Section 2 Examples of STI to Overcome the Problems

As described in the previous Chapter, after the Great East Japan Earthquake (GEJE), the expectations toward S&T to tackle social problems, such as energy problems and alleviation of damages caused by natural disasters, has been elevated. Therefore, we need to promote STI to steadily contribute to overcoming of such challenges, taking into account its application in real life.

Furthermore, the 4th Basic Plan describes that "the urgent challenges of our country to be tackled first is the reconstruction from the GEJE and the rehabilitation of the society." As such, we need to build a society with strong tolerability and resilience against damages.

In this Section, we will first describe the cases in which the utilization of S&T is promoted to respond to the challenges revealed by the GEJE. Secondly, we will introduce the handling cases for the reconstruction and the creation of employment in the afflicted regions that have newly started and led by S&T.

1 Advanced Efforts for Achieving Tasks

(1) Cases That Respond to Disasters, Such As Earthquakes and Tsunami.

Among a number of social problems brought up by the GEJE, one of the most important challenges concerning disaster prevention is the STI. Hereafter, we will first introduce The Earthquake Early Warning System and tsunami warning as these have been identified as urgent challenges and for which immediate measures have been taken immediately after the GEJE. Next, we will introduce information-collection and decision-making support system as a method to strengthen our resistance against disasters.

1) Upgrade of the Earthquake Early Warning System

The Earthquake Early Warning System started to be aired to the general public on October 1, 2007 by the Japan Meteorological Agency. By notifying the general public of an earthquake occurrence before the grand shake reaches them, various disaster prevention responses became possible. On the railways which are operating under the Earthquake Early Warning System, operating trains are able to be braked urgently. Furthermore, due to various earthquake precautions like the early earthquake detection system (which has been around since before the start of the Earthquake Early Warning System), all trains along the Tohoku Shinkansen Line were able to stop their operations urgently and accidents like derailment are prevented. On the other hand, because of the GEJE, many problems revolving around technical limitations became clear: for example, inaccuracy in forecasting the scale of an earthquake, decrease in forecasting accuracy caused by electricity outage, troubles in communication, and disability to distinguish individual earthquakes when multiple earthquakes occur at the same time. In the face of the last problem, the Japan Meteorological Agency revised the earthquake forecasting software in August 2012 such that it can now distinguish individual earthquakes.

2) Upgrade of the Tsunami Warning System

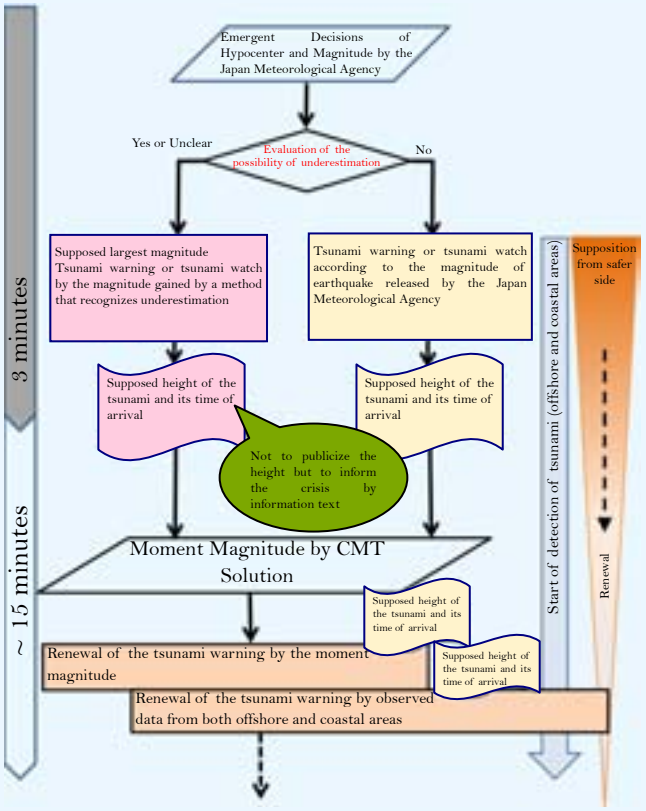
Keeping in mind the various challenges raised, the Japan Meteorological Agency sorted out On the Orientation of Improvement of Tsunami Warning, Considering Tsunami Damages Caused by the 2011 off the Pacific coast of Tohoku Earthquake in an attempt to review its tsunami warning system. (Figure 1-2-7) (Refer to Part 1, Chapter 2 (1).)

