable nuclear energy systems for future generations of mankind on which JAEC has put special emphasis all through its activity. With that, I would like to express my appreciation to the International Atomic Energy Agency for organizing this conference and the French Alternative Energies and Atomic Energy Commission (CEA) and the French Nuclear Energy Society (SFEN) for hosting this conference, in cooperation with the OECD Nuclear Energy Agency (NEA).

As you know, the Great East-Japan earthquake and the resulting tsunami struck people and facilities including nuclear power plants located on the Pacific coast of Japan on March 11, 2011. This caused an unprecedented severe accident at the Fukushima Daiichi nuclear power plant of Tokyo Electric Power Company (TEPCO): the simultaneous progression of severe core damage at multiple units and the continuation of large-scale release of radioactivity over an extended period of time. The fact that this accident has raised concerns around the world about the safety of nuclear power generation is a matter that Japan takes with the utmost seriousness and remorse.

Japan has received tremendous outpouring of supports and expressions of solidarity from around the world in the face of this hardship. Approaching the two year anniversary of the 3.11 event, I would like to convey the Japanese people's sincere gratitude to the global community for its support.

At the Fukushima Daiichi unit 1 to 4, radioactive releases have been virtually suppressed and reactor cores and spent fuel pools have been maintained at low temperature. At present, major short-term challenges at the site are;

- A) Management of contaminated water accumulated,
- B) Reduction of environmental radiation dose,
- C) Improvement of work environment, and
- D) Retrieval of spent fuel from spent fuel pools.

In parallel with the efforts to meet these challenges, a joint team of the Government, TEPCO, manufactures and R&D institutes is promoting various R&D projects that aim at;

- A) Equipment/device development, assessment & analysis of fuel conditions and fuel/debris characterization, with a view to preparing for fuel debris removal;

- B) Development of technologies for conditioning and disposing radioactive waste; and
- C) Development of robotics and remote-manipulation technologies as common tools for cleanup activities.

As for the off-site consequences, the accident has caused a wide range of direct and indirect effects: about 80,000 people are still requested to be out of hometowns and about the same number of people have made choice to leave home. People are suffering from a psychological agony due to fear of radiation exposure, separation of family, disruption of communities etc.

The Government designated eleven municipalities as special decontamination area where it is promoting decontamination work to reduce the annual exposure of the people who will live there below 20mSv in two years, excluding areas where current annual dose is higher than 50mSv. Three cities have decided, however, that they would not return to hometowns in five years, pointing out the uncertainty in the attainment of remediation sufficient for living. One of the biggest issues in this connection is the appropriate measure for and level of decontamination of forests that cover more than 70% of the areas.

We feel deep remorse to the fact that, though anyone has not been hurt by the radiation so far, the accident has caused several hundred deaths due to the worsening of diseases owing to dislocation, including emergency evacuation from hospitals, and the stress of life in a shelter after dislocation. It is unbearable but true that the sales of the products from Fukushima Prefecture have been plummeting due to consumer fear, even though they are not contaminated as the production of agricultural and marine produce are strictly restricted at the place where we see the danger of contamination.

Direct damage compensation is estimated at present to be at least 6 trillion yen (70 billion US\$). In addition, as only two NPPs are in operation at present, the expense of electric utility companies for fossil fuel in 2012 was at least 3 trillion yen (40 billion US\$) larger than that in 2010. Therefore total disaster cost will be far larger than 10 trillion yen.

After the accident, accident investigation teams were organized by various organizations, including the IAEA, the Japanese Government, the Japanese Diet, and NPOs, and they published their judgment and lessons learned already. Most of them judged that though the accident was triggered by a massive force of nature, it was existing weaknesses regarding defense against natural hazards, regulatory oversight, accident management and emergency response that allowed the accident to unfold as it did.

The publication of such judgment made it difficult for the Government to permit nuclear power plant operators to restart their plants after refueling and inspection outages. This is the reason why only two units are in operation at present.

