Promotion of Measures to Secure and Develop Human Resources for Nuclear Energy
(Statement)

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Atomic Energy Commission of Japan

The Innovative Strategy for Energy and the Environment (the Strategy), established by the Energy and Environment Council of the government, stipulates the principle that new nuclear plants will not be built and criteria that restrict the lifetime of a nuclear reactor to 40 years should be strictly applied while allowing the use of nuclear plants where safety has been confirmed by the Nuclear Regulation Authority as key power sources, under a basic policy of realizing a society non-dependent on nuclear energy as early as possible.

The Strategy then identifies it essential to strongly support manpower with advanced skills and highly safety-aware to ensure nuclear safety and establish the technologies required both for processing/disposing of generated spent fuel and for decommissioning nuclear plants after their termination, since the safety of nuclear energy used as an important power source is the top priority. It also assumes that developing advanced decontamination technology and human resources for using the technology will facilitate the earliest possible return of Fukushima prefecture residents forced to evacuate due to the accident in Fukushima Dai-ichi Nuclear Power Plant of TEPCO. In addition, in a country which promotes the peaceful use of nuclear energy, studies into the effects of radiation, and uses of nuclear power, developing nuclear human resources is essential to support the safe operation of nuclear power plants, including back-end operations such as decommissioning and waste disposal. Japan is obliged to help improve the safety and security of global nuclear energy management by sharing its experiences and lessons learned from last year's nuclear accident with the international community. To meet these obligations, it says that Japan should offer necessary technology if other countries want to use Japan's nuclear technology, for which the continued development of human resources is essential.

Now in the 21st century, numerous engineers who have played vital roles in researching and developing nuclear technology in the international community, or mainly in nuclear developed countries, will reach retirement age. To ensure a smooth handover to the next generation, requirements of enhancing human resources development, supporting human resources

development in nuclear emerging countries planning to start nuclear power generation, and securing manpower to offer safety technology to emerging countries have been identified and human resource development has been promoted. Here, Japan is no exception, and has planned and promoted the required activities.

However, when nuclear power plants are operated based on the policy of the Strategy, the share of nuclear power in Japan's energy mix will gradually decrease. Considering the results of countries having reduced the share of nuclear power, it is predicted that fewer young people will choose nuclear technology as an academic subject or want to work in the nuclear sector if nothing is done, even if nuclear power remains an important power source. Accordingly, JAEC exchanged opinions with key persons in the human resource development field, including the Nuclear Human Resource Development Network, concerning restructuring of human resource development programs in Japan to meet the requirements of Strategy at a JAEC's regular meeting in October 2012, and issued a draft Statement focusing on critical issues in future according to the above exchange of opinions, seeking public comments. This statement was finalized taking into consideration of the comments received. JAEC expects that parties concerned should promote these efforts steadily, keeping the following points in mind.

This document does not cover human resource development for the decommissioning of Fukushima Dai-ichi Nuclear Power Plant of TEPCO, which will be addressed in "Promotion of medium- and long-term efforts toward the decommissioning of Fukushima Dai-ichi Nuclear Power Plant of TEPCO," a document separately published by the commission.

(1) Prospective analysis of demand-supply gaps of nuclear human resources

Developing human resources is time consuming, as it needs time not only for activity to develop human resources itself but also for implementing a necessary system for that, in many sectors including the nuclear sector. Now that the Innovative Strategy for Energy and the Environment has been formulated, the prediction of future demand for human resources, adjustment of supply according to demand, and review of human resource development itself are the most pressing issues.

First of all, the related government agencies and demand side, including the nuclear industry, clarify when, in what areas and how much manpower is required based on operational plans in accordance with the policies of the Strategy. Key considerations during this work include demands concerning administrative activities of related administrative bodies, nuclear power generation and subsequent decommissioning of nuclear plants, equipment production,

and fuel cycle services in the nuclear industry, as well as those imposed by the medium- and long-term measures for decommissioning Fukushima Dai-ichi Nuclear Power Plant of TEPCO and offsite decontamination, and related demands for qualified personnel, such as the chief reactor engineers.

