TOPICS Fukushima 1 May 2015 No.65

On February 12, the Japan Atomic Energy Agency (JAEA) held a briefing session in Iwaki City, Fukushima Prefecture. The purpose was to present the research and development efforts, being carried out by the Sector of Fukushima Research and Development, JAEA, aiming at decommissioning of the Tokyo Electric Power Company's (TEPCO) Fukushima Daiichi Nuclear Power Station and restoration of the environment. About three hundred people attended the session. The following gives an overview of the contents of the briefing session.

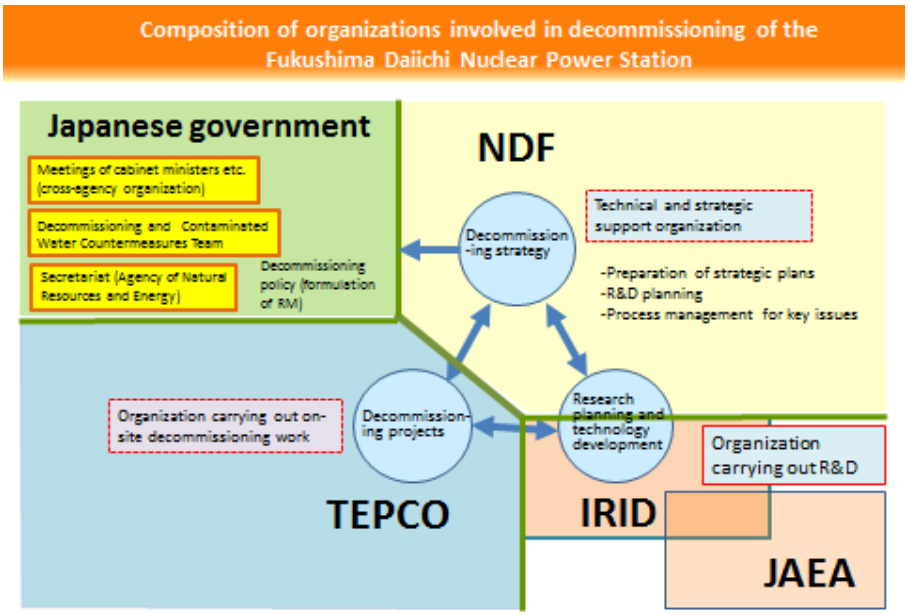
Expectations on the JAEA to meet challenges

Consolidation and concentration/Investigation and application

Hajimu Yamana, Vice President, Nuclear Damage Compensation and Decommissioning Facilitation Corporation

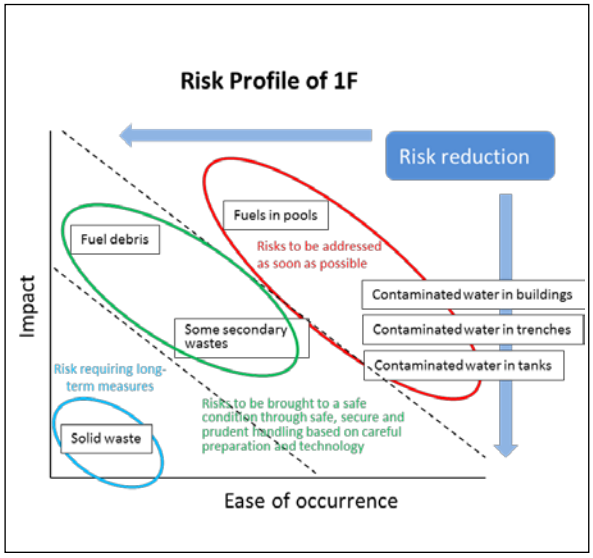
As a national project, the efforts for the decommissioning of the TEPCO Fukushima Daiichi Nuclear Power Station (1F) are progressing to a new stage. The Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF) has been established to strengthen decommissioning strategies, and work is underway to revise the strategic plan and medium/long-term roadmap. It is expected that the NDF will play a role as a coordinator of decommissioning strategy, and research and development (R&D). In the area of R&D, the roles of the International Research Institute for Nuclear Decommissioning (IRID) and JAEA will be extremely important.