The Agency gathered opinions from experts and the general public, and presented the consolidated result in "The Proposals on the Standard Tsunami Warning Announcement" in February 2012. In summary, the most opinions pointed out that the immediate evaluated scale of an earthquake has a tendency to be underestimated. Moreover, the warning given is usually the safer estimation, and the foreseen height of the tsunami is not announced. Furthermore, the height of the observed tsunami is much shorter than the forecast height, and the figure is classified to be "under observation." These serve to increase a sense of urgency during evacuation activities. However it should be noted that the general public is informed of the limited accuracy in the forecast of tsunamis.

In addition, in order to improve the accuracy of the warning itself, MEXT arranged a seabed observation cable network off the Pacific coast of Tohoku region (seismometers and tsunami recorders). MEXT is also scheduled to accelerate the arrangement of an earthquake and tsunami monitoring system in the Nankai Trough where there is a threat of giant earthquakes and tsunamis. Furthermore, in the Geographical Survey Institute technology development that aims to utilize real time information on crustal movements gained from Electronic Reference Stations[1] on land areas has started.

[1] Set by the Geographical Survey Institute at 1,200 points nationwide at the interval of approximately 20 km. where continuous tsunami observation by GPS satellite is done.

Figure 1-2-7 / Release Flow of Warning by Improved Measures for Tsunami Warning



Source: "On the Orientation of the Improvement of Tsunami Warning after the Tsunami Damage by the 2011 off the Pacific coast of Tohoku Earthquake" prepared by the Japan Meteorological Agency.

The Agency decided to evaluate first the possibility that the scale of a tsunami has been underestimated immediately after an earthquake. The Agency also decided to release tsunami warning based on the supposition from safe side. If there is a possibility of underestimation on the scale of the tsunami, the supposed height of the tsunami will not be released to the public.

3) Development of information-collection and decision-making support systems to ensure sound operations in case of any unexpected disasters

The year 2011 saw many natural disasters, not only the GEJE in Japan. The number of the dead and missing caused by the typhoons No.12 (Typhoon Roke) and No.15 (Tropical Strom Talas) that hit Japan in September of the year counted up to more than 100 in total. Taking these natural disasters into account, we need various measures to strengthen disaster prevention system in regions. As one of these measures, we will like to introduce our method that utilizes information communication technology as follows.

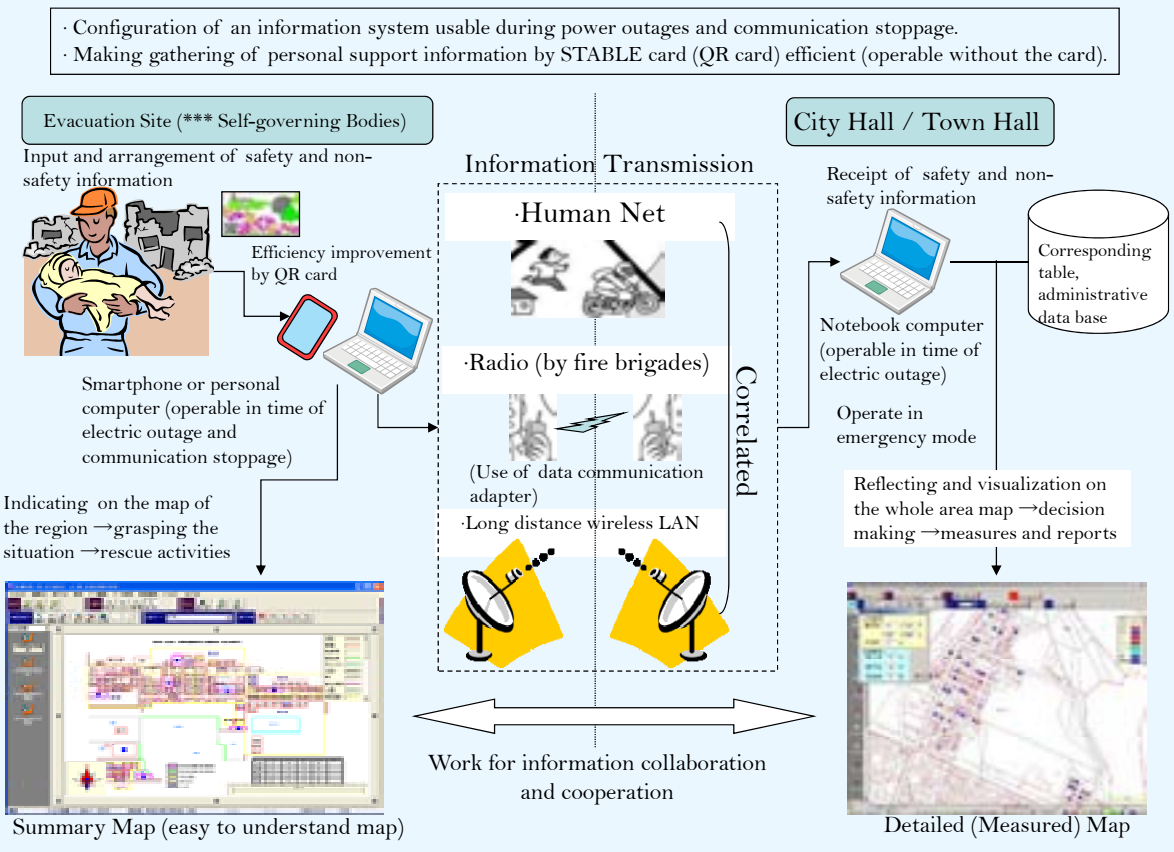
In "The Project on Science and Technology for a Safe and Secure Society" of MEXT, Tokyo Institute of Technology, Kyoto University and National Research Institute for Earth Science and Disaster Prevention (NIED) have developed "disaster prevention system by standing alone basis with cooperation support[1]"(Figure 1-2-8) able to gather large amount of disaster information in short time, even in a terrible environment, immediately after the occurrence of the disaster (stoppage of power and communication) and make it possible to support responses to the disaster after then. Under the system,

