Assessment and Prognosis for Nuclear Emergency Management in Korea

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1. Introduction

This paper reviews the status of assessment and prognosis system for nuclear emergency response in Korea. The Korea Institute of Nuclear Safety (KINS) performs the regulation and radiological emergency preparedness of the nuclear facilities and radiation utilizations. Also, KINS has set up the "Radiological Emergency Technical Advisory Plan" and the associated procedures such as an emergency response manual in consideration of the IAEA Safety Standards GS-R-2, GS-G-2.0, and GS-G-2.1. The Radiological Emergency Technical Advisory Center (RETAC) organized in an emergency situation provides the technical advice on radiological emergency response. The "Atomic Computerized Technical Advisory System for nuclear emergency" (AtomCARE) has been developed to implement assessment and prognosis by RETAC. Through the system, the assessment and prognosis of nuclear emergency can be quickly performed and technical advice for comprehensive public protective actions can be provided. This paper reviews the current status, improvement, and future plan of assessment and prognosis system in Korea.

2. Assessment and Prognosis System for Nuclear Emergency

The KINS performs the review and inspection of regulatory activities in accordance with laws, regulations and guides related to nuclear safety and radiological emergency preparedness and response. The emergency response organizations of Korea consist of the followings: the National Emergency Management Committee (NEMC) and the Off-Site Emergency Management Center (OEMC) run by the NSSC; the Local Emergency Management Center (LEMC) run by the local government; the Radiological Emergency Technical Advisory Center (RETAC) run by the KINS provides the technical advice for protective action decision making using assessment and prognosis system. The KINS is appointed to give the technical advice to government for the nuclear emergency management of NPPs. In case of accident, the KINS organizes Radiological Emergency Technical Advisory Center (RETEC) to provide the technical advice on radiological emergency response and dispatches the technical advisory teams to the OEMC at affected site. Also, the RETAC initiates the emergency operation of 128 nation-wide environmental radioactivity monitoring network in accordance with the Nationwide Environmental Radioactivity Monitoring Plan. The KINS coordinates to organize the Joint Radiological Monitoring Center to conduct the off-site radiation monitoring and collecting the data using SIREN system (System for Identifying Radiation in Environments Nationwide). The environmental monitoring results and Operational Interventional Level (OIL) are provided to make decision of public protective measures.

The KINS also has developed the Atomic Computerized Technical Advisory System to provide various technical advice effectively for the public and environment protection in nuclear emergencies. The AtomCARE permits not only the rapid assessment and prognosis of nuclear emergencies and radiation impacts, but also the comprehensive emergency management information to protect the public. Its configuration is represented in Figure 1. The KINS is continuously monitoring nationwide environmental radiation and dose rates and also it monitors routinely radiation contamination of airborne particles, fallouts, rain, farm products, soil, water and milk for early detection of abnormal situation or symptoms and also for a timely response to them. The KINS has also been operating Automated National Environmental Monitoring Network since 1997. A total of 128 radiation monitoring stations are interconnected to the central monitoring station at the KINS on this network. The national environmental monitoring results open to public through web (http://iernet.kins.re.kr) and application of smart devices (eRAD@now).

3. Reflection of Lessons Learned from Fukushima Accident

The KINS had operated the RETAC during Fukushima accident not only to monitor accident progression, radiation environmental condition, an air stream trajectory, but also to assess domestic impact including radiation environmental condition and public heath impact. The KINS and related expert organizations dispatched the experts to the 4 international airports and 2 seaports for radiation surveillance to immigrants from Japan. About 400,000 immigrants were surveyed voluntarily and only a few people were identified for light surface contamination. As a result of these activities, several enhancements were made to reflect the lessons learned from Fukushima accident. First, the environmental monitoring stations were increased from 70 to 128 during last three years. The AtomCARE for technical
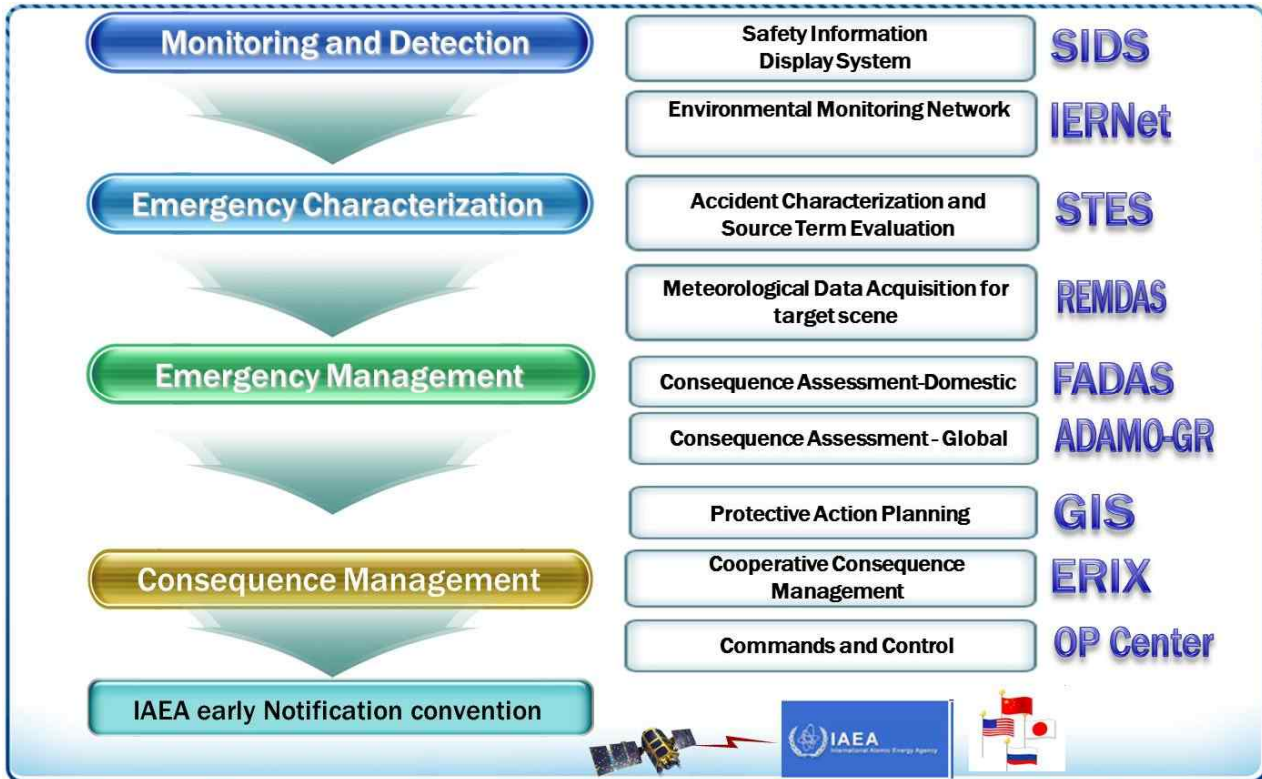
Fig. 1. Atomic Computerized Technical Advisory System for the Radiological Emergency (AtomCARE)