The overall organization relating to 1F decommissioning is as follows:



In addition, in the strategic plan that is the technical foundation for the government's medium/long-term roadmap, policies governing the fuel debris[1] removal method will be determined by stressing the following:

- PDCA[2] for decommissioning and R&D
- Formulation of a risk-based decommissioning strategy
- Multiple methods of debris removal
- Starting to examine waste strategies
- Formulating a decommissioning R&D plan
- Broadening international collaboration
- Broadening technical coordination and discussion

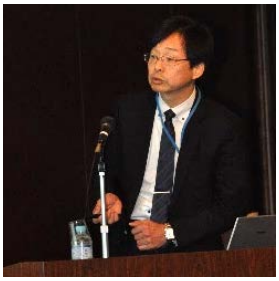


Our objectives for the time being are to reduce risks at 1F and achieve recovery of the disaster-affected area. Therefore, in the strategic plan, the risk profile of 1F is clarified, and on that basis risk management is carried out—always taking into consideration which efforts need to take priority. At the same time, various approaches are being considered for achieving more rational resolution of problems.

The JAEA is a group of experts covering a broad range, from basic science to applications, and it will play an extremely important role in these efforts. It is expected that the JAEA will advance R&D based on knowledge it already has, and will integrate its knowledge with that acquired by IRID and other relevant organizations and deploy it in applications, through close communication with them.

Overview of activities of the Sector of Fukushima Research and Development

Hideyuki Funasaka, Director, Planning and Co-ordination Office, Sector of Fukushima Research and Development, JAEA



The JAEA is Japan's only comprehensive research and development organization relating to nuclear power. Since the 1F accident occurred, the JAEA's top priority has been to put all of the agency's resources into efforts to respond to the 1F accident, while exploiting the knowledge it possesses. These

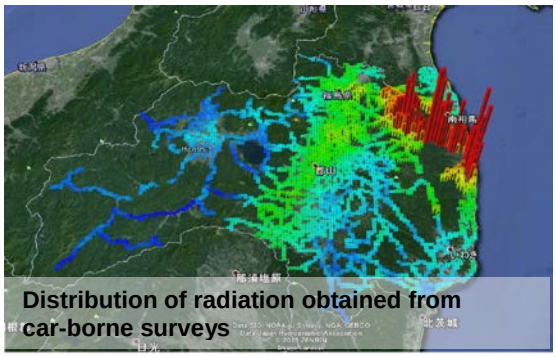
[1] debris: fuel assembly once melted and then solidified with the other materials in the reactor core

[2] PDCA cycle: A method for carrying out work smoothly and achieving continuous improvement by repeatedly cycling through the steps: Plan→Do→Check→Act.

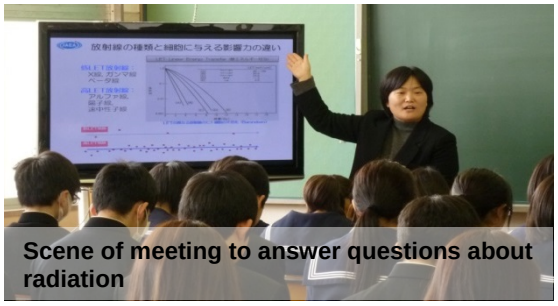
efforts fall under two basic areas: decommissioning and restoration of the environment. This report gives an overview of these efforts, while presenting a few specific examples.

Moving forward with decontamination by measuring radiation

In order to make progress in restoration of the environment, it is required to investigate where and how much radioactive materials are. Therefore, JAEA has clarified the distribution of radioactive materials and radiation dose rates by using manned and unmanned helicopters to investigate from the sky, car-borne surveys on the ground, and walking surveys using gamma plotters. In addition, a Decontamination Pilot Project has been carried out under commission from the Cabinet Office, and a series of work procedures from decontamination to temporary storage of removed items has been established. Going forward, future conditions will be predicted by elucidating migration behavior of radioactive materials, and knowledge acquired there will be reflected in decontamination measures.



Distribution of radiation obtained from car-borne surveys



Scene of meeting to answer questions about radiation

Simultaneously with these efforts, we have carried out purification of swimming pool water in schools and kindergartens, and conducted radiation measurements using whole body counters for approximately 80,000 residents of Fukushima Prefecture since just after the accident. We have also held meetings called “Question-and-Answer Session on Radiation and Health” for approximately 20,000 people to respond to their various questions and worries about radiation.

