Progress of Medium- and Long-term Efforts to Decommission Fukushima Dai-ichi NPP of TEPCO (Statement)

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Japan Atomic Energy Commission

Tokyo Electric Co., Ltd. (TEPCO) announced the "Roadmap towards Restoration from the Accident at the Fukushima Dai-ichi Nuclear Power Plant" in April 2011, following the nuclear accident at the Fukushima Dai-ichi Nuclear Power Plant (Fukushima NPP accident). Its progress was supervised by the Government-TEPCO Integrated Response Office, established the same month, and the step 2 mentioned in the Roadmap was completed after the "cold shutdown condition" had been achieved in December the same year.

During this period, the Atomic Energy Commission of Japan (JAEC), considering the obligation of the government and TEPCO to decommission the disabled reactors while minimizing risk to nearby residents and workers who engaged in the work at the accident site, concluded that they should promptly determine a roadmap that specifies the medium- and long-term tasks pending the completion of decommissioning, such as removing and storing spent fuel as well as fuel that had melted and hardened (fuel debris), dismantling nuclear facilities, processing waste from dismantling into manageable forms, and decontaminating radioactivity and cleaning the site. JAEC also considered it important to identify R&D themes that may be useful for carrying out the roadmap and ask the government and TEPCO to share them and work on the roadmap next to restoration from the accident. In July 2011, JAEC established the Advisory Committee on Medium- and Long-term Measures at the Fukushima Dai-ichi Nuclear Power Plant, Tokyo Electric Power Co. (Advisory Committee) to discuss these matters, and in December the same year, made recommendations to the government on decommissioning according to the "Results of Investigations into Mid- and Long-term Measures at Fukushima Dai-ichi Nuclear Power Plant, Tokyo Electric Power Co., Inc." provided by the Advisory Committee.

As the step 2 of the abovementioned roadmap was completed, the Government-TEPCO Integrated Response Office was disbanded, and a new Government-TEPCO Mid-to-Long Term Countermeasure Meeting (Countermeasure Meeting) was formulated the same month. The Countermeasure Meeting established a Medium-to-Long-Term Roadmap for Decommissioning Reactor Units 1 to 4 of Fukushima Dai-ichi Nuclear Power Plant, TEPCO (Medium-and Long-term Roadmap) based on the recommendations of JAEC, since which time efforts have been focused on cleaning up the accident site.

In March 2012, the Nuclear and Industrial Safety Agency (NISA) instructed TEPCO to prepare a practical plan to enhance medium- and long-term reliability of measure to maintain the stable condition of the disabled units. In response, TEPCO submitted an action plan. NISA assessed this at a public hearing held in July, based on expert opinion, and announced the results. The same month, the Countermeasure Meeting revised the Medium- and Long-term Roadmap, and currently is conducting its stage 1 operation, namely, investigating the inside of unit 1, and checking the integrity of the spent fuel pool of unit 4 etc.

Even though they could start the removal of the fuel assemblies from the spent fuel pools within two years and fuel debris removal within a decade, in line with the Medium- and Long-term Roadmap, decommissioning of all disabled reactors will take more than 30 years, during which time it is essential that safe and secure operation should be assured to allow Fukushima prefecture residents to live safely and peacefully.

JAEC checked the revisions made to the Medium- and Long-term Roadmap and the progress and result of the work to date at the regular meeting in August 2012, and exchanged opinions with experts closely involved to the relevant tasks. Furthermore, JAEC listened to opinions from Advisory Committee members, including experts who participated in the Countermeasure Meeting as an advisor and understood the site status, and to requests from the local residents made in the public hearing in Koriyama City in March 2012, and Iwaki City in July 2012. Based on those opinions and requests, JAEC first published a draft statement including recommendations and sought public comments on it. The draft recommendations called for efforts to eliminate any shortage of and delay in the adoption of measures on important matters highlighted in the report of the Advisory Committee for the future operation of the roadmap, and indicated matters that were clarified and noteworthy as the work proceeded.

This final statement incorporated and reflected some of the public comments in response to draft statement. JAEC expects the parties concerned to make steady progress in their obligations while observing the notes indicated below.