[1] Not only collaborative work (cooperation) among the terminals of administrative system network, when the communication among the terminals stops, each terminal can be used solely (autonomously).

local governments incorporate the function to respond to disasters in their administrative system network used in their routine work of normal phase, and make it possible to promptly confirm the safety status of afflicted people as well as the relief of human lives, utilizing the complied information of the residents.[1] In addition, the system is based upon the information gathered on the safety status of residents as well as the degree of damages in all aspects of afflicted regions, utilizing hand-written information on white boards and QR cards[2] as personal verification. Through the introduction of the system, gathered information is shared by the persons concerned and is visualized on maps. This enables local governments to immediately respond to the disasters.

In the future, through wide regional collaboration among the local governments using this system, 1) affliction risks due to diffused holding of servers and data as "guaranteed disaster prevention system" and 2) the proxy of the work of afflicted local governments by non-afflicted local governments can be evaded[3].

Figure 1-2-8 / Outlook of Information Gathering and Decision Making Support System



Source: Supplied by Shigeru Kakumoto, special researcher of Tokyo Institute of Technology

1 Disaster response function that correlates with administrative process functions used at peace time. It utilizes the common use of operation and data base and enables the secure operation of the system by the alleviation of burdening including costs. Together with these, it enables one stop service of contact work for afflicted people.

2 Card with QR code (bi-dimensional barcode read out by a mobile phone with camera). By storing personal information (name, address and medications that the owner is on) to a QR code and always holding the card, when the card holder is afflicted, a third party can promptly attend to the needs of the card holder.

3 The system was implemented at Engaru Cho of Hokkaido and has been prevailing both in Japan and abroad. At Nasukarasuyama City of Tochigi Prefecture where the system was introduced immediately after the GEJE, it was utilized during the issuing of certificates of affliction.

Column 1-5

Prevailing Use of Intelligent Gas Meter (Microcomputer Meter)

After the occurrence of the GEJE, it was pointed out that, while a large scale of fire caused by the tsunami had occurred, the function detecting vibrations and cutting off gas by microcomputers set at gas meters at individual homes worked effectively.