Moving forward with R&D for decontamination

On the other hand, the government, TEPCO and other involved parties are working in a public-private partnership to achieve decommissioning of 1F. Recently, the JAEA has been working on the R&D and measures to deal with contaminated water which form the core of the roadmap for moving forward with decommissioning. As part of that, we have analyzed the flow of groundwater into the 1F harbor and circulation of seawater within the bay, and shown that influx of groundwater from the seawall into the bay can be prevented by installing a water impermeable wall near the water intake port. In addition, efforts are being made in the basic R&D that will be needed for medium/long-term efforts.

To carry out these tasks, an International Collaborative Research Center for Decommissioning has

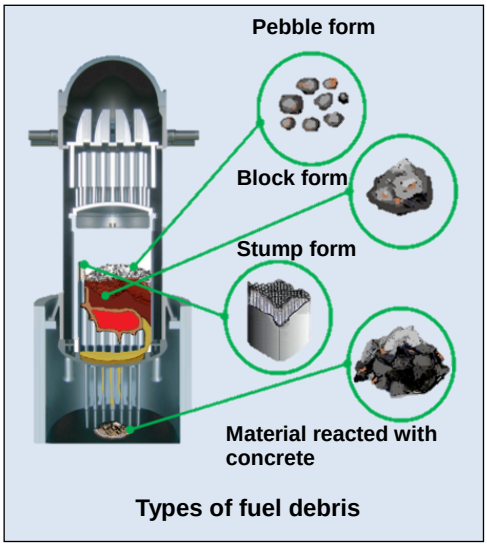
been established. Preparations are underway to develop an international base which will bring together researchers from both inside and outside Japan, and promote R&D and development of human resources.

Further details on this topic are provided in the following report.

Efforts toward decommissioning

Seiichiro Takeda, Director, Fukushima Decommissioning Technology Center, JAEA

Decommissioning of 1F will begin with removing spent fuels in the reactor buildings, removing fuels which melted and solidified, and then disassembling and disposing the reactor and related equipment. These works will take as long as 40 years. In addition, the work in the case of 1F will be different from that assumed with ordinary decommissioning. It will have unique characteristics such as the extremely high radiation dose of fuel debris, and production of large amounts of contaminated water and other radioactive waste. Adequate preparation and technical development will be necessary for each type of work.



Types of fuel debris

Here the process is described according to the sequence in time.

To make progress with decommissioning, it is first necessary to investigate what has happened in the reactor core, and how it is now. By using accident progression analysis code and other tools, we are analyzing what happened inside the reactor, and estimating the properties, components and amounts of fuel debris in the reactor core. We have also developed equipment enabling actual observation in the reactor core by developing optic fibers which can withstand high radiation.

Next will be removal of fuel debris inside the reactor core. However, the radiation dose is high in the reactor core, and thus we are developing equipment which can be operated remotely. We plan to conduct demonstration test to ascertain whether or not that equipment will function well on-site. Information on this topic will be presented later.

On the other hand, large amounts of radioactive waste will be produced in the decommissioning

process. Those amounts are estimated to be: 600,000 cubic meters of contaminated water, 1,575 units of secondary waste from water treatment (as of January 15, 2015), 130,000 cubic meters of rubble, and 80,000 cubic meters of cut trees (as of November 30, 2014).

