Report

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Dr. M.Tsubokura

Title is "The current situation of the radiation exposure screening program in Hama-dori and the future tasks".

Dr. Tsubokura reported from his experiences of the Fukushima Daiichi Nuclear Power Plant accident at the Minamisoma Municipal General Hospital.

The contents of his talk are 1)background information, 2) problems regarding evacuation, 3)radiation exposure control, 4)indirect health effects and 5)conclusion.

The background information shows the damage due to tsunamis and earthquakes and radiation maps. Pictures after the accident shown by Dr.Tsubokura are really terrible and hideous.

The problems regarding evacuation were serious problems. Especially Fukushima people's evacuations were difficult because of the multiple evacuations that for the number of evacuations, about 36% evacuee had more than 5 times according to the handout of the 32th Nuclear Energy Council. The seriousness also depends on the living conditions of the evacuation site. Due to these difficulties the survival probability decreased after the accident and the risk due to evacuation was much higher than the radiation risk.

For the radiation control for internal and external exposure, the internal exposure levels measured by whole body counters were less than 2mSv for most of Minamisoma residents. The external exposure measured by glass budges showed mostly less than 2 mSv/y. The exposure levels were not so large and decreased with elapsed time. The other difficulty is the fact that in spite of low exposure, and small intake of radioactive material from food, there still exists a tendency to avoid food products produced in Fukushima prefecture.

Dr. Tsubokura emphasized following important messages in his conclusion. The biggest problem is indirect health effects. The present situation in Fukushima is many people were losing their interest to get radiation information year after year, however, many people are fear of potential irradiation and future results from the exposure that they got. There are still students with loss of sense or lack of self-esteem. The impacts of the nuclear disaster on health are not limited to that from radiation exposure. In Fukushima, the biggest impact is not from radiation exposure but from societal change. There are some puzzling phenomena, such as the number of ambulance calls by month increased, the number of dog bites also increased after the accident. The nuclear accident accelerated aging of the population in Fukushima, resulted in an extra burden on the local health system. The chronicle diseases such as high blood pressure, hypercholesterolemia, diabetes, obesity, depression and alcohol addiction will result in increases of cardiac infarction, stroke and cancer. To prevent this situation, extra attention will be needed.

I think the relief or supportive efforts for important material of natural history or intangible cultural heritage are important from the view point of getting the respect, the self-esteem back.

Dr. M.Fujiwara

Title is "What we learn from the large-scale soil sampling for radioactive nuclides emitted from the Fukushima Daiichi nuclear power plant accident?"

Dr. Fujiwara reported from his experiences of the supportive actions for Fukushima prefecture.

The contents of his talk are 1)what happened in the Japanese academic community after the TEPCO Fukushima Daiichi Nuclear Power Plant accident? 2)what was worried about the radioactive fallouts? 3)what were the difficulties? 4)what we studied from the accident for future? and 5)what should we prepare for urgent accidents?

In Japanese academic communities after the accident, the nuclear physics group started their activity as early as March 16, 2011 to have a meeting at RCNP Osaka University. Researchers of nuclear physics group joined the screening work for evacuees from March 20, 2011. Their activity expanded to include research groups from different scientific fields, and finally evolved to accomplish the detailed distribution maps of radioactive nuclides.

The radioactive material was released from the nuclear power plants and contaminated vast area of Fukushima prefecture. The people terribly feared to be exposed to radiation because they had never thought of being exposed to radiation or ingesting radioactive material. They also did not have any idea for external exposure and internal exposure.

The research group, however, had difficulties to start the investigation to make detailed distribution maps of radioactive nuclide. Since in spite of the short half-life of ^{131}I of 8 days, the vast number of soil samples had to be taken from the more than 2,000 points and had to be measured accurately in a short time. At that time there had been no applicable procedure manual. Since this project was finally approved as a MEXT project. all procedures for budget request had to be followed as formal procedures. This took a long time to start collection of soil samples, resulting in an insufficient map for short half-life activity of ^{131}I.

The soil samples were taken from the one points from 2 km×2 km mesh within 80 km from the nuclear reactor and the one point from 10 km×10 km mesh from 80 km to 100 km. The total number of point was about 2,200 points. Since 5 soil samples from each point were taken, the total number of soil samples was about 11,000. The number of people and organization joined this project were 440 people from 94 organizations for soil sample collection and 340 people from 21 organizations for measurement of soil samples. This was a valuable and amazing collaboration.

