Call for Evidence on
Nuclear Research and Development Capabilities in Japan
Before and After the 3/11 Fukushima Nuclear Accident

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Select Committee on Science and Technology
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It is my honor to present oral evidence on nuclear research and development capabilities in Japan, in particular, after the Tokyo Electric Power Co.'s Fukushima Dai-ichi nuclear power plant accident on March 11, 2011. As a member of Japanese government and an expert who has been conducting research on nuclear energy policy, I would like to express my sincere regret for what happened at Fukushima. Also, by taking this opportunity, I would like to express my heartfelt appreciation for the generous assistance given by the UK government to Japan. Especially, we were grateful for two individuals, one is UK's Chief Scientific Advisor, Prof. Sir John Beddington and the other is UK's Chief Nuclear Inspector, Dr. Mike Weightman. Sir Beddington's accurate and objective assessment of the situation of Japan in March was greatly appreciated, and his visit to Japan in June was also highly popular among Japanese experts as well as the public. Dr. Mike Weightman also visited Japan, leading the IAEA (International Atomic Energy Agency) Fact Finding Team and published well-respected report in June. Thank you very much again for your extraordinary efforts.

As requested by the Committee, I am very happy to present the summary of Japanese nuclear R&D capabilities and possible implications of the Fukushima nuclear accident.

Historical Review

Historically, Japan's nuclear R&D was initiated in 1954 when the Diet passed the first nuclear R&D budget, and the first Long Term Plan for Development and Utilization of Atomic Energy was published in 1956 by the Japan Atomic Energy Commission (JAEC). Since the first Long Term Plan, Fast Breeder Reactor (FBR) and closed nuclear fuel cycle is the cornerstone of Japanese nuclear R&D program. While Japanese utilities imported Gas-Cooled Reactor (GCR) from the UK as the first commercial reactor, US-developed light water reactor (LWR) later became the dominant reactor type for commercial programs.

The JAEC's 1967 Long Term Plan concluded that the FBR should be the mainstream of future

nuclear power generation and the government established the Power Reactor and Nuclear Fuel Development Corporation (PNC) as the primary R&D institution for FBR and nuclear fuel cycle development. Japan's first FBR reactor was the experimental Joyo (Eternal Sun). The Prototype FBR Monju (280 MWe) was developed in parallel with Joyo, but construction was delayed and it did not achieve criticality until 1994. On December 8, 1995, Monju experienced a sodium leak accident which led to long shutdown period until May, 2010. But again Monju is now shutdown due to a technical problem.

While Japan's public commitment to the FBR and closed fuel cycle has not wavered, the FBR R&D budget has been steadily declining until 2005. The FBR program share of total nuclear R&D peaked at 35 percent in early 1970s during the construction of Joyo. In 1989 it fell to 20% (￥77 billion) during peak construction at Monju. Since 1989, both the FBR budget and its share of Japans total nuclear R&D budget has steadily declined and by 2005 it had had fallen to 5% (￥27 billion) of the total budget. Since then the budget is gradually increasing until now. Cumulative spending on FBR R&D from 1956 to 2007 was ￥1,480 billion representing approximately 12% of total spending. Figure 1 shows the budget trends for all nuclear energy and FBR related R&D.

[FIGURE 1]

As the share of FBR in total budget declined, shares of nuclear fuel cycle and waste management as well as LWR R&D increased while total budget has been in steady decline in the last several years. Nuclear fusion budget has increased due to the ITER (International Thermo-nuclear fusion Experimental Reactor) project. Basic science R&D such as J-PARC (Japan Proton Accelerator Research Complex) has also increased its share.

Current Status and Major Issues

The latest 2005 Long Term Plan was renamed the Framework for Nuclear Energy Policy which reaffirmed the development of FBR and closed nuclear fuel cycle policy, and thus allowing startup of the Rokkasho reprocessing plant. But the Rokkasho reprocessing plant is not in commercial operation yet as of June 2011 due to technical problems, and thus spent fuel management has become an urgent issue for nuclear utilities. Another issue is plutonium management. Japan has more than 46 tons of plutonium (8.7 tons in Japan, approximately 37 tons in Europe) of separated plutonium in stockpile, but its MOX recycling program has made only a little progress.