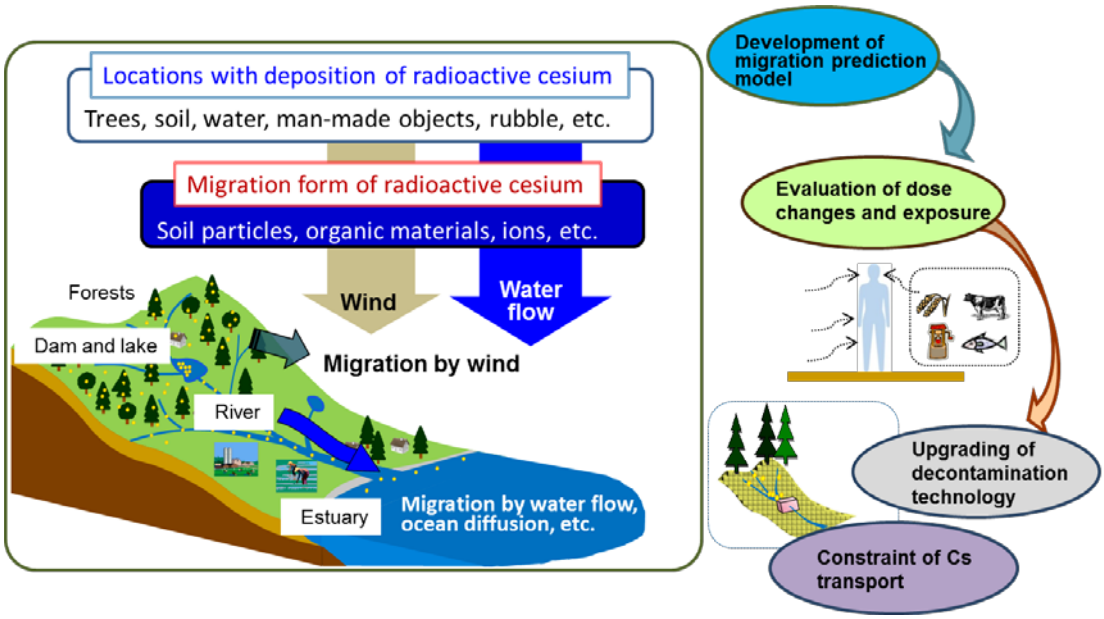
Regarding this waste, it is first necessary to investigate what sort of radionuclides it contains, in what amounts, and what their condition is. To achieve this, we have begun to create simulated fuel debris, investigate its basic properties, and examine cutting/removal methods and storage/treatment measures, while referring to materials such as fuel debris from the accident at the Three Mile Island Nuclear Power Station (U.S.) as a model for the melted fuel. Also, for the secondary waste produced after the treatment of contaminated water, we are considering baking treatment in which the cesium is immobilized.

Efforts to restore the environment

Mikazu Yui, Director, Fukushima Environmental Safety Center, JAEA

Previous presentations have discussed on-site efforts, focusing primarily on 1F. Now I will describe off-site efforts in the surrounding area.

In order to restore the environment off-site, JAEA is conducting environmental monitoring, research on the migration behavior of radioactive cesium, and development of technologies for decontamination and volume reduction.



Recently, as environmental monitoring, we have carried out monitoring of environmental radiation, primarily in Fukushima Prefecture, under commission from the Ministry of Education,

Culture, Sports, Science and Technology (MEXT) and the Nuclear Regulation Authority. Through this process we ascertained the status of air dose rates and deposited amounts of radioactive cesium, and mapped the results. The results of these investigations have been consolidated in a database, and released to the public. We are also continuing to investigate changes in these conditions. Furthermore, it is known that the majority of radioactive cesium in forests is stabilized on the surface of the ground or in the soil just below it, and the rate of efflux from the forests to the outside is about 0.2% per year on average.

With regard to decontamination work, on the other hand, JAEA has carried out a Decontamination Pilot Project commissioned by the Ministry of the Environment, and supported the government to select the decontamination technology. Also we have consolidated previously obtained information and data on decontamination, and released this information as a database. Techniques such as high-pressure washing and scraping of road surfaces, and scraping of surface soil in agricultural fields, were first demonstrated in Japan by the JAEA. The results obtained here have also been incorporated into guidelines for decontamination technology.

In addition, the JAEA has developed and publicly released a system to evaluate decontamination effectiveness. Based on this system, we are supporting Ministry of the Environment and municipalities to evaluate the decontamination effectiveness.

Also, large amounts of soil are produced as a result of decontamination. The soil types and radioactive concentration have been investigated, and R&D efforts are being made to enable volume reduction and reuse.

The next topic I will introduce is communication activities.


Scene of Caesium Workshop

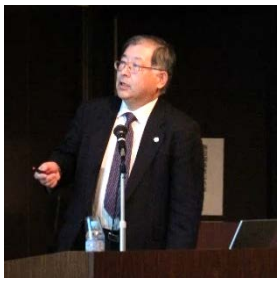
JAEA has been holding meetings called “Question and Answer Session on Radiation and Health” primarily for parents, guardians and teachers at elementary/middle schools, kindergartens, and nurseries in Fukushima Prefecture. So far, these meetings have been held at 241 locations, and about 19,800 people have participated. We have also held two international workshops where views were shared with experts from overseas, and opinions were exchanged regarding future issues.