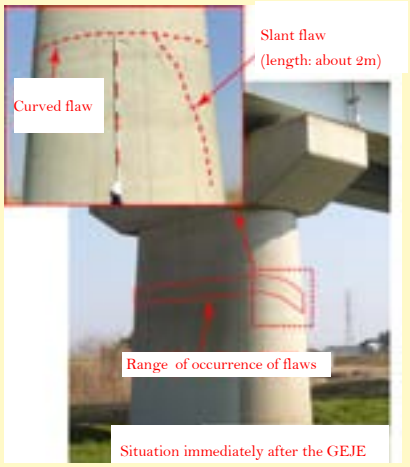
Other than detection of gas leakage, a microcomputer is able to automatically stop gas supply and prevent secondary affliction during a level 5 earthquake occurrence. The setting of the microcomputer was legally obligated after the Great Hanshin-Awaji Earthquake (January, 1995) with a 100% prevailing rate. Automatic fire extinguishers in oil stoves enabled during earthquakes are prevailing as well. By using this equipment, people are unburdened of fire precautions and are able to evacuate more efficiently.

"The Report of Working Group on the Evacuation Activities etc., as a Result of Disaster Prevention at the Time of Earthquake" publicized in May 2010 by MEXT, points out, including cases such as the ones described above, the importance to check the most recent recommended evacuation activities at the time of an earthquake in securing one's life. Though fire extinguishing activities are still very important despite the equipping of the automatic fire extinguisher such as a microcomputer meter, it is written on the website of the Tokyo Fire Department that "Nowadays, Microcomputer Meter is set to automatically stop the supply of city gas and propane gas at earthquake level 5 or so. Certain kinds of oil stoves are even equipped with automatic fire extinguishers to resist earthquake too. Therefore, the danger of a fire due to the fire equipment you use at the time of an earthquake is low. Should a fire occur, you should extinguish it after the shaking has stopped. By choosing to protect yourself first, you cannot only avoid injuries but also immediately take important actions, such as evacuation or rescuing of others. During an earthquake, it is the most important to protect yourself first."

Column 1-6

Seismic Reinforcement Technology

The Railway Technical Research Institute makes seismic designs for bridges, develops the technology for earthquake resistance in tunnels, and is responsible for the preventive measures of derailment and deviation of trains on Shinkansen Lines. During the GEJE, there was no damage in pillars that had been reinforced for earthquake resistance along the elevated bridges of the Tohoku Shinkansen Line. Furthermore, the Public Works Research Institute had practiced high level diagnosis and evaluation of the seismic abilities in existing bridges through large scale experiments. Learning from earthquake experiences in the past, the Public Works Research Institute developed seismic designs and seismic reinforcement methods, and reflected upon each of the designs and methods through various standards starting from its 1996 technical standard. There are bridges that show the effects of these efforts by the Institute (see the images below). In the future, it is expected that not only seismic reinforcement, but also the technical development in the field of civil engineering to maintain the 50-something-year-old structures constructed during the period of high economic growth will become important as well.



Flaws occurred at the feet of bridges that had not been reinforced for earthquake resistance.

Feet of bridges that were reinforced for earthquake resistance.

Note: Damage was small for the bridges that had been reinforced for earthquake resistance. These bridges were able to promptly recover after an earthquake, thus are largely contributed along the roads to ensure the safety of the roads during emergencies (the distance between the left photo and the right photo is approximately 400 meters. The photos were taken near Mito City in Ibaragi Prefecture).

Supplied by the Public Works Research Institute.

(2) Cases to Respond to Challenges Arising From the Accident at the TEPCO Fukushima NPSs

Through the incidence of the diffusion of radioactive substances caused by the accident at the TEPCO Fukushima Daiichi NPS, Japan faced challenges we have never faced before, namely, the need to continuously measure a wide area affected by radiation and the decontamination of radioactive substances arising from the accident. In addition, the ability to maintain a stable supply of electric power after the GEJE is also an important difficulty that we had to face.

To respond to these challenges, all areas of S&T are mobilized, new methods and technologies have been adopted and tried.