Meanwhile, the commercialization target for FBR was set at around 2050. In 2006, the Sub-committee on Nuclear Energy Policy of the Government's Advisory Council on Energy published the Nuclear Power Nation Plan, which laid out detailed policy measures based on the JAEC's Framework. The Nuclear Power Nation Plan reiterates the 2050 commercialization target for

the FBR and announced a goal of developing a post- Monju demonstration FBR (DFBR) by 2025. The associated Phase II "Feasibility Study on Commercialization of Fast Reactor Cycle Systems (FaCT)" compared various types of fast reactor designs and associated fuel cycle technologies, and tentatively identified a sodium-cooled fast reactor with advanced wet reprocessing technology as the preferred option. It was expected that FaCT project report would be reviewed by experts and the plan for the next step was supposed to be discussed this year's newly established Council on New Framework for Nuclear Energy Policy which was suspended in March due to the Fukushima accident.

As for other R&D activities, there is an increasing concern that declining budget would undermine basic and safety research capability. The total nuclear budget of FY2011 is 316.2 Billion yen, which is 4.9% decline from 331.6 Billion yen in FY 2010, and almost 36% decline of its peak at 494.6 Billion yen in FY 1996. The JAEC Advisory Committee on Research and Development started discussions on measures to promote nuclear R&D in August 2008, and prepared a report in November 2009. The report indicates in terms of R&D activities in Japan that "some projects are not progressing as intended and their schedules were being reviewed." Also indicated is the future vision of nuclear R&D in Japan, including adoption of a "spiral-type" R&D approach, which consistently reviews R&D activities through the proposal / utilization of the latest scientific findings in order to respond to social requests, instead of the linear approach of "fundamental research empirical study commercialization." Another important finding of the Advisory Committee was that diversity of R&D activities should remain important and thus sufficient attention should be paid to keep various R&D programs which may not be regarded as "commercially viable" in the near future; such as high-temperature reactor, thorium fuel cycle, uranium from sea, etc. Another important trend was that safety R&D budget has been in steady decline due to putting higher priority on project-oriented engineering research.

[FIGURE 2 Safety Budget decline]

Implications of the Fukushima Accident

Although the long term impact of the Fukushima accident is not known yet, its short term impact on Japanese nuclear programs are already quite significant. On April 12, JAEC stated that "*we are gravely concerned about this accident which can fundamentally undermine public trust in safety measures, not only in Japan but also in other countries*." And on May 10, JAEC also issued the statement in which it said as follows;

> "*…. JAEC recognizes that plenty of urgent technical issues exist in extensive fields, from restoration from the accident to the restoration of the disaster-stricken communities and environment, and decommissioning. Therefore, JAEC will request research and development*

institutions, etc. to give top priority to the research and development and technology demonstration concerning these issues."

While there are 54 commercial nuclear power plants currently licensed in Japan, only 19 reactors are operating (14 units are shut down due to the earthquake, and 21 units are now shutdown due to maintenance or other technical reasons). Prime Minister Kan requested Chubu Electric Power to shutdown Hamaoka nuclear power plants on May 6, 2011, until new measures against Tsunami will be in place (for about two years) which was accepted by the Chubu Electric Power. Since then, it is becoming more difficult to restart up all other nuclear plants which are currently shutdown. The energy basic plan published last year, which called for additional 14 units by 2030, has been scrapped and will be reviewed soon.

The Fukushima Dai-ichi nuclear crisis still continues. We expect many technical, social, legal and economic hurdles to overcome. Technically speaking, stabilizing the reactors and managing large amount of contaminated water (more than 100,000 tons) are still challenges. Cleanup of the site as well as large amount of contaminated debris from the accident is another big challenge. Finally, decommissioning and dealing with spent fuel from both storage pools and damaged fuels in reactors are long term challenges. The Japanese government's report to the IAEA published in June, 2011, stated as follows;

"….Japan will promote the 'Plan to Enhance the Research on Nuclear Safety Infrastructure' while watching the status of the process of settling the situation. This plan is intended to promote, among other things, research to enhance preparedness and responses against severe accidents through international cooperation, and to work to lead the results achieved for the improvement of global nuclear safety." (p.43)

In this context, we believe significant changes in priority of R&D activities would be needed in order to respond urgent and various needs from the Fukushima accident. Globally, the recent IAEA Ministerial Meeting on the Fukushima accident also called for enhanced nuclear safety, emergency preparedness and radiation protection. It is our hope that lessons drawn from the Fukushima accident could contribute to achieve such global goals.

Moreover, on the recognition that the social environment surrounding nuclear power generation has dramatically changed as a result of the accident at the Fukushima Dai-ichi Nuclear Power Plant, JAEC will start sorting out the important issues to be considered when making decisions on nuclear policy in the future, without waiting for the results of the investigation of the accident. As part of this effort, JAEC will re-evaluate the characteristics (including the risks, cost, etc.) of nuclear power generation as an energy source, and the roles of nuclear power generation in view of today as well as the next 20 and 30 years based on such characteristics. For this purpose, JAEC is now carrying out public hearings with experts from various quarters at the regular meetings, etc.