His conclusions are as follows. The improvements for such a big investigation in future are 1) simpler procedures for budget request, 2)in-situ measurements by using Ge detectors, 3)international collaboration will be needed to use a number of detectors and measurer, 4) most important thing is good education at the university level for understanding the radiation and its biological effect. The required preparations for emergency situations will be 1)we have to take the fact "Fukushima story is not yet ended" to heart, 2)health fear decreases, but economical fear increases, 3)depopulation in radioactive contamination area in Fukushima has been already accelerated, 4)we have to take drastic measures to improve the situation, there are many things to do at present and in future.

I think why such a big project was successfully ended is due to the fact the most of researchers joined in the project strongly hoped to contribute the recovery and reconstruction of Fukushima and thus it was amazing and great.

Dr. N.Toyoda

Title is " Development of gamma camera for visualization of radioactive cesium to support Fukushima people recovering from the nuclear disaster"

Dr. Toyoda reported from his experiences of being involved in the gamma-ray detector development.

The contents of his talk are 1)introduction, 2)job carrier of radiation and radioisotopes, 3)accident of nuclear power plant in Fukushima 4)decontamination from residential area, 5)development of gamma camera, 6)prospect for the future.

He studied at the faculty of science, Kyoto university where Dr. Hideki Yukawa (1907-1981) was a faculty member. He is a Nobel laureates for physics 1949 for prediction of meson.

He has been working in the field of radiation and radioisotopes, such as nuclear medicine for diagnosis of disease using gamma camera and radiopharmaceuticals which emit gamma-rays, and manufacturing radiopharmaceuticals and protecting workers from radiation hazards.

At that time(1970), the limit of occupational radiation dose was 3 rem (30 mSv) per quarter (3 months) and accumulated dose= 5 rem (N-18). He felt some fear for invisible radiation exposure due to the work such as repairing cyclotrons and handling radioisotopes. The total accumulated exposure for 10 years was 13.4 rem (134mSv). He felt dilemma of increasing production and radiation control of employees as a radiation health physicist.

At the Fukushima Nuclear Power Plant accident, Japanese government's policies and measures were, for area where additional exposures over 20mSv/y aim at stepwise and rapid reduction of those areas based on the ICRP recommendation (2007), and for area where additional exposures less than 20mSv/y, as a long term goal, aim at reducing to 1mSv/y and the goal to be reviewed periodically.

The decontamination actions were applied to the roofs of houses, space around houses, and contaminated water. For these actions, the gamma-ray camera is desirable to measure the distribution of radioactive nuclides.

He involved in development of gamma cameras to get radiograph of gamma-rays emitted from Cs-137 (plus Cs-134). The first generation was pin hole collimator type, second generation was Compton scattering type, third generation was coded aperture type, and fourth generation was multiple pin holes type. The requests from potential customers of coded aperture type camera were 1)weight is less than 10kg (to the half), 2)capturing time was 2 min (to the half), 3)price should be less than 10 million yen (to the half) and 4)made in Japan if available.

The specification and performance of the multiple pin holes type are as follows. The visualized method is Multi-collimator type, targeted nuclides were ^{137}Cs/ ^{134}Cs, the energy range is 30-1500 keV, the capturing time is1 min(in case net air radiation dose rate from ^{137}Cs be is 1 μSv/h), the viewing angle is 60°, the spatial resolution is 3°. the detector is as follows, scintillator material is CsI(Tl), size is10mm ×10mm ×25mm, number of crystals is 64. MPPC (Multi Pixel Photo Counter) is as follows, number of devices is 64, the optical camera is a flat CCD camera, the external output terminal is USB 3.0, power supply's capability is internal battery(8h) and external battery of 2.5h×2 set, the body size is 175mm(W) ×175mm(D) ×205mm(H), the body weight is 10 kg, operating machine (PC) is Windows ProTough book 10.1 inch.

I think the measured results are satisfactory, thus it may be useful for other needs. The boron neutron capture therapy (BNCT) has been developed using the neutrons produced by research reactors. Recently the neutrons produced by accelerators are intrigued for BNCT, because installation of a research reactor in hospital is impossible, but an accelerator can be installed. The stability of the neutron intensity produced by an accelerator is, however, not stable as neutrons produced by a research reactor. Thus the measurement of neutron intensity during the therapy is desirable for BNCT using neutrons produced by an accelerator. In BNCT, thermal neutrons are captured by ^{10}B taken up by cancer cells, then they emit alpha-particle and ^{7}Li. The alpha-particle and ^{7}Li deposits large energy in cancer cells results in killing of cancer cells. In this reaction, some of ^{7}Li are in the excited state and emit 478 keV gamma-rays. By looking this gamma-ray by the present gamma-camera, the number of the reaction can be measured during the therapy. This might be useful for BNCT.

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