1) Utilization of S&T in Environment Monitoring

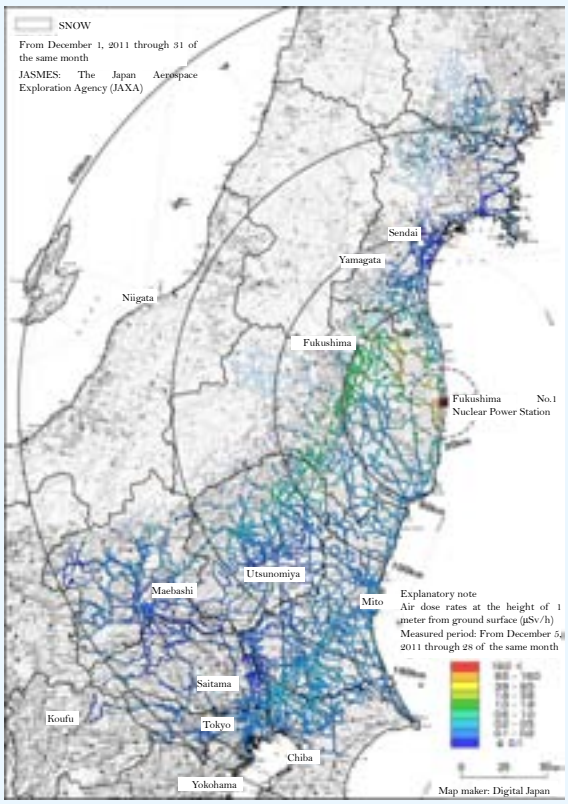
MEXT has performed environment monitoring through various methods like the use of airplanes (refer to Part 1 Chapter 1 Section 2 (2)). However, to ensure that afflicted regions are safe to live in and advance the decontamination activities, we need more detailed information. Kyoto University Radiation Mapping System (KURAMA) correlated with GPS, was newly developed by Kyoto University Research Reactor Institute after the accident at the TEPCO Fukushima Daiichi NPS. In this measuring system, a radiation meter with data transmission system is equipped in a car to continuously measure air dose rates around roads while the car travels. It also records the correlated values of measured position information in high density gained through the GPS, transmits them to a server via mobile phone line and stores the data. Furthermore, the measured data are shown on a map and anyone can view the result. KURAMA, after its technology has been improved, had been utilized in the monitoring efforts by MEXT and Fukushima Prefecture governments. The new small type KURAMA2 that enables more convenient measurement was later developed and used in the monitoring efforts in May 2012 by MEXT and local governments in their cooperation. In the future, it will be used in continuous monitoring by MEXT and it is also expected to be used in the measuring of radiation in the life zone.

With respect to the analysis of the radioactive substances, the national government of Japan and the local government of the Fukushima Prefecture implemented continuous monitoring efforts of the environment specimens of the soils, and autonomous efforts have been made by researchers in relevant fields. In this process, utilizing the Strategic Fund for Promotion of S&T with participation from over 100 universities and colleges as well as research organs all over Japan and over 400 researchers with the cooperation with the Science Council of Japan, MEXT and the Ministry of Agriculture, Forestry and Fisheries (MAFF) implemented "The Investigation concerning the Distribution Situation etc. of Radioactive Substances Released by the Accident at TEPCO Fukushima Daiichi NPS." Through this Investigation, professional knowledge of "The Investigative Commission Related to the Preparation etc. of the Distribution Maps of Radiation Volume[1]," composed of various professionals related to radiation and led by the local government of Fukushima Prefecture, is used by the MEXT and MAFF to measure radioactivity in the soils of approximately 2,200 places and the running survey using KURAMA (Figure 1-2-9) , investigate the transition situation of radioactive substances and analysis the radioactive

[1] The Commission was held to investigate technical matters related to 1) preparing "maps of radiation measurement" in order to grasp the distribution situation of radioactive substances, 2) preparing "maps of the density in the soils" in order to grasp the accumulation situation of radioactive substances in the surface of soils, 3) confirming accumulation situation of radioactive substances from the surface of soils, in preparing the distribution maps of radiation volume, and 4) confirming transition situation of radioactive substances on the ground surface.

substances in agricultural soils. The results of this investigation were publicized on the website of MEXT, along with a map and data base for easy understanding, after the validity of the measured values was verified.

Figure 1-2-9 / Measuring results of continuous air dose rates by running survey using KURAMA (as of December 2011)