At the same time, educational institutes such as research bodies, universities and technical colleges (universities, etc.) should clarify when and how much manpower they can offer to meet the needs of the demand side, and predict future demand-supply gaps. Based on these results, the nuclear industry, educational institutes and research bodies should make policies for future human resource development, which are then promoted to foster human resources. Meanwhile, the government should supports the activities of the nuclear industry, educational institutes and research bodies within the scope of public interest.

Demand-supply gaps have been predicted in certain areas by related academic societies, but under present circumstances, it is appropriate for the Nuclear Human Resource Development Network to perform the task with the cooperation of related parties. The parties concerned must assess various situations, and review demand-supply gaps periodically to ensure suitable human resource deployment and development.

(2) Nuclear education in educational institutes based on lessons learned from the accident at Fukushima Dai-ichi Nuclear Power Plant

Preferably, nuclear education programs in universities, etc. are based on their unique educational policies, designed according to the required demand for human resources, and improved as needed. Teachers and trainers are expected to consult with organizations requiring nuclear human resources based on the results of analysis of human resource demand and supply gaps mentioned in paragraph (1), and investigate standard nuclear education programs and new programs to be added, based on the predicted increase in the need for highly skilled, safety-aware manpower in the area of nuclear power generation, decommissioning, waste management, and decontamination.

The post-Fukushima Dai-ichi Nuclear Power Plant accident evaluation suggested that grave consequences ensued due to the insufficient preparation at nuclear facilities for unexpected events, particularly rare but devastating natural disasters, efforts to provide robust preventive and mitigation measures against severe accidents, and inability to respond to emergencies associated with natural disasters. Also highlighted were the insufficient efforts of educators and researchers to provide the public with objective information. Some also

underlined the lack of responsibility for ensuring safety and the defects in ethical education as factors behind the accident.

Generally speaking, engineering produces equipment and mechanisms that meet social needs by combining techniques and technologies in various fields and sufficiently taking into account the safety and restraints based on scientific knowledge, but such equipment and mechanisms have diversified impacts on people's lives in areas of politics, the economy, society and the environment. Back-end operations including decommissioning and decontamination are based on various knowledge and insights of many academic fields, as applied now in Fukushima, and characterized by strong and diversified impacts of these fields. Accordingly, those engaged in the research and development of nuclear energy must be capable of integrating a system to meet social needs in cooperation with experts in various fields, responsibly taking control of unexpected events with a strong sense of ethics to prevent an event from developing into a disaster, and providing timely information which may affect society in various ways. In this sense, educational institutes for nuclear-related engineering are expected to enhance their curricula by checking educational programs based on the above perspectives, incorporating liberal arts education in the second semester, and providing programs such as "nuclear sociology" in consideration of the awareness of students of social influence, offering an intellectual environment focusing on the accountability of students to society, and enhancing the experience of internship in nuclear facilities for which accountability is required.

Those familiar with global trends and good practices in nuclear-related industries, businesses, regulations, and R&D must achieve the goal of providing the world's safest and most secure nuclear system. Therefore, educational institutes are expected to focus more on developing the ability of students to allow active participation in system design and construction in the international community through lectures in English and on-the-job training by the engineers working abroad.

(3) Enhancing opportunities for nuclear education in educational institutes

Only part of the engineers in the nuclear sector majored in nuclear engineering: many who are active in this sector studied mechanical engineering, electric and electronic engineering, chemical engineering and so on. With this in mind, educational institutes can provide courses to give students combined bachelor's degrees such as nuclear engineering and material engineering, mechanical engineering or chemical engineering, in addition to nuclear engineering courses. Considering the manpower required to plan and promote

back-end operations, including future decommissioning, urban engineering, environmental engineering, civil and earth resources engineering and other engineering courses should consider the merit of substituting certain lectures and practices with nuclear engineering. In technical colleges, it is important to offer lectures on radiation science, safety management and nuclear power generation, etc., tours of related facilities, and on-the-job training for interested students. Recognizing the importance of offering as many students as possible opportunities to familiarize themselves with nuclear energy and internships, educational institutes and nuclear organizations are expected to cooperate actively to provide these opportunities.