advice of nuclear emergency is under improvement for better assessment and prognosis. The data transmission from NPPs to AtomCARE system changed to fiber optic cable and dual transmission system. The Safety Information Display System (SIDS) using the upgraded data transmission channel provides the operational status, accident progression, accident assessment and prognosis of the NPPs. Also, the REMDAS system has improved to collect meteorological information including weather data of NPPs, data from automatic weather system about 600 sites, and numerical weather prediction data with high resolution and widened region (including wind speed, direction, temperature, precipitation, etc.) from the Korea Meteorological Administration (KMA). The Follow Accident Dose Assessment System (FADAS) to estimate the public projected doses using estimated source term and numerical weather prediction data is under improvement to enhance the accuracy of estimation and predict the widened region including all domestic and oversea regions. In addition to this, as a result of reviewing the IAEA standards and the lessons learned from Fukushima accident, the act of radiological emergency management revised to adopt the Precautionary Action Zone (PAZ, 3~5 km) and the Urgent Protective action Planning Zone (UPZ, 20~30 km) from the NPP sites May 21, 2014. Therefore, PAZ area will be evacuated at general emergency situation, then projected dose using general intervention level criteria will be applied for public protective action, and finally urgent

environmental monitoring results using OIL will be applied to decide the public protective measures.

In order to reflect the lessons learned from Fukushima accident, KINS develops the Accident Dose Assessment and Monitoring (ADAMO) system to incorporate (1) the dose assessment on the entire Korean peninsula, Asia region, and global region, (2) multi-units accident assessment (3) applying new methodology of dose rate assessment and the source term estimation with inverse modeling, (4) dose assessment and monitoring with the environmental measurements result. The ADAMO is the renovated version of current FADAS of AtomCARE.

The ADAMO increases the accuracy of the radioactive material dispersion with applying the LDAPS(Local Data Assimilation Prediction System, Spatial resolution: 1.5 km) and RDAPS(Regional Data Assimilation Prediction System, Spatial resolution: 12km) of weather prediction data, and performing the data assimilation of automatic weather system (AWS) data from Korea Meteorological Administration (KMA) and data from the weather observation tower at NPP site.

The prediction model of the radiological material dispersion is based on the set of the Lagrangian Particle model and Lagrangian Puff model. The dose estimation methodology incorporate the dose assessment methods of IAEA, WHO, and USNRC. The dose assessment result will express on the GIS (GIS (Geographic Information System) to provide to the local-governments and the central government.

Table 1. Comparison FADAS (Old) and ADAMO (New)

	FADAS	ADAMO
Assessment area	40 X 40km	Korean peninsula Asia region Global region
Numerical weather prediction data (Spatial resolution)	RDAPS (12km)	GDAPS(25km) RDAPS (12km) LDAPS(1.5km)
Prediction periods	~ 3 days	~ 10 days
Atmospheric dispersion model	Lagrangian Particle model	Lagrangian Particle model & Lagrangian Puff model
Multi-unit evaluation	No	Yes
Inverse model with environmental monitoring	No	Yes

4. Summary

The nuclear accident of Fukushima, March 2011, raised public concerns over the safety of nuclear facilities and emergency preparedness in Korea. Therefore, KINS has enhanced the AtomCARE for assessment and prognosis and environmental monitoring system. The KINS has reinforced the radiological/radioactive environment monitoring system across the country to ensure prompt and effective protective measures for the public. Also, the act of radiological emergency management revised to adopt (PAZ) and the (UPZ) at 2014. All in all, Korea will give comprehensive effort to reflect the lessons learned from Fukushima accident for improvement of the assessment and prognosis system.

Acknowledgement

References

[1] Long-range transport and dispersion of radionuclide using the FLEXPART model and the backward trajectory method for identification of their sources, KINS/HR-1314, 2013.