Summary of the 2nd IAEA –MOE Experts' Meeting on Environmental Remediation of Off-Site Areas after the Fukushima Daiichi Nuclear Power Station Accident

Tokyo and Fukushima, Japan
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Introduction

The 2nd IAEA-MOE Experts' Meeting on Environmental Remediation of Off-Site Areas after the Fukushima Daiichi Nuclear Power Station Accident was hosted by the Ministry of the Environment (MOE) of the Government of Japan in Tokyo from 14 – 18 November 2016. The series of meetings between the IAEA and the MOE is intended to provide a forum for continued discussions in such a way that Japanese authorities can benefit from inputs provided by experts in order to enhance the ongoing remediation projects while updating the IAEA staff and experts on the progress of the off-site-area remediation process. As an additional outcome of the meetings, the collected information will also be shared with the international community, so that lessons learned can be assimilated and incorporated in the preparedness of IAEA's Member States to deal with similar situations they may face.

From the side of the IAEA, seven experts took part in the meeting including four international experts and three internal staff members. From the Japanese side, the meeting was attended by officials of the MOE and the Fukushima Prefectural Government, representatives from the Atomic Energy Society of Japan, and representatives from private companies that implemented decontamination activities. During the week, a visit to Fukushima Prefecture took place from 17 – 18 November 2016 to obtain first-hand information on the environmental remediation activities taking place in the off-site areas affected by the Accident.

This experts' meeting focused on five pre-selected topics: Current status of environmental remediation at and around Fukushima; Volume reduction (e.g., reuse, recycle) of the waste materials (including soil) resulting from the decontamination work; Knowledge management on environmental remediation; Integration of the overall remediation efforts into the recovery actions; and Development of a waste estimation tool.

The text below highlights the major points observed during the discussions indicating the aspects that deserve follow up. Suggestions for consideration by the Japanese authorities are also offered.

Session 1: Current status of environmental remediation at and around Fukushima

The MOE made significant and continued progress with the remediation of off-site areas in Japan affected by the Fukushima accident. Completion of the full-scale decontamination project in the Special Decontamination Area (SDA) is one of the critical requirements for lifting of the evacuation order. Because of the full-scale decontamination efforts, some municipalities in the SDA had already lifted evacuation orders. The lifting of the evacuation orders in municipalities requires the completion of planned decontamination activities and the availability of infrastructure for returnees (e.g., schools, health care, transportation, fuel supply, drinking water, etc. are in place for use).

The MOE has a 'long-term' target of reducing air dose rate to 1 mSv/year or below. Even after the full-scale decontamination is completed in March 2017, the MOE may want to continue its efforts to secure radiation protection, disclosure of relevant information and communication with the public.

Since minor hotspots could still be present in the areas where full-scale decontamination has been implemented, continued efforts will be necessary to identify these hotspots for further decontamination. The MOE might consider developing routine hotspot surveying and rapid remediation action plans in the relevant areas. These plans will be communicated with the stakeholders and this communication will help reduce potential concerns of returnees.

Personal dosimeters were distributed to the members of the public in the decontaminated area. This programme will provide accurate exposure information to the public and will support effective remediation practices. This programme has also been recognised by the experts as a very effective measure. TEPCO developed mapping software for the dosimeters and made the devices available to the local governments. These dosimeters "DOSEe-nano" are equipped with a GPS tracking device which facilitates mapping of dose rates. This topic was also discussed during the visit to TEPCO's office in Koriyama as presented below in this text.

The MOE may wish to gather more information on the methods of dose rate evaluation, including the method mentioned above, and to identify whether these methods are equivalent to those documented in the MOE's guidance on decontamination technologies.

It was also suggested that an updated contamination/air dose rate map be prepared periodically (by helicopter or other aerial survey technologies) and be made public for citizens in Fukushima and in other parts of the country, in order to provide an overview of the current situation.

Session 2: Volume reduction (e.g., reuse, recycle) of the waste (including soil) resulting from the environmental remediation

A significant volume of material has been generated by the decontamination work and the Japanese authorities are facing a challenge to reduce this. Recycling has been considered as well as different approaches for volume reduction (e.g. Classification, Chemical and Heat Treatment). The importance of developing a recycling procedure as quickly as possible was agreed by the meeting participants. Reuse of the soil from decontamination is also considered under well-established situations.

The Japanese Government is considering an activity level (e.g. 8,000 Bq/kg) as a potential criterion for reuse of the soil from decontamination for specific construction purposes (e.g., construction of roads, banks and coastal levees).

During the meeting the following points were raised:

- The need to demonstrate the extent of the potential release of radioactivity to the environment: for example, if the materials from decontamination were used in the construction of roads, banks or coastal levees. It has been suggested that estimates could be achieved by conducting modelling exercises and subsequent monitoring;
- Whether construction workers would require radiation protection training, for example, to minimise external dose, as well as internal dose (from inhalation). In this particular case, if any use of materials from decontamination work (containing Cs-137) is to be granted, workers should be monitored while handling these materials.