1. On-Site Activities

(1) Activities to prevent any recurrence of unexpected incidents

The government and TEPCO have been working to ensure the reliability of cooling systems for units 1 to 4 at Fukushima Dai-ichi Nuclear Power Plant and the durability of unit 4

reactor building, the earthquake resistance of which was often questioned, and prevent incidental criticality due to unexpected morphology or configuration of fuel debris during removal as well as recurrence of unexpected incidents, such as explosions of hydrogen in a confined space, or copious leaks of contaminated water, gas or dust. However, as situations will change according to work progress, the possible recurrence of unexpected incidents should always be checked based on the site status, and all available measures should be taken to maintain the safety of the public and workers. Information concerning such preventive activities should be shared with the public and workers.

(2) Activities to prepare for emergency

The government and TEPCO should deliberate appropriate emergency management measures for disabled reactors and reactor units 5 and 6 that are to be in shutdown state for a long time by analyzing emergency scenarios including serious accidents, and prepare the required equipment for emergency response. They also should work with the local government and communities in Fukushima for the establishment of disaster prevention plan and the preparation of response capability in accordance with new disaster prevention guidelines.

(3) Activities to ensure the safety of workers and working conditions

The government and TEPCO should be ever-mindful of the fact that the workers and their activities are crucial to the successful decommissioning of reactors, including cleaning work according to the Medium- and Long-term Roadmap, enhanced safety measures such as the reinforcement of radiation control and medical treatment for radiation during emergencies, and working conditions such as a guaranteed employment plan for workers reaching the dose limit. It is particularly important to continue improving worker safety, and enhancing the transparency of work, e.g. by third party audits as described later. The importance of strict access control is also significant for nuclear security. Therefore continuous efforts should be made in this respect with a view to managing an appropriate work environment from workers' perspective.

As activities in the Medium- and Long-term Roadmap involve operations over time, ensuring worker safety and maintaining the technological level all the time are crucial. The government and TEPCO should examine the suitability of conventional employment using second and third subcontractors to ensure workforce in long-term operations in the context mentioned above, deliver a vision of a new form of employment and strive to implement it.

(4) Activities to treat contaminated water

Current key issues include limiting the generation of contaminated water by preventing groundwater from flowing in reactor buildings, and treating the contaminated water, for which effective and robust activities should be definitively planned and implemented. Even if the plan is implemented, the contaminated water may need to be discharged into the environment after being treated to a level meeting the required standard, for which public understanding and cooperation are essential. The government and TEPCO should tackle this issue as early as possible.

(5) Removal of spent fuel

The Advisory Committee urged that spent fuel be moved as early as possible from the accident site to spent fuel pools in other buildings or spent fuel casks, with the long-term integrity of fuel assemblies stored in spent fuel pools into which sea water had been injected and reactor building damage in mind. The potential for damaged spent fuel cannot be excluded. The Committee advised the government and TEPCO on sufficient preparations to cope with unexpected events and the risk of handling fuel assemblies leading to the repeated discharge of nuclear materials again. These efforts have been steadily promoted to date, and should be continued till the early removal of fuel is completed through steady preparations, based on knowledge acquired on site.

(6) Waste disposal activities

The government and TEPCO should develop facilities and systems for the safe and secure temporary storage of radioactive waste and rubble caused by the tsunami and subsequent reactor accident and stacked inside and outside buildings, secondary waste from cleaning work such as the removal of rubble, decontamination, treatment of contaminated water, and removal of fuel, and high-level radioactive waste such as fuel debris. They should also examine technological options for the final disposal of such waste, and integrate them into the current cleaning work to avoid wasteful activities. They should start from what is possible, including the incineration of flammable waste, promote R&D of technologies to dispose of and stabilize waste for long-term storage and disposal in future, and implement the technologies developed as soon as practicable.

(7) Activities to reduce workers' exposure dose

The government and TEPCO should reduce the discharge of radioactive materials in the form of gas. Regarding direct dose from radioactive waste and cutover wood stored in the premises as well as sky-shine dose, they should focus how to effectively reduce the

exposure dose of those working inside and outside the site, taking in consideration of the fact that the high dose come from the forests outside the site of which decontamination is delayed and the progress of decontamination there. Furthermore, the results of periodic and detailed assessment of the quantity of radioactive materials discharged into the environment should be disclosed to residents around the plant.

