Lessons learned from Fukushima accident in relation to emergency management

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1. Introduction

The latest accident in Fukushima, Japan, which involved concurrent accidents at multiple nuclear facilities due to the earthquakes and tsunami, as well as station blackouts for an extended period of time, demonstrated the need for an overall review of existing prevention measures. These measures include emergency protection measures for residents beyond the emergency planning zone, the application of radiation protection criteria that consider the release of radioactive materials to the environment over an extended period and the disposal of large-scale radioactive wastes and radiation protection criteria to be applied upon recovery. Accordingly, Japan has taken improvement initiatives in the area of prevention by submitting a government report on the Fukushima accident prior to the IAEA Ministerial Conference on Nuclear Safety in June last year, and the US has devised a regulatory system of its own, including directions for improvement through the NRC, which operated a temporary taskforce specifically for this purpose. This study examined how Japan is responding to the Fukushima accident and investigated directions that countries around the world can take to improve the area of nuclear protection in order to enhance Korea's own radiological emergency management system.

2. Status of emergency response in Japan

Since the JCO accident in 1999, Japan has been improving its disaster prevention system and conducting drills regularly. However, in its response to the Fukushima accident, major issues arose for which no emergency measures, unlike the disaster prevention plans, could be used.

2.1 Relocation of offsite center

Although a local disaster response center was supposed to be in operation at an offsite center (OFC) for the purpose of prompt emergency management onsite, emergency personnel from relevant authorities could not be dispatched in a timely manner due to factors, such as traffic conditions. Since the OFC was located within a 5km radius of the Fukushima facilities, it could not perform its roles properly due to high radiation, communication disruption, and difficulties in logistics and transportation, and in the end, the OFC was relocated to the Fukushima Prefecture Office on March 15 in order to continue operation.

2.2 Trouble in environmental radiological monitoring

Moreover, due to disruption in communications with those at the nuclear reactors, source term evaluation with an IT-based emergency response support system (ERSS) could not be carried out properly. This disruption made it impossible to evaluate the accident's impact by using the System for Prediction of Environment Emergency Dose Information (SPEEDI). Finally, 23 environmental radiation monitoring posts out of a total of 24 units installed in the Fukushima Prefecture were disabled in the aftermath of the earthquakes and tsunami. In Japan, local autonomous governments are in charge of environmental monitoring. However, as of March 16, 2011, due to insufficient infrastructure in the field, the central government (the Ministry of Education, Culture, Sports, Science and Technology) took over the tasks of environmental radiation monitoring and information disclosure in connection with relevant authorities.

2.3 Public protective action

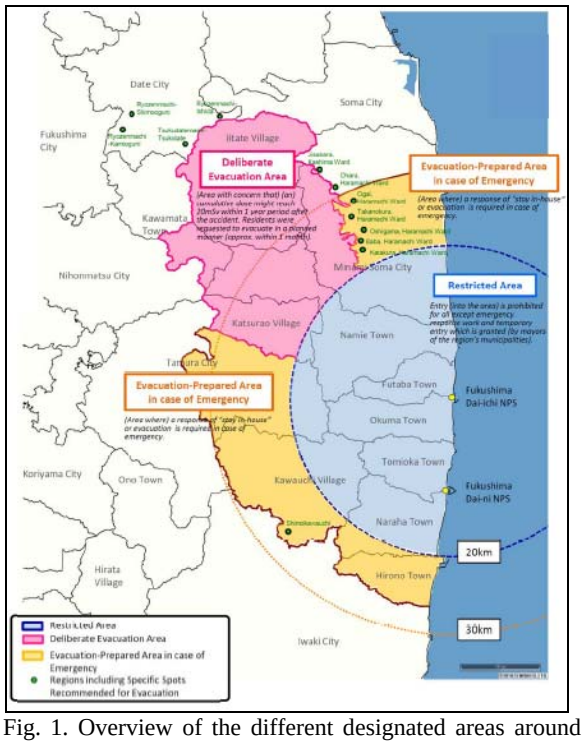

Fig. 1. Overview of the different designated areas around the Fukushima Dai-ichi NPP

The Japanese Prime Minister, who is the head of the Nuclear Disaster Response Headquarters, determined

the zone for evacuation and to take shelter indoors and informed the Fukushima Prefecture and Municipalities. Accordingly, about 78,000 people within a 20km radius of the nuclear facilities were evacuated, and the number of population subjected to the planned evacuation areas amounted to about 10,000. In addition, as of April 21, 2011, the area within a 20km radius of the reactor unit 1 was declared the restricted areas. In the initial aftermath of the accident, evacuation was applied to 50mSv and 10-50mSv for indoor sheltering, but as the accident was prolonged, an addition of 20mSv was applied to the planned evacuation areas. Also, evacuation was not mandated at the government level for areas with locations that had higher local contamination that did not exceed an annual dose of 20mSv, but caution is still required in these areas and information on related radiation levels are still being provided.

3. Lessons learned from Fukushima accident

3.1 U.S. NRC

The US has conducted a review of the NRC regulatory system and policy direction in light of the Fukushima accident on March 23 and made 12 recommendations for the NRC regulatory system, prevention, alleviation, emergency measures and NRC programs. Of these, details of emergency preparedness are as follows:

Table I: Recommendations for emergency preparedness

Field	Recommendations
Emergency Preparedness	Strengthen facilities and emergency plans to address prolonged station blackouts(SBO) and multiunit events
	Long-term review of additionally proposed emergency preparedness (EP) topics related to multiunit events and prolonged SBO
	Long-term review of proposed emergency preparedness topics related to decision making, radiation monitoring, and public education

3.2 The government of Korea

In light of the accident, a special review was carried out in Korea from March to April 2011 to examine the safety and emergency preparedness of domestic nuclear facilities against accidents beyond the design base or caused by natural disasters, like that of Fukushima. As a result, 11 items of improvement in the area of radiological emergency preparedness involving earthquakes and tsunamis were identified. This result reflects the improvement plans put forth by the US and Japan which generally target SBO and multi-concurrent accidents.

In addition, the government added new items – establishment of measures to protect residents and support for disaster response activities in case of wide-area, long-term damage beyond EPZ – by amending the existing standard manual for nuclear power plant safety as a result of the lessons learned from the Fukushima accident. Therefore, every local government that has nuclear power plants will need to establish guidelines on long-term protection measures for residents, including the operation of wide-area government-level shelters, when drafting local radiological emergency plans.

4. Conclusions

The field of emergency preparedness has made great strides over the years based on lessons learned from accidents, such as the TMI accident in 1979, which led to the introduction of emergency plans, and the Chernobyl accident in 1986, after which systems for international coordination in this field, including the Convention on Early Notification of a Nuclear Accident, were established. Moreover, the JCO accident in 1999 raised awareness of the importance of prompt situation management at an accident site and emergency medical care.

The Fukushima accident has become the worst accident since it involved concurrent accidents at multiple reactor units. In terms of engineering, there was also a loss of safety facility functions as a result of long-term SBO, which far surpasses all preexisting assumptions.

Accordingly, comprehensive and practical plan of improvement should be established through cooperation among government agencies and local autonomous governments in order to ensure the practical effect of IT-based emergency management systems that consider long-term SBO or the operation of off-site emergency management centers. Also, as part of the longer term review, additional emergency preparedness topics related to multiunit events and prolonged SBO should be considered.

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