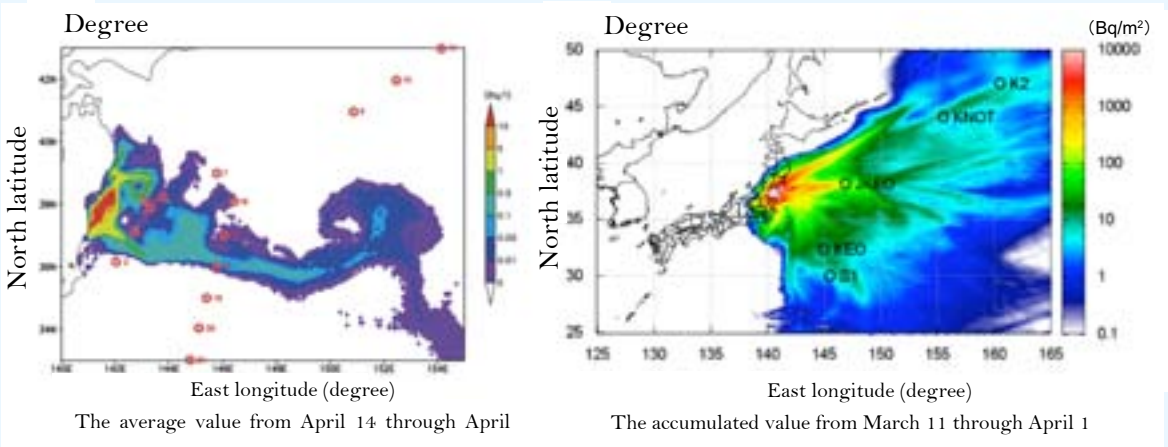
Source: Created by MEXT

2) Simulation of Marine Pollution

As for contamination in the sea, we implemented the measuring of radiation in the sea and employed the use of simulations based on the "Japan Coastal Ocean Predictability Experiment 2 (JCOPE2)," the most accurate system to foresee the currents of the seas near Japan from the East China Sea to 180°E and based on a modified one-way nested global-regional air quality forecasting system (AQF). With cooperation from the National Institute of Radiological Sciences, the Meteorological Research Institute of the Japan Meteorological Agency and Kanazawa University, the Japan Agency for Marine-Earth S&T (JAMSTEC) investigated the dispersion situation of artificial radioactive nuclide (cesium 137 and 134) in the Northwestern Pacific Ocean one month after the accident at TEPCO Fukushima Daiichi NPS. In the investigation, using the oceanographic research vessel "Mirai," sea surface water was collected along the cruise track and analyzed for its radiation. Although the level of radiation was far lower than that of the provisionary standard for drinkable water, it was observed that radionuclide from the Fukushima Daiichi NPS were dispersed in the wide range of the Northwestern Pacific Ocean one month after the accident. On the other hand, using radiation data near the Fukushima Daiichi NPS reported by TEPCO and others,

a simulation of the horizontal distribution of radiation in the seas Fukushima Daiichi NPS was made, and it was simulated that contaminated water originating from Fukushima Daiichi NPS were dispersed in the wide range of the Northwestern Pacific Ocean (mainly to the eastward). However, as observed radiation north of 40°N and south of 35°N could not be explained by the simulation of contaminated water, a separate simulation for the diffusion of eolian dusts was implemented (Figure 1-2-10). As a result, it was supposed that the distant diffusion of artificial radioactive nuclide in the Northwestern Pacific Ocean after one month from the accident at Fukushima Daiichi NPS was attributed to the dispersion of contaminated eolian dusts that were transported to that region.

Figure 1-2-10 / The result of simulation for the diffusion situation of cesium 137 caused by contaminated water and the result of simulation for diffusion situation of cesium 137 caused by eolian dusts.



The average value from April 14 through April

The accumulated value from March 11 through April 1

Source : Created by the Japan Agency for Marine-Earth S&T (JAMSTEC)

It was believed that the distant diffusion of artificial radioactive nuclide in the North West Pacific Ocean attributed to contaminated eolian dusts rather than contaminated water from the fact that no cesium appeared in 40 degrees North (measured at the places circled in red) in the simulation for the dispersion of contaminated water but presence of cesium was reproduced in the simulation for the dispersion of eolian dusts. The circles in the left figure show time-series stations.

3) Decontamination Using Zeolite, etc.

Conventional decontamination methods were used to decontaminate the minute volume of radioactive substances within only a narrow scope in research facilities. Therefore, for the decontamination of radioactive substances from the accident, a new decontamination agent and decontamination methods need to be developed.

Though it was necessary to immediately decontaminate the radioactive substances diffused in urban areas and piled up in houses, roads and parks, the decontamination must be securely and safely done by professionals and residents, and there is a limit to the costs for this. Under such unprecedented circumstances, academic societies and researchers seek to improve on the decontamination methods. The results were consolidated by Ministry of the Environment in its "Decontamination Guidelines" in December 2011. For the removal of cesium from outdoor pool and

standing water, the Japan Atomic Energy Agency (JAEA) developed a method that uses zeolite[1] and flocculating agent (polyaluminum chloride), and prepared a manual for the method (Figure 1-2-11).