Educational institutes in Europe including universities, etc., which underwent nuclear moratorium policies, suffer significant outflows of students wishing to study nuclear science and engineering, and related educational resources due to reduced research funding. Insufficient practice facilities and experimental installations hamper efforts of universities to maintain nuclear engineering programs which meet internationally acceptable standards, meaning they barely manage to provide such programs through collaboration with research institutes and other universities. It is unclear whether such problem will occur in Japan in the near future, but a nationwide educational network has been discussed and part of it has already been constructed to provide an inter-university credit transfer system and share educational resources through the Internet. Educational institutes are therefore expected to study the viability of the network system joined by universities on a voluntary basis, in preparation for the decision to validate sharing of educational resources to maintain nuclear engineering programs when the demand for human resources is reduced to the minimum required scale for maintaining standard nuclear engineering courses.

(4) Improving educational programs on Radiation

The Fukushima Dai-ichi Nuclear Power Plant accident made us aware of the lack of well-developed education concerning the basics of radiation in academic fields other than engineering, particularly medicine. Urgent measures for radiation education have been taken in Fukushima prefecture, which the government should thoroughly support. Long before the Fukushima Dai-ichi Nuclear Power Plant accident, the National Institute of Radiological Sciences (NIRS) had requested related government authorities to enhance education concerning radiotherapeutics, radiation medicine and radiation science to improve this situation, and supported the revision of the “medical education model core curriculum” in universities. In this context, the parties concerned are expected to expand this activity as early as possible, collaborating with each other, and extend their efforts to enhance radiation

education in medical departments.

Lectures relating to research into radiological effects, which is the basis for radiation education, have also been declining. Primarily, the academy sector is responsible for investigating how to establish educational bases under these circumstances. In Europe which has experienced a similar situation, the European Master of Science Course in Radiation Biology was opened by mainly funded the Gray Cancer Institute. With this and other cases in mind, the parties concerned are expected to gain consensus on self-help as early as possible, mutually assisting and publicly supporting efforts to ensure educational and research bases on the effects of radiation, including the establishment of a human resource development network, based on the need to use related research and educational resources effectively.

It is also important to build a system that trains medical physicists and radiation safety officers who work at the workplace, and allows them to improve their careers to secure human resources for such jobs.

(5) Providing new education opportunities for mid-career experts

Nuclear personnel generally accumulate knowledge of nuclear systems that meet various social needs through “actual work” on designing, manufacturing, operating and managing systems. In this process, opportunities to learn the latest global knowledge may be offered for career progression. Although the in-house education system usually provides such opportunities, programs in universities, etc. may also be available. Similarly, related administrative bodies have also offered the stuff opportunities for education.

If there is no potential to build new nuclear power plants in Japan in future, issues of how to utilize human resources, which are valuable national assets, such as those producing the world’s highest quality nuclear-related products through high-level production technology and the issue of how to foster competent persons by retaining basic human resources should be fundamentally addressed by the nuclear industry that hires them in accordance with its future business prospects.

Meanwhile, companies in the nuclear industry require globalization by, for example, employing an army of foreigners targeting global deployment of their business, as described later. Moreover, students, researchers and engineers are encouraged to contribute their papers to international scientific journals, present them in international conferences, and

hold international conferences and seminars in Japan in order to disseminate the existence of capable experts and technologies.

According to the government commitment to support other countries wishing to use Japanese technology, a certain standard should be maintained in technology and human resources, and the parties concerned should consider how to weather the hardships of current demand, such as devising a chance for young people to participate in “actual work” e.g. through demonstration tests prior to equipment renewal by utilities to transfer know-how of high-level production technology; a scheme which is supported by the government.

(6) Human resource development for nuclear safety, security and safeguards

From an international perspective, employing experienced people in the nuclear industry and providing them with educational programs and training courses suitable for new jobs are said to be effective for fostering competent people in the regulatory field. In Europe, an organization supporting the scientific and technological activities of regulatory bodies (Technical Support Organization: TSO) is also responsible for developing related human resources through international cooperation.

Reflecting on lessons learned from the Fukushima Dai-ichi Nuclear Power Plant accident, establishment of an international organization called the “International Nuclear Safety Training Center”(tentative) is planned in Japan, aiming to develop human resources for nuclear regulation authorities to enhance the qualification of workers engaged in nuclear safety regulations. Nuclear related organizations are expected to cooperate in this plan.