With these observations as background, I will provide you with my perspective on new objectives of nuclear energy R&D and SFR R&D after explaining the current status of deliberation of energy strategy in Japan, though the views I am about to express are my own and may not represent the collective view of the Commission on which I serve or the view of the Japanese Government.

Let us start with Japanese energy policy. About a half year after the accident, the Government of Japan had started the review of energy policy including nuclear energy policy, taking a hard look at the causes and impacts of this accident. The Government had concluded the review last September, though it was recognized that the set of policy strategy decided involved several serious problems to solve. Then the general election was held and it changed the Government. And the new Government announced recently that they would go back to the drawing board again.

Accordingly all I can say at this moment is that actions taken by the government at present are;

- A) To make it possible to restart the operation of idling nuclear power plants, as an important power source, that have a firm plan to satisfy the new safety rules to be set before July by the Nuclear Regulation Authority, which is a new independent nuclear regulatory agency that came into force last September.
- B) To mobilize all policy resources for promoting conservation of energy, utilization of advanced fossil fuel power stations and renewable energies so as to assure the stable supply of energy, compensating the probable decrease in the contribution of nuclear power in mid- and long-term basis.

The NRA recently published the main points of New Safety Rules for LWRs under consideration. Obviously, the NRA is, recognizing that a major uncontrolled release of radioactivity, whether driven by natural or malicious causes, is unacceptable, to request the operator to;

- A) Ensure that design base external events such as seismic, seismic-tsunami and other events are properly evaluated;
- B) Ensure extended losses of power and ultimate heat sink are covered under design extension condition and protection of severe accidents is provided by a diverse and flexible alternate capability to supply power and cooling;
- C) Ensure adequate severe accident management procedures including reliable hardened vents for specific reactor containments are in place, taking into consideration of the fact that external events might affect the entire site.

I would like to mention that, in connection with this, the NRA has already asked all the operator of nuclear facilities to accelerate the survey and characterization of active faults around the site, including their interlock condition, based on the most up-to-date knowledge in seismology and detailed geological studies including 3D observation of underground structure.

It should be also mentioned that the NRA suggests that it will publish the new safety rules for MONJU and nuclear fuel cycle facilities based on the same principle after the publication of that for LWRs.

We do not know how each operator will decide when he find that it will cost him a significant amount of money to conform his plant to the new set of rules and requirements arising from the findings about active faults. It is fair to say, though, that not all of the unit will recover their operation and the contribution of nuclear power in the future power production in Japan will

decrease to a certain extent, as there are small capacity plants and aged plants for which it is difficult to justify a large amount of additional investment.

Taking this situation into consideration, I believe it important for the Government to focus the nuclear energy R&D activity on;

- A) Developing innovative technologies usable for decontaminating affected areas and managing associated radioactive waste effectively and efficiently, and those for promoting cleanup and decommissioning of the disabled NPPs;
- B) Improving computer simulation tools for severe accident analysis that can be used for the estimation of the distribution of core debris in the stricken units, and those for seismic engineering analysis that can be used for exploring innovative technologies usable for improving seismic safety of NPPs effectively and efficiently; and
- C) Pursuing steady progress in the use of plutonium recovered by reprocessing in light water reactors and in the assurance of safety of geological repository for high-level radioactive waste, including used fuel.

Then how should we define new objectives of FR R&D in this situation? Japan started its SFR R&D program by constructing experimental fast reactor JOYO at O-arai and the 280 MWe prototype FBR MONJU at Tsuruga. Though MONJU started operation in April 1994, as the operator's inappropriate information management in the face of a sodium leakage event gave rise to the loss of public trust on its operator, it had been shutdown for almost 15 years. It restarted operation in May 2010. The MOX fuel for JOYO and MONJU has been fabricated at the Plutonium Fuel Production Facility (PFPP) since 1988, utilizing plutonium recovered at Tokai Reprocessing Plant (TRP).

