Annex 1

Session Summary of
FNCA 2017 Workshop on
Radiation Safety and Radioactive Waste Management

Session I: Introductory Speech at the Start of Phase 6

1) Outlines and Achievements of FNCA Activities (Mr Tomoaki Wada, FNCA Coordinator of Japan)

The FNCA started in 2000, under the belief that exchanging frank views among ministers of the member countries on promoting regional cooperation in nuclear field is most important. Today, twelve countries and eight projects are active in FNCA.

Some projects in the field of radiation utilization development including Mutation Breeding, Electron Accelerator Application, and Radiation Oncology, have achieved remarkable success. Furthermore, the FNCA has just launched a new project this year on climate change using nuclear and isotopic techniques, which is led by Australia. In the last Coordinators Meeting held in March 2017, it was agreed that the Radiation Safety and Radioactive Waste Management project would go forward to the next phase for supporting member countries with safety improvement related to radiation safety and radioactive management of low-level radioactive waste repositories.

Another important role of the FNCA is to cooperate closely with two human resources development programs operated by the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT). The Nuclear Researchers Training Program and Instructors Training Program provided a variety of programs to nearly 300 Asian researchers in 2016 in total.

2) Summary of Phase 5 and Introduction of the Phase 6 (Prof Toshiso Kosako, Emeritus Professor, the University of Tokyo)

[The Former Project]

The former project, named “Nuclear/Radiological Emergency Preparedness and Response” in the field of Radiation Safety and Radioactive Waste management was successfully finished this March 2017.

It is a matter of indispensable for the safe use of nuclear and radiation to prepare the emergency preparedness and response against an emergency accident for the nuclear and radiological facilities. This emergency preparedness and response have features for each nuclear and radiation facility, and have characteristics for each country. To discuss on the emergency preparedness, we need to understand the emergency type. There are two types of emergency, namely nuclear emergency and radiological emergency.

Here, the situation of emergency preparedness and response for the nuclear and radiological facilities of each FNCA country are summarized. This integrated report not only shows the situation of FNCA countries, but also becomes mutual reference and understanding.

“FNCA Consolidated Report on Nuclear/Radiological Emergency Preparedness and Response (March 2017)”http://www.fnca.mext.go.jp/english/rwm/FNCA_EPR.pdf

[This Project：2017－2019]
The project of this term is “Low-level Radioactive Waste Repository”. The structure of next workshop will be discussed in the tomorrow’s session.

Session II: Country Report

1) Australia (Mr Duncan Kemp, Australian Nuclear Science and Technology Organisation (ANSTO))

Australia is going through a site selection process for a co-located low level waste repository and intermediate level waste store. This process requires volunteers to nominate land which is then assessed for suitability. The concept and nominated sites are discussed, along with the selection criteria for the sites. South Australia (a state) has considered where in the nuclear Fuel Cycle it could make money, and looked at the storage and disposal of international high level waste. After 6 months of public consultation, the answer from the public was no.

2) Bangladesh (Dr M. Moinul Islam, Bangladesh Atomic Energy Commission (BAEC))

Presentation highlighted the status of radioactive waste management in the country. In Bangladesh, both sealed and unsealed radioactive wastes are generated from the use of radioactive sources (RSs) in various activities, which include nuclear techniques in medicine, agriculture, industry, research and education etc. The Central Radioactive Waste Processing and Storage Facility (CWPSF) is the unique facility of Bangladesh working for the safe management of radioactive wastes (RWs) arising from the different stakeholders throughout the country. The presentation also highlighted the policy of Spent Nuclear Fuels (SNF) from existing research reactor (RR) and the SNFs from any future Nuclear Power Plant (NPP) and RRs. Challenges transition from a non-nuclear to a Nuclear Power programme in the country also briefly addressed in the presentation.