The Integrated Center for Nuclear Nonproliferation and Nuclear Security of the Japan Atomic Energy Agency (JAEA) is responsible for developing human resources for nuclear security and safeguards. Suitable promotion of this work is expected, taking into account the demand for human resources and supply gaps in Asian countries.

(7) Enhanced incentives for nuclear businesses

To date, the nuclear industry has attracted students, young researchers and engineers because of the dominance of nuclear generation for energy security and climate change prevention, and the integration of future technology such as breeder and fusion reactors, in national research and development. However, if no new domestic plants are built in future, it will be difficult to attract people to the domestic nuclear industry as previously.

Nuclear-related organizations should establish policies to increase the incentives for significant results in this industry while learning various approaches in Europe and the U.S., both of which have already experiences of period when no new plants were built. For example, they can appeal by challenging industry with the fact that the nuclear industry can still offer effective power generation technology for energy security and curb climate change from a global perspective.

Although back-end operations, including decommissioning, are a long-term issue, they may spawn technological innovation in terms of robotic technology and waste management applications required for the impending renewal of public infrastructure. The nuclear industry, which has produced and operated such equipment and mechanisms to meet new, diversified requirements, will cultivate the capability to use these in various fields in future.

There is also potential to introduce a system to invite students to workplaces in two or more nuclear organizations to experience and learn actual work on site like “nuclear graduates” in the U.K. In addition, meticulous scholarships, overseas study and skill-training programs should be provided; acknowledging the actual demand for human resources, as well as expanding the scope of university laboratories, etc. to enhance the expected quality of education and research. Planning and promoting R&D projects with attractive and challenging themes also appeals to young and competent people interested in the nuclear industry.

It is important for the nuclear industry and educational institutes to commence and promote these activities on their own initiative, and the government should also support such activities within the scope of public interest. This takes into consideration its policies to utilize nuclear power as a critical power source, the increasing future importance of decommissioning and waste management, and the commitment to offer safe Japanese technologies, including for decommissioning and waste management, to the international community.

In addition to these activities, the government, nuclear industry, educational institutes and research bodies should encourage and support students, young researchers and engineers belonging to nuclear organizations to strive voluntarily to become competent international human resources.

(8) Education about radiation risk

Many people nationwide, particularly in Fukushima prefecture, are deeply anxious about radiation which cannot be perceived with the five senses and we should take this seriously. The government formulated the “action plan to cope with evacuees who are anxious about their health” to support the people worrying about radiation, and share the problems and questions in daily lives with these people. Human resources are essential to accomplish these tasks.

The key requirements for those engaged in the action plan are insight and in-depth knowledge of radiation risks, and an awareness of the sense of value concerning risk management. Improvements to the expert education system for producing knowledge and transferring it to people has been discussed in paragraph (4). However, human resource development is also important for providing competent people, including experts developed in the expert education system, capable of responding suitably to diversified situations in various parts of the nation, particularly Fukushima prefecture, through a dual approach; one to offer knowledge of nuclear energy and radiation to psychologists and the other to offer knowledge of psychology to nuclear and radioactive specialists. When implementing these efforts, cooperation and improvements in human resource development facilities owned by the JAEA, National Institute of Radiological Sciences and other organizations should be enhanced. These human resources should also take an important role in local authorities to develop disaster prevention plans and conduct disaster drills based on the same. Education curricula should also assume these tasks.

Radiation education has already been included in school curricula, and it is recommended that the government increase the opportunities to educate teachers assigned to radiation programs via seminars and lectures for radiation education. It is also important to increase the opportunities for adults to learn about radiation at, for example, social educational facilities including science museums.

(9) Securing human resources for maintaining the operation of domestic nuclear power plants

Electric utilities owning nuclear power plants require their employees to learn lessons from the Fukushima Dai-ichi Nuclear Power Plant accident. At the same time, this is a good chance for utilities to review human resource development and enhance the system as early as possible, considering systems already employed overseas, including a shift safety engineer system in which safety engineers join nuclear power plant operation teams, and a system requiring operating personnel to acquire a bachelor or equivalent academic

qualification to meet high-level qualifications of operating personnel.