When developing criteria and practices for reuse of materials, the experts suggested that the MOE take note of the criteria and practices already in place for the reuse of NORM materials and contaminated scrap.

It was noticed that the MOE:

- is working toward the construction of an Interim Storage Facility (ISF) to manage the radioactive decontamination material before the final disposal outside Fukushima Prefecture.
- continues its efforts to be transparent and inclusive of interested parties during the development of the recycling procedures.

It was then suggested that the MOE may consider:

- recycling soils directly from the Temporary Storage Site before transporting them to the ISF to ease resource constraints.
- recycling soils for construction of the ISF and final disposal sites.

- If materials containing Cs-137 are used, for example, to build roads banks or coastal levees, a database could be established to document the site(s) where such material has been used to inform future generations.

Session 3: Knowledge management and environmental remediation

Over the course of the remediation works, individual contractors have been developing their own approaches to document their knowledge and experiences.

In addition, the contractors performing the full-scale decontamination project have formed a council to exchange information amongst the member companies. That initiative deserves recognition. This council was founded by TEPCO, and has a membership of 67 private companies. Through regular meetings and workshops, the companies have been exchanging knowledge and experience associated with the remediation.

The Technical Advisory Council on Remediation and Waste Management (formed in Nov. 2011) is a consortium of private companies with the "aim of playing a leading role in decontamination and waste management". Their intentions are to:

- share information technology and know-how;
- optimise application of techniques; and
- contribute to the smooth implementation of remediation activities.

The MOE has also published the "Decontamination Report" in 2015 to address the lessons learned from the full-scale remediation. This report, available on the MOE's website, will be helpful for other Member States that may wish to increase their preparedness to deal with similar situations, should they occur.

The value of continued compilation and updating of information on lessons learned by the MOE, based on the field-applied approaches, was discussed. Emphasis on remediation methods, as well as waste management for storage, transportation, and treatment technologies is considered of particular importance. This information may be scattered throughout the records maintained by field project performers and municipalities. Therefore, it was suggested that the MOE consider sharing the compiled knowledge and experience amongst municipalities to improve their remediation efforts and also with international community, recognising that some of the information may be commercially sensitive.

The information and field data would need to be adequately detailed to be useful. For example, field conditions at the time of decontamination could influence decontamination effectiveness (e.g., weather; the nature of the ground (sand, gravel, rock); the state of the ground (icy, snowy, muddy, clear); the slope of the landscape, such as in mountainous areas) and should be specified to provide information on the efficiency and possible challenges met by decontamination workers.

The importance of establishing formal mechanisms for gathering feedback, experience and lessons learned on selected important topics was noted. Such mechanisms could be valuable for application at all levels (the MOE, the Fukushima Prefectural Government, and the municipalities).

The MOE may wish to consider establishing a project to capture the knowledge and experience of personnel involved in decontamination activities in such a way that information can be shared and communicated.

In doing so, it would be important for the MOE, together with the IAEA, to be clear about future audiences within and beyond Japan and to tailor content and format accordingly.

Knowledge capture needs also to cover a range of topics, for example, strategic oversight, management and coordination, interfaces between organisations, efficacy of remediation techniques, communication with and engagement of interested parties, and others.

Session 4: Integration of the overall remediation efforts into the recovery actions

It became clear that there is a need to integrate both planning and implementation of remediation work with the restoration of infrastructure.

It is important to establish structures for organisations involved in recovery and remediation to develop strategy, make decisions, manage resources, and coordinate operations. In doing so, and without prejudice of specific arrangements regarding the preparedness for remediation of post-accident situations, it may be possible to make use of existing arrangements that have been established for other types of events, such as earthquake, terrorism, flooding, or major transport accidents. Having agreed ways of operation, with good links between local and national effort, is important for effective response and recovery – strategy, decision-making, resourcing allocation and operations.

Where there are concerns and potential issues, it could be beneficial to identify potential solutions to bring about change - escalating where necessary through appropriate government channels.[1]

Session 5: Development of waste estimate tool:

The international community is working to enhance waste management platforms. One of these examples is the USEPA's Waste Estimation Support Tool (WEST); a GIS-based decision support tool for estimating the characteristics, amount, and residual radioactivity of waste generated from remediation activities after a radiological incident..

These types of tools need to incorporate detailed contamination information (e.g., 3D contamination maps), country-specific infrastructure information, specifications of decontamination methods, and waste treatment technologies. This enhancement can be achieved by collaborating with the Japanese agencies that can provide real case validated information. The enhanced waste estimation support tool will provide significant support to other Member States for their potential response to an incident similar to the Fukushima nuclear power plant accident.