3) China (Ms He Huan, China National Nuclear Corporation (CNNC))

No Summary

4) Indonesia (Mr Moch Romli, National Nuclear Energy Agency of Indonesia (BATAN))

The use of nuclear isotopes within the research, industry, and medical sectors generates radioactive waste. Based on Governement Regulation No. 61 year 2013 that adopted from IAEA General Safety Guide (GSG) 1 radioactive waste is divided into 3 classes: low-level waste, intemediate-level waste, and high-level waste.To protect human and the environment from radiation, the waste is collected, processed, and contained by deposition in repositories. Center for Radioactive Waste Technology (CRWT) is one unit in BATAN (National Nuclear Energy Agency of Indonesia) which responsible for managing radioactive waste from all Indonesia. After being processed, the radioactive waste was stored in some storage depending on the classification of the waste type. There are some storage in

CRWT, among them 2 (two) units interim storage for store the low & intermediate level radiaoctive waste, interim storage for high-exposure waste, and interim storage for spent fuels. Two interim storage for low & intermediate level radioactive waste have a similar design. With an area of 1247,585 m2, this repository each can store as many as 526 concrete shells of 950 L and 1716 drums of 200 L. In addition, for the low & intermediate level radioactive waste with high exposure is provided interim storage for high exposure with an area of 132.733 m2 equipped with 20 (twenty) wells with a depth of 6 meters underground and each has a capacity of 7.2 m3, and 3 (three) ponds with depth 6 m and each has a capacity of 129.6 m3. These repository facility is monitored for safety and security in real time. Indonesia does not have a disposal facility, so the interim storages is also used as long-term storage.

5) Japan (Dr Yoshiaki Sakamoto, Japan Atomic Energy Agency (JAEA))

The disposal concept of near surface disposal with engineered barrier (Concrete pit) for LLW and without engineered barrier (Trench) for VLLW was mainly introduced. From some implementation of LLW in Japan, outline of disposal business of JAEA for radioactive wastes generating from nuclear research and use of radioisotopes was presented. The disposal business was in siting process with siting criteria and procedure formulated by JAEA. In addition, technical study of trench and concrete pit facilities about the structure from the point of safety and construction cost was shown. For the concrete pit type, the facility structure was examined to be achieved target dose from the view point of the safety assessment and construction cost. From these results, the grasp of the environmental condition of the disposal site was important to the design of the cost effective disposal facilities.

6) Kazakhstan (Ms Aliya Izbaskhanova, National Nuclear Center (NNC) of the Republic of Kazakhstan)

One of the main tasks facing the world community was the problem of handling of ionizing radiation sources, radioactive waste and spent nuclear fuel resulting from human use of nuclear energy.

This issue is also relevant for Kazakhstan. Firstly, because of the large amount of accumulated on the former grounds of nuclear tests and is continuously generated at the enterprises of the uranium industry and in medical institutions of radioactive waste. Secondly, due to the presence on the territory of Kazakhstan of five nuclear reactors, which are the main sources of spent nuclear fuel.

To regulate the handling of ionizing radiation sources, radioactive waste and spent nuclear fuel in Kazakhstan for 2015 – 2017 was developed and revised a number of documents in the form of laws and other normative legal acts.

But despite the fact that Kazakhstan has 20 years of experience in radioactive waste management, ionizing radiation sources and spent nuclear fuel, nevertheless, there are tasks in the regulatory legal framework and infrastructure of nuclear energy facilities that require compulsory solutions in the very near future

7) Republic of Korea (Dr Hyuncheol Kim, Korea Atomic Energy Research Institute (KAERI))

The first nuclear power plant in Korea was started in 1978, and there were 25 reactors in operation until May 2017. Among of them, a nuclear power plant was stopped on June 18, 2017 (24 reactors are in operation, now). The Korean government has strived to secure a disposal site for the safe management of radioactive waste since the early 1980s. It was planned the construction of a Low and Intermediate Level Radioactive Waste (LILW) disposal facility by 2008, but the site selection was not successful.

In Dec 2005, the disposal site was selected based on the "National Radioactive Waste Management Policy" and public consensus of Gyung-Ju (pros: 89.5 %). The construction of the repository was started at Aug 2008 with the total capacity of 800,000 drums (200 L) in the area of 2,100,000 m3. The first phase construction of it was completed in June 2014 as underground silos with the capacity of 100,000 drums. The facility has been disposing of the radioacitve wastes since July 2015. Korea Radioactive Waste Agency (KORAD) was established in 2009 to manage low and intermediate level radioactive wastes produced in Korea in a safe manner in order to protect public health.