In 2006, Japan started FaCT Project, aiming at establishing a feasible concept of innovative fast reactor and its fuel cycle system to be introduced into grid in 2050. The project selected the Japan Sodium-cooled Fast Reactor (JSFR) concept for detailed review and identified innovative technologies to be developed for realizing this concept. However, this project was suspended after the accident so as to unite our efforts to Fukushima.

Considering this situation, we are, in parallel with deliberating the effective use of research and engineering capabilities as well as knowledge basis developed through FaCT project in the development of sustainable nuclear technology worldwide, tentatively considering that the first priority of SFR R&D in the future should be placed on the accomplishment of full-power operation of MONJU by completing system startup tests (SST), after improving the severe accident management procedures in accordance with new safety rules to be set by the NRA.

After that, we hope that we will continue to operate it as an international fast neutron irradiation facility and enrich the knowledge basis for safe, secure and proliferation-resistant SFRs. In this connection, please allow me to announce that Japanese government will host an international workshop in April that explores various possibilities of utilizing MONJU for conducting international collaborative research and development activities. Participation from countries interested in R&D on fast reactors will be welcome.

We are considering it also important for us to continue the R&D for strengthening sodium cooled fast reactor safety so as to make SFRs as the most promising fourth generation nuclear energy system. R&D activities currently promoted and to be continued are the establishment of a safety design rule for fourth generation SFRs that includes rules to request built-in passive features for the working of critical safety functions in the system and strengthen defense-in depth features by introducing measures to control beyond design basis events or level 4 defense-line, as contemplated in Requirement 20 of the IAEA Safety Standards. We believe it important for SFR designers to pursue to build passive features in the existing safety systems for the working of alternate safety functions, without adding another systems, as countermeasures for prevention & mitigation of severe accident.

We believe that the third objective should be to promote R&D for minimization of volume and toxicity of waste from nuclear power generation. As this is one of the most important objectives of the FaCT project, we want current R&D activities being continued even in the new environment, in principle. They are MA bearing fuel fabrication technology, fuel irradiation study and cladding materials development, development of both aqueous process and pyro-process reprocessing technologies for oxide fuel, nitride fuel and metal fuel. We are also promoting R&D on the assurance of their safety, security and proliferation resistance. It should be noted that as MOX fuel in the MONJU core contains Americium already, Americium bearing fuel is to be irradiated when operation is restarted.

Last but not least, I would like to stress the importance of international cooperation, not to mention the tremendous benefit we have enjoyed by the prompt and useful supports outpoured to the Fukushima from international nuclear community, for that we can never thank enough. Needless to say, it is a Japan's responsibility to make utmost effort to share its experience and lessons derived from the severe accident at Fukushima with the world so as to contribute to strengthening nuclear safety worldwide.

In addition, however, I believe that Japan should continue, as in the past or more than in the past, to promote a multilateral and bilateral dialogue and cooperation with members of the Generation IV International Forum (GIF) and the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), with a view to making effective use of our knowledge basis and research and engineering capabilities cultivated through the FaCT project in the development of sustainable nuclear energy systems as a long-term project of global community.

In summary, new nuclear energy policy is still in the process of deliberation in Japan. Though the operation of many of idled plants will be restarted after renovation of their safety features in accordance with new safety rules set by the NRA, the contribution of nuclear power in Japan will probably not return to the level before 3.11. Japan is also in the process of reviewing its strategy for SFR R&D with a view to make it compatible with the new situation to be realized under new safety regulation, not to mention our obligation to Fukushima.

It is contemplated at present that major emphasis of the SFR R&D in the future should be on the completion and use of MONJU, SFR safety and minimization of volume and toxicity of waste from nuclear power generation, in parallel with the effort to make effective use of our knowledge basis and research and engineering capabilities cultivated through the FaCT project in the

promotion of sustainable nuclear energy systems worldwide. And last but not least, we believe that the promotion of international cooperation should be an essential ingredient of our new program.

Thank you for your kind attention.