For the safe and secure operation of nuclear power plants, electric utilities, maintenance and service contractors, fuel suppliers, plant manufacturers, etc. need human resources to supply the materials and equipment required for the operation, maintenance and repair of nuclear plants. However, from a short-term perspective, utilities cannot predict the restart schedule for nuclear plants currently under shutdown status, and present the maintenance and repair plans to service contractors, which may result in the demission of skilled workers employed by service contractors. Dozens of nuclear plants are currently temporary shutdown, and service contractors nationwide currently have nothing to do. Considering this situation, the government and nuclear organizations must collaborate to tackle the problem as early as possible to prevent skilled workers from retiring, such as dispatching service contractors to TEPCO's Fukushima Dai-ichi Nuclear Power Plant site if there is a lack of manpower for decommissioning procedures.

In terms of medium- and long term prospects, it is likely to be difficult to secure new employees wishing to work in nuclear plants due to the uncertain future of nuclear power generation and related work. The nuclear industry should make medium- and long-term operation plans and examine how to ensure the availability of sufficient qualified people required for achieving these plans. Specifically, discussions should focus on close liaisons between the Maintenance Skill Certification System implemented by the Japan Nuclear Safety Institute (JANSI; former Japan Nuclear Technology Institute) and the respective qualification and certification systems for maintaining and repairing nuclear facilities established by local governments hosting nuclear facilities, and nationwide deployment of the same.

The skill training in these systems may include not only those required for operating the present nuclear facilities and for radiation environment and waste management, but also the phased acquisition of capabilities to improve and promote the work, complying with various laws and regulations, supervising junior staff, and designing and operating workplaces. In so doing, skilled workers can help fill a manpower gap, reasonably pursue their careers by receiving skills training, and continue to receive higher skills training elsewhere, contributing to their motivation of work, and enhancing the efficiency of human resource development and flexibility of work assignments. Refer to similar programs in Europe, such as "Skills Passport" and "Skill Academy" as good examples. The nuclear industry should cooperate with educational institutes to implement these systems, and when the nationwide

deployment of these systems is planned, the government may support cooperating education institutes in the public interest.

(10) Human resource development for the international deployment of nuclear energy and technology

It is important for nuclear research bodies and nuclear generation equipment manufacturers in Japan to deploy their business overseas aggressively to, for example, contribute to improving safety of existing nuclear plants overseas based on lessons from the Fukushima Dai-ichi Nuclear Power Plant accident, and planning the introduction of nuclear power plants worldwide. In support of the introduction of nuclear power plants overseas, based on efforts made by various experienced countries, a comprehensive plan including human resource development in relevant areas is required, as well as knowledge of regulations, construction and operation. The parties concerned should therefore consider how to apply the human resource development system for domestic regulations, construction, operation and education to demand abroad and take the necessary measures. For this purpose, a system usable for developing skill, such as the skill training system mentioned above should be considered. In this system, individual human resources in various fields systematically integrate necessary skills and knowledge relative to the international standards to make them visible. This clarifies the work individuals can do based on their knowledge and experience relative to international standards, allowing effective human resource development, and fostering competent persons sufficiently adaptable to the international community.

These systems can be planned and promoted only when a bilateral agreement is made with suitable financial provisions, and an environment is provided for the nuclear industry to be active abroad.

(11) Education about energy and environmental issues

Ever since the Fukushima Dai-ichi Nuclear Power Plant accident, education in schools about energy, especially nuclear power generation is said to be difficult. Nevertheless, stable energy supply remains a fundamental issue directly affecting people's lives. Citizens must have constant concern over the energy supply in Japan on a regular basis, regardless of the presence or absence of nuclear generation. Energy issues are closely related to environmental issues, and understanding the relations between energy and the environment is also important. Support for suitable education in schools concerning global energy and environment issues, circumstances in Japan, the effective use of energy, and the importance of developing a sustainable society are essential. More chances for adults to learn about

energy and environment issues in social education facilities such as science museums are also expected.

Electric utilities should desirably provide the residents of regions hosting nuclear generation facilities with the opportunity to know about the nuclear operation and experience nuclear generation.