On the other hand, at the Fukushima Prefectural Centre for Environmental Creation, studies are underway to create an R&D roadmap for restoring the off-site environment. For this center, facilities are being constructed in Miharu Town and Minamisoma City. The facility in Miharu Town will conduct research on environmental dynamics, and the facility in Minamisoma City will focus on development of remote measurement and monitoring technologies. The JAEA hopes to play a

central role within this center.

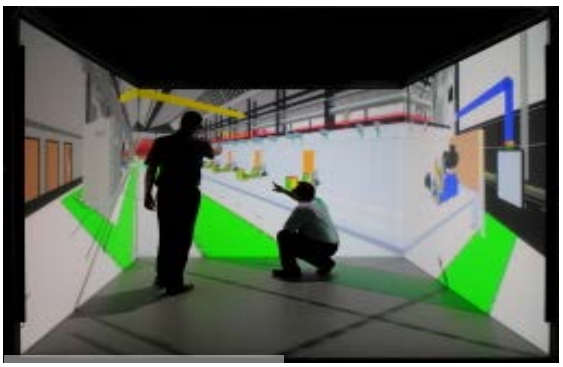
Development and use of R&D facilities — Creating a research infrastructure

Hiroshi Kawamura, Director, Nuclear Plant Decommissioning Safety Research Establishment, JAEA



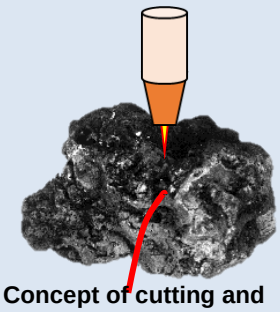
In order to smoothly implement the on-site and off-site efforts discussed thus far, it is essential to develop a research infrastructure to support the related R&D.

To proceed with decommissioning work at TEPCO 1F, it will be necessary to develop devices and equipment which can be operated remotely, and thereby allow work to be carried out safely in an environment of high radiation. The Naraha Remote Technology Development Center is a test facility for demonstrating the performance of devices and equipment under research and development. This center has areas for checking various types of technology, including technology for repairing leaks of the reactor containment vessel, and disaster response robot technology. The center is also developing virtual reality systems and robot simulators for training workers in operation, and checking the performance and operation of remotely controlled robots. A virtual reality system enables a person to experience the sensations of actually being in a certain place. This allows workers to efficiently carry out planning in a short time before actual work at the site. In addition, it may enable reduction of exposure during work, and shortening of work times. With the robot simulator, it is possible to check the performance of a disaster response robot beforehand on a computer, and proceed with robot fabrication based on those results. It is also possible to carry out training in robot operation. This facility, equipped with the above research infrastructure and technology, will begin partial operation in the summer of 2015.



Virtual reality system

Technology will also be necessary for treating and disposing the radioactive waste produced in the process of decommissioning—including rubble, secondary waste from treatment of contaminated water, and fuel debris. The Okuma Analysis and Research Center will be a facility for carrying out tasks such as analysis of the properties of radioactive waste and testing to evaluate safety. The detailed design began in 2014 fiscal year.



Concept of cutting and fragmenting fuel debris with a laser

Next, I would like to introduce the remote technology development which is one of our major research themes. The remote technology being examined in connection with TEPCO 1F is comprised of robot technology, laser processing technology, and radiation measurement/control technology.

Robot technology involves improvement of robots for nuclear emergency support, development of robot simulators, and development of powered suits. For example, going forward it is expected that powered suits will help to reduce radiation exposure for workers and improve work efficiency.

In the area of laser processing technology, lasers are being applied to cutting and fragmenting fuel debris. In the area of radiation measurement and control technology, progress is being made in R&D to enable nondestructive viewing of the inside of materials by using the gamma rays produced by wastes.

Finally, our aim is to serve as an international R&D facility which the Fukushima Hamadori region can be proud of. For achieving this aim, we will promote collaboration with universities, industry and organizations overseas in carrying out above mentioned research activities to broaden opportunities for using these facilities, and will actively disseminate the knowledge obtained in the facilities throughout Japan and the world.

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