(8) Clarification of the accident development mechanism

Recognizing that further clarification of the detailed accident development mechanism is one of the critical components of medium- and long-term measures, The government and TEPCO should promote the detailed study of accident progression in detail steadily and suitably reflect the result when making decisions on individual action plans, and their degree of urgency and priority.

2. Highly Safe, Transparent and Efficient Operation

(1) Response to regulatory authorities and International Atomic Energy Agency (IAEA)

TEPCO should safely and promptly proceed with medium- and long-term measures, including many unprecedented tasks, for which prompt permission from the relevant regulatory authorities should be obtained. They should consider various ways to minimize risk in individual works at an early stage prior to the commencement of these works, and give a detailed explanation to authorities as reasonable grounds for judgment. Regarding the IAEA safeguards of nuclear materials, TEPCO should develop technology for safeguards of fuel debris, and consult regulatory authorities and the IAEA for its application, ensuring no loose ends.

(2) Development of related laws, regulations and standards

Considering the urgent need to implement medium- and long-term measures steadily, the regulatory authorities should examine the provisions of laws, regulations and standards that should be imposed on the dispose of damaged fuel, fuel debris and waste produced from unprecedented cleaning work at the Fukushima Dai-ichi Nuclear Power Plant accident site by, for example, referring to the laws and regulations applied to the Chernobyl accident, and enforce them in time so that prompt and efficient operation at the site should not be hampered due to the absence of them.

(3) Government obligation to medium- and long-term measures

The government is responsible for implementing medium- and long-term measures safely

and securely by ensuring the operator optimally exploits its capability to engage in various work through the effective use of knowledge at home and overseas, and securing its technological and administrative capability, procurement of facilities, manpower, costs, technologies and materials. The government is also obliged to strive to maintain transparency of operations throughout the work so that the domestic and international communities correctly understand that the medium- and long-term measures are carried out in this manner. The government should establish an independent (third party) organization with overseas experts as members to assess and audit the medium- and long-term measures based on the above criteria, with the authority to make recommendations to the government on improvements as required. Based on these recommendations, the government should optimize the administration system, paying due attention to the merit of establishing a dedicated decommissioning body in future.

(4) Communication with local residents

JAEC has held public hearings in which the progress of the work was informed to surrounding local communities, firmly believing that transparency of work is essential for maintaining the safety and validity of medium- and long-term measures from the perspective of experts, local governments and the general public. JAEC expects that the Countermeasure Meeting will take over the task and continue operations efficiently in consultation with Fukushima prefecture. The abovementioned independent organization, if implemented, should be assigned to meet regularly and present the progress and prospects of medium- and long-term measures to related local governments and residents and ask their opinions and requests.

(5) Systematization of results

An archive (collection and storage of records) is planned to organize records of the analysis of the causes and results of the Fukushima Nuclear Power Plant accident, for open public access, so that everybody involved can confirm the safety and security of nuclear energy. The results announced to date about efforts in the form of medium- and long-term measures over the coming 30 years should be collected systematically as part of archival records, which may be useful for future decommissioning operations. The government and TEPCO should actively cooperate for this task. Needless to say, intellectual assets contained in these records should be handled accordingly.

(6) Human resource development

In the short run, collaboration and coordination of related organizations are needed to

provide the required manpower on site when conducting medium- and long-term measures and R&D. As generation change of engineers is unavoidable in operation over 30 years, the government and TEPCO should clarify human resource requirements from medium- and long-term perspectives, and promote the development of the basic technologies and human resources required for the decommissioning of the Fukushima Dai-ichi Nuclear Power Plant, utilizing the accumulated experience of the Japan Atomic Energy Agency (JAEA) and existing facilities to meet these requirements in cooperation with educational institutions and research bodies that have capabilities to do so. For the work requiring highly skilled workers, such as remote control for handling fuel and fuel debris, effective technological transfer is important. For this purpose, educational institutions should be located around the site, together with the test installation mentioned later, which acts as the basis for R&D and engineering development. Attractive curricula in such institutions are essential so as to be able to appeal to young engineers seeking educational opportunities as technology transfer from generation to generation and the willingness of young engineers to join the project are important in a long-term project such as this.

