Japan's Nuclear Reactor Strategy[1]

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Thank you very much Mr. Chairman for your kind introduction.

Distinguished colleagues, ladies and gentlemen, it is a great pleasure for me to have the chance to address you at this International Conference on Fast Reactors and Related Fuel Cycles FR09 held in this beautiful city of Kyoto. As Kyoto had been the capital of Japan for more than a thousand year and is rich in miracles to sustain long-term prosperity, I am sure that this city is one of the best places in the world for having discussion about such long term issues as the challenges and opportunities of fast reactors and related fuel cycles for the future of humankind.

Ladies and gentlemen, we are witnessing today global emergence of interest in the construction of nuclear power plants. There are a number of reasons for this. Major factors are the urgent and ever-growing need for energy, particularly in the developing part of the world, fluctuations in fossil fuel prices, the pursuit of security of energy supply and the growing recognition of the need for combating global warming.

Despite the midst of the global economic crisis, the IAEA´s latest projections continue to show a significant increase in nuclear generating capacity in the medium term. The low projection for 2030 is now 511 GWe of generating capacity, compared to 370 GWe today. The high projection is 807 GWe, more than a doubling from present levels.

Most of the 30 countries that already use nuclear power plan to expand their output. Growth targets have been raised significantly in China, India and the Russian Federation. In addition, according to the IAEA, 50 some countries - mostly in the developing world - have informed the IAEA that they might be interested in launching nuclear power programmes and 12 countries of them are actively considering a timely introduction of nuclear power.

Even in the high case, however, the nuclear power’s share in global power generation will go down from the current 16% level to 14% in 2030 and then rise to 22 % in 2050, according to the projection published by the OECD NEA last year. In other words, the growth of nuclear power in the global power sector will not be able to keep pace with the growth of electricity demand in the world at least in the medium term.

Then, what should the global nuclear community do before dawn, preparing for the day when nuclear energy will play the leading role in global energy supply? My answer is

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let promote carefully planned yet highly aggressive actions across three different time frames; short-term, mid-term and long-term.

The major short term action should be to continue to operate existing reactors safely and reliably, maintaining the public trust in both plant operators' safety management and the Government's regulatory activities for safety and security.

In the case of Japan, an urgent action in this category is to complete the re-evaluation of seismic safety of every nuclear facility in Japan, taking into consideration of lessons on the directional propagation of the seismic wave generated in the faults located in the vicinity of a facility and so on learned from the analysis of the July 2007 seismic event at Kashiwazaki-Kariwa nuclear power plant, in which the seismic input to the plant significantly exceeded the level of design basis seismic input. We hope that this review for the prototype fast breeder reactor Monju will be completed very soon.

The major medium-term actions in the case of Japan are to add new generating capacity steadily, operate Rokkasho Reprocessing Plant steadily, overcoming the current difficulty, and construct intermediate spent fuel storage facilities timely, in addition to globally concerted actions of both delivering assistance to countries that consider the introduction of nuclear power in building the necessary nuclear infrastructure and training young generation of nuclear scientists and engineers who are to sustain the development and utilization of nuclear energy toward the future.

The one of the major long-term actions should be to promote research and development programs that exploit a nuclear energy's innate feature, namely, its economically harvestable resource base good for a millennium of world energy supply, by closing the nuclear fuel cycles using fast neutron reactors.

In the previous century there had been active fast breeder reactor research and development programs in the world. But commercial development of fast reactors was put on hold in the 1980s and 1990s for numerous reasons, but primarily because they were projected to be uncompetitive.

At the crack of this century, however, recognizing that the environmental benefits of nuclear energy can expand and even extend to other energy products besides electricity in the latter part of this century, not a few countries have started to consider it wise to promote as a long-term action a significant research and development of fast reactors and closed fuel cycles that meet the technology goals in sustainability, economics, safety and reliability, and proliferation resistance and physical protection that will help nuclear energy play an essential role worldwide in the future.

In the case of Japan, the JAEA has been and is promoting the R&D of a fast reactor and its fuel cycle technology that can make nuclear energy technology competitive and sustainable in the energy supply market beyond 2050. Japan's current program goals are to produce by 2015 a conceptual design of a fast reactor and its fuel cycle system that can satisfy the performance goals in safety, economy, sustainability, and proliferation

resistance, and to start the operation of its demonstration system at around 2030 on the assumption that the system is promising enough.

Currently the JAEA is exploring candidate technologies for a sodium cooled fast reactor that loads mixed-oxide fuel that contains minor actinides as ingredients. Specifically, it is exploring advanced reprocessing technology that can efficiently recover minor actinides (MAs) as well as plutonium from spent fuel and advanced technology to fabricate such fuel so as to make the fast reactor and its fuel cycle system a very unattractive route for diversion of weapons-usable materials.

Furthermore, it has been claimed that selective separation of the various long-lived actinide from spent fuel in the reprocessing process would allow their fabrication into fuel or targets to be irradiated in specifically adapted fast reactors or in an accelerator-driven systems where they would be transmuted into shorter-lived elements while contributing to energy production, leading to the reduction of the volume and radiotoxicity of the waste to be disposed of.

As we all know well, innovation of technology and innovation of the business to make full use of it are not so easy to achieve successfully. According to Professor Ikujiro Nonaka, it is necessary in this endeavor to promote innovative learning through knowledge conversion cycle of socialization, externalization, combination and internalization of knowledge steadily. From my viewpoint, the deliberation of technology goals done at the outset of the GIF project is an excellent process of knowledge socialization and that set of goals has worked quite effectively for guiding the externalization of knowledge, stimulating search for innovative technology candidates.