Figure 1-2-11 / Scenes of Decontamination in the Pool

Source: "The Manual for Decontamination in Pool Water in Schools ~to resume the safe use of pools~" prepared by the Fukushima Support Headquarters of JAEA.

In the premise of TEPCO Fukushima Daiichi NPS, it was necessary to dispose massive amount of water that was contaminated by radiation with cesium. Though the examination of cesium in contaminated water had been done beforehand, the sea water contained massive amount of water contaminated during the accident. Thus, there was a need to verify its influence once again. The absorption agent, zeolite, is very cheap and is being massively produced in Japan. In March, a research team of approximately 60 voluntary researchers from JAEA and multiple Japanese universities and colleges was established. The team, along with Zeolite Industrial Association and other industrial societies as well as absorption agent suppliers, conducted absorption experiments for cesium, strontium and iodine, using zeolite and other various absorption agents. The team obtained 600 overall data that will be useful for the establishing a contamination water disposal system, which makes use of the density of sea water to exert influence on the absorption ratio of these substances, the density of hydrogen ion, the ratio of the volume of absorption agent over the volume of contaminated water, the density of radioactive substances, and the influence of absorption time. This experiment was done within approximately one month, and the results were publicized on the website as "The Basic Data Collection for the Technical Disposal of Contaminated Water in Fukushima Daiichi NPS." On the other hand, various organizations including the National Institute for Materials Science (NIMS) collected approximately 800 basic data on 60 kinds of absorption agents from various production sits and their chemical compositions. These results were publicized them in the data base in December.

In addition, numbers of improvements were made for absorption agents themselves, and the National Institute for Materials Science and JAEA have been tackling the development of new agents that can absorb cesium in high density and stably contain it for a long time.

[1] It is a mineral called otherwise as "boiling stone." It has a tunnel structure and absorbs cesium in its pores. Other than being used for catalyzer in industries, it is being widely used for the purification of aquariums for watching and for the deodorizing of excrements of pet animals.

Column 1-7

For Making Use of World Experiences Like Chernobyl for the Reconstruction of Fukushima

A symposium and a seminar gathered scientists from Russia, Belarus and Ukraine who had experienced the accident at Chernobyl Nuclear Power Plant were held in Tokyo and Fukushima respectively in February 2012[1]. The symposium and the seminar were held by the International Science and Technology Center (ISTC) and Science and Technology Center in Ukraine (STCU), funded by the U.S. Department of Energy. About 250 people participated in the symposium that was held in Tokyo on February 3, 2012 and about 200 people participated in the seminar held in Fukushima on the next day, February 4.

Scene of the Symposium (in Tokyo)
Supplied by MEXT

At the symposium held in Tokyo, other than the lectures on decontamination agents and soil recovery technology from the contamination by radioactive substances , the associated staff of the Nuclear Energy Agency of the Organization for Economic Co-operation and Development (OECD/NEA) who witnessed the measures against the accident at Chernobyl Nuclear Power Plant pointed out that the importance of the engagement of stakeholders like local residents, agricultural producers and consumers in decision making during reconstruction and introduced concrete cases.

In Fukushima, a seminar mainly in the form of panel discussion aiming to enable communication among the residents of Fukushima, administrative officials and professionals to move towards early reconstruction was held. At the beginning of the seminar, Mr. Hosono, the Minister the Environment and concurrently the Minister for the Restoration from and Prevention of Nuclear Accident specially appointed by the Cabinet, delivered a greeting address, stating that we should learn from the international experiences in response to the accidents of nuclear power stations including the accident at Chernobyl Nuclear Power Plant and establish a Japanese style of reconstruction. Next, Mr. Sato, the governor of Fukushima Prefecture expressed his thanks to visiting professionals and expressed that he believed the experiences from the accident at Chernobyl Nuclear Power Plant would be the largest reference for the reconstruction of Fukushima.

The panel discussion were participated by the persons related to medical care, administration and education from Ukraine, Belarus and United Kingdom who were engaged in the response to the accident at Chernobyl Nuclear Power Plant. From the audience, questions about the standards of the radiation doses overseas and the reliability of the national governments were raised The panelists answered these questions based on their experiences in their respective countries.

From the accident at Chernobyl Nuclear Power Plant, in addition to the direct parties countries like Belarus, Ukraine and Russia, other European countries, where the radioactive substances diffused, have too various experiences in the matter. It is believed that information exchange and cooperation is significant in the progress towards reconstruction.