3. R&Ds and Engineering Developments

(1) Support activities to promote R&D

To promote medium- and long-term measures, knowledge in various fields and various technologies are required, some of which are only available through research and development. The R&D issues have already been identified, and proposed solutions promoted, involving collaboration of the government and related organizations, but these R&D and engineering development efforts should be reviewed as related work proceeds to ensure effective and efficient operation as a whole. This should be ensured by forming technical, economic and strategic analysis teams that report to dedicated leader, who is capable of overseeing the entire operation and supervising the persons in charge who perform their respective jobs under strong leadership.

The operation may be managed mainly by the Countermeasure Meeting held in Tokyo for the time being, but delegation of authority to implementation forces should be discussed to prepare for the future when related facilities are built on site, experts assigned, and the headquarters moved to the site. Particularly in terms of technological development, the system involving a steering committee has limited effectiveness. The establishment of a practical organization such as a research association headed by a suitable person should be considered from the viewpoint of assuring effectiveness in the developmental activities.

(2) Utilization of global knowledge

It is important to use high-level skills and knowledge worldwide in the implementation of medium- and long-term measures, in which unprecedented tasks, such as treating highly radioactive contaminated water and fuel debris in bulk are included. Both the government and TEPCO should be aware of their obligation to prioritize needs at the site above all, and support the development of the most effective and efficient technologies to meet such needs, while carefully listening to the opinions of overseas experts as to optimal technologies to be applied on site.

Operators supporting R&D are gathering information concerning potentially viable technologies offered by domestic and overseas research institutes and private companies in Japan and overseas to make a technology catalog, with a view to utilizing it in the development of technical specifications for required products and self-developed products. However, information contained in the present catalog is not sufficiently comprehensive. They should share with the private companies and individuals with viable technologies and knowledge the results of technologies introduced to date and their assessments even if they are at the R&D stage.

Furthermore, a new framework for collecting knowledge should be discussed, considering the increasing need for and importance of generic technology and knowledge leading to solution and system integration in future. Therefore the government should not only disclose information on the progress of the technology selection scheme and provide opportunities for domestic and overseas experts to exchange information to improve design and promotional work, but also start discussion on the future modes of operation, including restructuring and management of the technology catalog so as to ensure the most suitable technologies are continuously used on site.

(3) Incentives for gathering wisdom

The present R&D framework is considered less functional as an incentive to encourage parties involved to acquire knowledge and technology at home and overseas, though they are expected to strive to collect wisdom in Japan and overseas to develop reliable and outstanding technologies that meet site needs efficiently and economically, by procuring viable technologies from outside, and developing technologies jointly with outside organizations having excellent technologies. If their efforts are insufficient, the framework of the basic development program, and public procurement and commission of work should

be examined again.

(4) Accident progression analysis using computer simulation

Accident progression analysis using computer simulation is important for understanding the details of core damage and the distribution of fuel debris in the reactors and essential for implementing medium- and long-term measures and planning those to deal with severe accidents. With these in mind, the government should promptly upgrade computer simulation tools for accident progression analysis to ensure the result of severe accident analysis is promptly available in the planning and the execution of relevant measures.

(5) Fostering of industry, creation of new jobs and construction of a community

The government and TEPCO are planning to construct facilities for analyzing the property of fuel debris and radioactive waste and testing processing methods, as well as mockup facilities for R&D into the operation of the robots and remote control equipment required to implement medium- and long-term measures, either on site or in the vicinity. The objectives for the former facilities are to maintain consistency between tests conducted by JAEA and those at the new facilities for effective use of JAEA equipment, and those for the latter facilities, including maintenance of equipment and training of operators, as well as pre-training of workers to make the work safer and more efficient.

The use of reactor units 5 and 6 is considered for performance tests of robots and remote control equipment according to certain opinions.

These facilities should be constructed according to the Basic Policies for Recovery and Reconstruction of Fukushima, decided by the cabinet as a science education center of the local community, and for developing robots and remote control equipment in cooperation with companies in affected areas, and for helping foster local industry and create new jobs in consideration of the importance of re-constructing a community with local residents, researchers, educators employed under this program and local residents.