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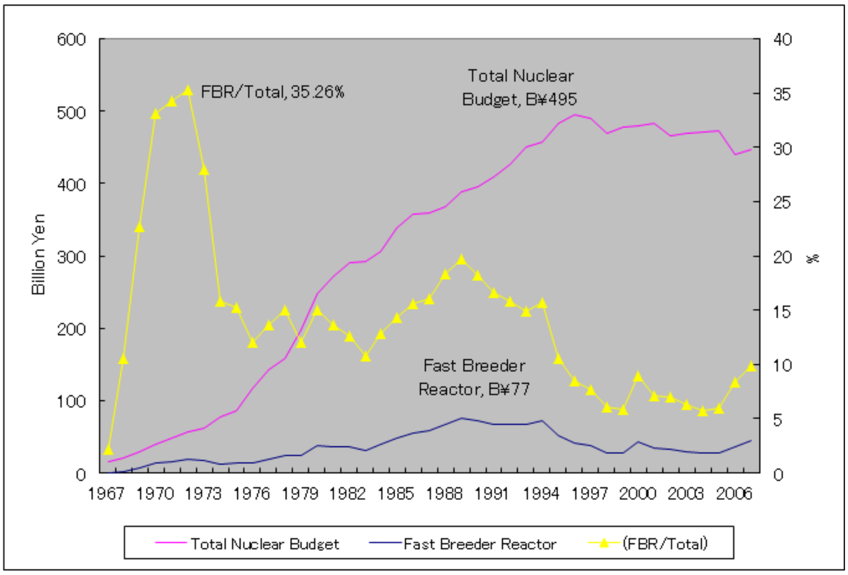
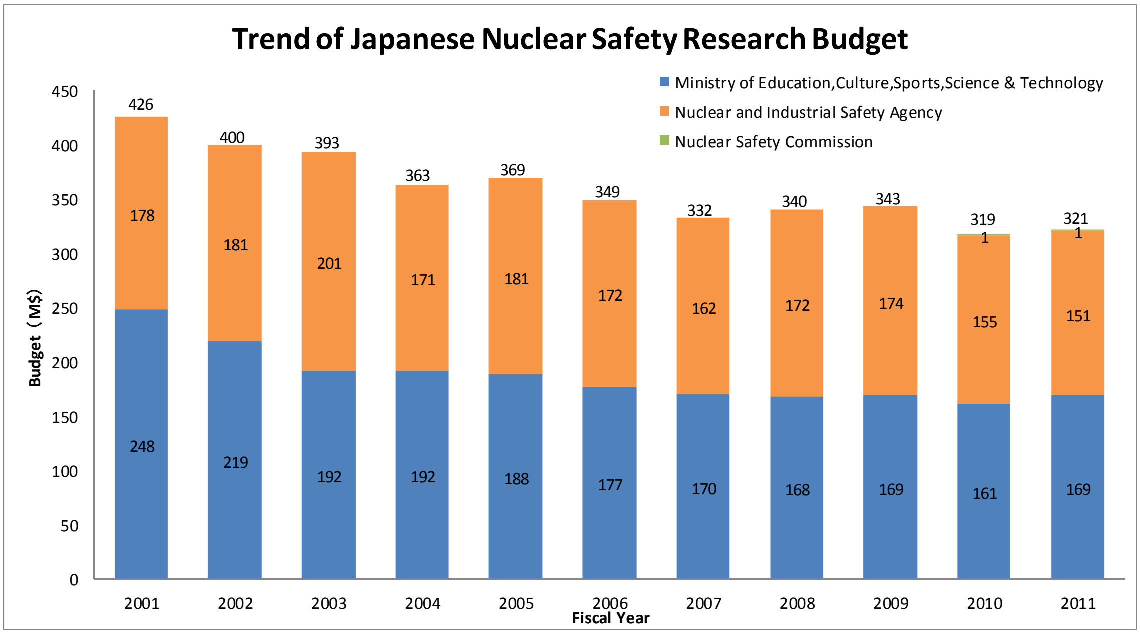
Figure 1



Source: Tatsujiro Suzuki, "The Fast Reactor and its Fuel Cycle Development in Japan: Can Japan unlock its development path?" *Science and Global Security*, vol. 17, pp. 99-107, 2009.

Figure 2 Trend of Japanese Nuclear Safety Research Budget



Source: Japan Nuclear Energy Safety Organization.