The MOE continues its efforts to manage the waste from different regions, contamination levels, and decontamination activities, as addressed in the Act on Special Measures concerning the Handling of Radioactive Pollution.

For Fukushima Prefecture, realisation of the ISF is progressing. Approximately 10.6%[2] of the land area needed has been contracted as of the end of October 2016. For five other neighbouring prefectures so called 'Facilities for long term management' have to be realised. Site selection is under discussion with local officials, and setting waste acceptance criteria for these facilities deserves attention.

Visit to Fukushima:

Decontamination Countermeasure Division at Fukushima Prefectural Government (Fukushima City)

The Fukushima Prefectural Government continues its efforts to reduce the radiation dose to residents. The decontamination work has shown significant progress. Efforts also include intensive health management of residents in Fukushima Prefecture. The programme involves a comprehensive set of activities to manage the long-term health of the residents, including whole body counting, distribution of personal dosimeters, thyroid examinations, mental health support, and special care to the vulnerable group (e.g., pregnant women). It could be useful to consider developing a follow-up action plan for the aftermath of the decontamination activities (i.e., for those areas where the evacuation order has been lifted). The action plan could include long-term environmental monitoring and decontamination of

[1] It is interesting to note that the IAEA Final Report of the International Mission on Remediation of Large Contaminated Areas Off-site the Fukushima Dai-ichi NPP (2011) noted the need '*to consider further strengthening of co-ordination among the main actors through the establishment of a more permanent liaison between the organisational structures of the government of Japan and the prefectural and municipal authorities*'.

[2] The figure has increased to 17.9% as of the end ofJanuary2017.

hotspots. It could also be useful to consider establishing the end-state conditions that are to be reached to indicate that no further remediation efforts are required. It could be beneficial to develop the end-state conditions in consultation with interested parties, including central government agencies.

Heat Treatment Facility (Iitate Village):

The MOE is operating a heat treatment facility in Iitate village as a part of a demonstration study to assess methods to reduce the volume of soil and ash. The facility is designed to remove Cs from contaminated soil and ash using a dry pyro-process. This method generates a concentrated Cs cake, leaving clean soil/ash material that can be recycled into concrete products and other civil engineering materials. Tests have shown high Cs removal reducing volume of material for disposal. The current system can process about 10 tonnes per day at 1,350 ºC. Stack emissions are routinely monitored for radioactivity, particulate matter, and other gaseous compounds. The experts expressed particular interest in:

- How the bag filters will be treated prior to disposal;
- How the kiln slag (coating) will be removed;
- Measures of success for this demonstration study. For example, cost effectiveness and volume reduction; and
- Other technologies considered.

Meeting with the Date City Mayor:

The mayor of Date City showed strong leadership during the accident and had an excellent team supporting him. Rapid critical decisions were made under the Mayor's direction during the emergency phase immediately following the incident. In the discussion, it was emphasised by the mayor and his senior policy administrator that building strong relationships with experts was important so that they could provide support to decision-makers during an emergency situation. Continued sharing of the lessons learned and achievements from Date City with national and municipality leaders would be beneficial. Translation of the Date City Three-Year Record, which documents how the city worked together through the emergency and during post-accident remediation, would also be beneficial.

Fukushima Prefectural Centre for Environmental Creation (Miharu):

The Centre for Environmental Creation was opened by the Fukushima Prefectural Government in July 2016. This Centre is designed to disseminate knowledge about radiation, environmental protection, recovery, and community revitalisation for the public. The Centre is also used to educate and train the visitors about radiation and the decontamination process in interactive ways using cutting edge technologies (e.g., cloud chamber, 360º theatre). This Centre is well established and provides easy-to-understand information, including movies, videos, games and interactive displays. The Centre may wish to consider making the information materials (e.g., videos, contents) internationally available.

Interim Storage Facility (Okuma):

The MOE has made progress to establish the ISF in Fukushima Prefecture. The MOE has developed a procedure for full-scale operation of the ISF while continuing land acquisition, facility construction, and waste transportation. A pilot-scale project to transport circa 45,000 m^3 of contaminated soil has been concluded, and the transportation routes have been revised for full-scale transportation to avoid high traffic areas. A plan to incrementally transport contaminated soil (5.0 – 12.5 million tonnes) to the ISF by 2020 FY is available.

TEPCO Office (Koriyama):

TEPCO has provided environmental decontamination and revitalisation support to central and local governments, including:

- follow-up decontamination;
- field surveys;
- proposals for decontamination methods;
- TEPCO’s decontamination work (when requested by the municipalities);
- technology development for decontamination; and
- radiation monitoring, etc.

TEPCO developed the software for making a map based on external dose by using a personal dosimeter and a GPS device to support residents of local municipalities. Some towns are considering use of these dosimeters.