4) In Response to a Tighter Electricity Supply-demand Balance after the GEJE, efforts to expand the use of renewable energy

With the momentum of the accident at TEPCO Fukushima NPS, amid the rising concern in the utilization of renewable energy, Kitakyushu City and other local communities aim to increase the use of renewable energy through social demonstration to verify technical and social challenges toward the establishment of smart communities.

[1] Symposium and seminar for the reconstruction of Fukushima ~Learning from the research results, technology and experiences concerning the decontamination and environmental recovery in Russia, Ukraine and others~.

Column 1-8

Challenges of the Building of Smart Community in Kitakyushu

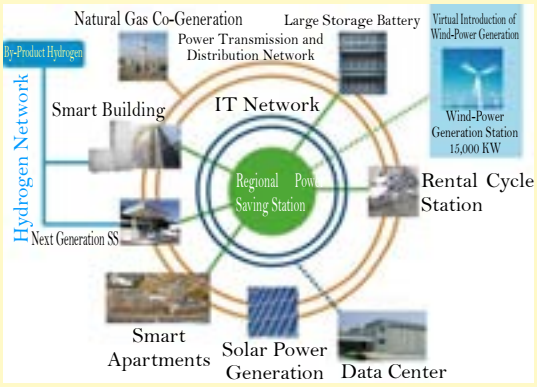
Kitakyushu City was known as a city of steel manufacturing in the past and the city had badly suffered pollution problems like factories' smoke and discharged water in 1950s. In response to this, the city, using the technology and experience in overcoming of pollutions, began its environmental policy in order to become "the environmental capital of the world," leading the world in the international environmental cooperation and the building of a resources recycling society. In December of 2011 after the GEJE, the city was nominated as the FutureCity[1] and has been implementing measures relating to renewable energy and smart grid[2] as well as the establishment of energy management system.

As the major effort, in Yawata Higashi District and Higashida District of Kitakyushu City, "the Creation Project of Kitakyushu Smart Community[3]" was launched in FY 2010 to demonstrate the next generation of energy and social system, in cooperation with local universities and colleges as well as companies. From November 2011, the city implemented a collaboration of tests, setting the Community Energy Management System to wholly adjust energy. Through this effort, the next generation of electricity meters that indicate consumption of energy per hour, energy management system at houses and buildings and a large storage battery will be tested, and these demonstration experiments are scheduled to be performed starting in FY 2012. In addition, changing the system of electric billing system from April 2012, the city, with the cooperation from local residents and companies, is scheduled to be the first in the country to implement "real time pricing" that changes the electric charge of a day according to the situation of demand and supply of energy.

However for the prevailing renewable energy, various challenges, such as the demand and supply of the whole electric power system and the adjustment of voltage arising from the instability of output, have to be tackled. In the above Creation Project, Community Energy Management System that controls energy adjusts the supply of regional electric power, taking the information from the next generation electric meters and the energy management system equipment into account, and solves the problems by expelling instable voltage by the large storage battery, thereby contributes to energy saving.

Through the efforts above, Kitakyushu City aims to reduce the emission of carbon dioxide in the Higashida District by 50% by FY 2014 (compared with 2005). Furthermore, as part of the reconstruction support of the afflicted regions, the city is cooperating with Kamaishi City in Iwate Prefecture to carry out similar efforts there, and it is expected that such highly advanced S&T will contribute the reconstruction of afflicted regions.

Thus, by promoting the introduction of renewable energy under the Business-Academia-Government collaboration, saving energy, embodying a smart grid, the way Kitakyushu City is tacking the situation may be said an advanced case that enables the achievement of stable energy supply and significant reduction of carbon dioxide emission.



Concept Chart of Smart Community

Scene in the Community Energy Management System

Outlook of Smart Community in Kitakyushu City

Source: Supplied by Kitakyushu City local government

1 Created as one of 21 national strategy projects for the new growth strategy and 11 places in total were nominated in the nation including 6 afflicted regions.

2 An electricity transmission network that adjusts the demand and supply of electric power and maintains the stable supply of electricity by controlling the electricity facilities of the supply side of electricity (including diffusion power source whose output is unstable like solar power generation) and the demand side, utilizing IT.

3 A regional community that integrally manages energy by region including heat and unused energy in addition to the effective use of electricity, where the changes of traffics system and the life style of citizens are complexly combined.