When we are to decide a system design for further development, however, it becomes necessary to convert them into a set of decision criteria. This is a starting process of knowledge combination and as there is a gap between available and required knowledge, this process necessarily involves risk, of which management is an essential element of operationalization of innovative learning. I would like to briefly elaborate concrete issues involved in this conversion in the following.

As you know, fast reactors will allow the recycling of used-MOX fuel that is not practicable in light water reactors (LWRs). This is an intrinsic achievement of fast reactors from the sustainability viewpoint as this will make it possible to make the whole amount of high-level waste to be disposed of in the same form of glass canisters with similar heat generation characteristics. Therefore there is no urgent issue in the sustainability goals.

As for economic goals, however, the criteria of economic competitiveness come from the requirement of the market place: it should be recognized that life-cycle and power generation costs and financial risk of a system proposed should be at least comparable with those predicted for the light water reactors introduced in 2050 time-frame, taking into consideration a certain level of project risk.

As for safety, we have regulatory requirements such as safety goals and even quantitative safety objectives in terms of core melt frequency for light water reactors in some countries. Therefore they should be used as references for considering the acceptance of a system proposed, though the difference between the core-melt phenomena in light water reactors and those in sodium cooled fast reactors and its impact upon the applicability of these requirements prepared for LWRs should be clarified beforehand. If not done so at this moment, this issue will be one of the major risk factors for the project in the future.

As for nuclear security, a procedure has been already established in many countries, in compliance with the IAEA INFCIRC 225, that is, the IAEA Guidelines on the Physical Protection of Nuclear Material and Nuclear Facilities, to define a design basis threat that outlines the set of adversary characteristics for which the facility operators and state organizations together have protection responsibility and accountability.

But unlike the safety area, nuclear community continues to receive pressure to increase security. This is presumably because quantitative risk analysis is still at an early stage in the nuclear security area and the quantitative security objectives have not been established in our society yet. I hope that more balanced view on this issue will prevail in the near future.

The situation is far vaguer for nonproliferation goals. The obligation under the NPT for its State party is to put any nuclear facility under the IAEA safeguards. This September, however, the United Nations Security Council has resolved to encourage efforts to ensure development of peaceful uses of nuclear energy in a framework that reduces proliferation risk, adhering to the highest international standards for safeguards.

Why is a framework mentioned in this resolution? Presumably because there is a recognition that the proliferation concerns should come not from the facilities itself but from the possible actions to be taken by a country.

You can read this recognition clearly in the speech Dr Elbaradei, past DG of the IAEA made at the IAEA conference in Beijing this spring. According to him, countries that have mastered uranium enrichment and plutonium separation, much more those mastered sophisticated nuclear fuel cycle technology such as that to handle highly radioactive and hot materials like minor actinide bearing liquid, can be viewed as nuclear weapons capable states, meaning they could develop nuclear weapons within a short time span if they walked out of the NPT or launched clandestine programmes.

He claimed that the NPT gives too narrow a margin of nonproliferation and therefore a multinational approach to the entire fuel cycle - including the back end - has great potential to facilitate the expanded safe and secure use of nuclear energy for peaceful purposes, while reducing the risk of proliferation.

It should also be mentioned that a series of recent G8 summits has asked the Nuclear Suppliers Group (NSG) to establish the guideline to restrict the transfer of reprocessing technology, which is an essential element for utilizing fast reactors for sustainability.

Considering these developments, may I propose global fast reactor R&D community to ask themselves, from the viewpoint of sound project risk management, whether they should pursue the development of fast reactor systems that fit to a global society with a large-scale regional fuel cycle center under multilateral control.

There has been a proposal as an innovative business model that this center will provide a cradle-to-grave services to operators of fast reactors, supplying fresh fuel that contain fissile plutonium just in time for loading to their reactors and immediately taking back the used-fuel when it is removed from the reactors.

In such case, it might be unnecessary to recycle minor actinide as a) to do so has no particular advantage in terms of safety of high-level waste disposal and b) minor actinide-bearing fuels feature a considerable increase in gamma and neutron doses and of the decay-heat, which would require specific protection and cooling means for transporting these fuels.

In belief, as the IAEA safeguards is a cog of the wheel of nonproliferation policy, we have a project risk of obtaining an insufficient answer to the request to develop a civil nuclear energy framework that reduces proliferation risk if we continue to concentrate our attention only on the innovative ways to strengthen the proliferation resistance of the technological systems concerned. It may be necessary for us to pay more attention to innovation of business model to fast reactors and related fuel cycles with a view to developing a civil nuclear energy framework that reduces proliferation risk.

In conclusion, ladies and gentlemen, many counties are committed to make long term investment for the development of the fourth generation nuclear reactor systems and fast reactors and its fuel cycle in particular with entrepreneurial imagination and willingness. The key for this endeavor will be to create and deploy innovative products and processes that do not exist yet today. The energy technologies that catalyze such development will reap the greatest rewards.

But innovation of technology and innovation of the related business to make full use of it are not so easy to achieve successfully. Innovative learning is necessary to be successful in this endeavor of knowledge creation through socialization, externalization, combination and internalization of knowledge.

I found in the program of this week many sessions for discussion about innovative learning in various contexts and areas with a view to pursuing innovation of both fast reactor and its fuel cycle technology and business for its utilization. I sincerely hope you the very success of this conference.

Thank you very much for your kind attention.