8) Malaysia (Dr Mohd Abd Wahab Yusof, Malaysian Nuclear Agency)

In Malaysia radioactive materials are used extensively in medicine, agriculture, research, manufacturing, non-destructive testing, minerals exploration and others. All the above practices and activities are the sources of radioactive wastes in Malaysia. There is no spent fuel from research reactor. All radioactive wastes need to be managed safely in accordance to the regulations prescribed by the Atomic Energy Licensing Act 1984 (Act 304) to protect the present and future generations of the general public and the environment. Malaysian Nuclear Agency (Nuklear Malaysia) provides basic facilities for safely manage radioactive waste. The latest facility is plasma thermal pilot plant, which can be used to treat and condition radioactive waste. Nuklear Malaysia is actively doing characterization and conditioning of disused sealed radioactive sources (DSRS). Nuklear Malaysia is also embarking a new project, a mobile hot cell project, which will be officially commissioned at the end of this year. With regard to radioactive waste repository, Malaysia is already has a NORM disposal facility which is managed by the State Government of Perak. Malaysia is also looking for suitable sites for disposal of radioactive waste. Management of DSRS was explained including borehole disposal project. Some issues and challenges were also discussed and shared.

9) Mongolia (Ms Batdelger Uranchimeg, Nuclear Energy Commission (NEC) of the Government of Mongolia)

Mongolia is a developing country without nuclear power plants. Economic development in Mongolia has been limited by the harsh climate, scattered population and sizeable expanses of unproductive land. But our country is rich in mineral resources (gold, cupper, coal), particularly uranium resource.

Sources of radioactive waste generation are research facilities, medical, industrial and military use of RI, decontamination of contaminated items, mining and milling activities, technology testing of mining operations etc.

Currently Mongolia has no national radioactive waste management strategy and insufficient infrastructure to manage the existing inventory of radioactive waste or the expected future waste arisings.

Accodring the Nuclear Energy law, article 11.2 Nuclear Energy Commission shall have a special facility of national level to centrally store, transport and dispose of nuclear material, nuclear waste and non-exploitable radioactive waste. This facility shall be the state restricted object.

IAEA has developing a project for radioactive waste management strategy and strengthen the regulatory framework to ensure the safe and efficient management of radioactive waste in Mongolia.

10) The Philippines(Mr Edmundo P. Vargas, Philippine Nuclear Research Institute (PNRI))

The National Radioactive Waste Facility in the Philippines is operated by the Radiation Protection Section, Nuclear Services Division of Philippine Nuclear Research Institute (PNRI). It was established through the assistance of the Department of Science Technology and the International Atomic Energy Agency as a low-level radioactive waste treatment and interim storage facility. It is authorized to operate, treat, condition radioactive wastes received for interim storage. The facility is located within the compound of the Philippine Nuclear Research Institute consisting of an office, three (3) trenches, a conditioning area and decay store area. The facility is secured with a electric perimeter fence and surveillance cameras. It is intended to manage short-lived radionuclide (λ<30 yrs) and temporarily contain radioactive wastes with longer half life. The waste inventory consists of conditioned and unconditioned solid, aqueous, and disused sealed sources. The current strategy for waste storage consist of compaction and cementation for solid and liquid waste. Category 1 and 2 conditioned sealed source are placed in long term storage shield. Unconditioned sealed sources remain in teletherapy head or original working shield. Category 3 to 5 sources are retrieved and conditioned in stainless steel capsules . Sources in devices that can not be retrieved are temporarily stored in storage shelves. PNRI is currently conducting studies on the borehole disposal to disused sealed radioactive sources and near surface low level waste repository. The site being studied is located outside the PNRI compound.

11) Thailand (Ms Nanthavan Ya-anant, Thailand Institute of Nuclear Technology (TINT))

Ms. Nanthavan Ya-anant gave a presentation on the current activities of radioactive waste management and spent fuel management in Thailand. She introduced the draft of national policy of radioactive waste and spent fuel management. The Office of Atoms for Peace (OAP) plays as the regulatory body and the Thailand Institute of Nuclear Technology (TINT) plays as the implementation body. At present, there are 3 sites of radioactive waste management facilities, at Bangkok, Pathumthani, and Nakhon-Nayok province. Recently, the OAP has re-organized its functions for the suitable authorization, inspection, and controls. The new Nuclear Energy for Peace Act B.E.2559 (2016) has enacted into force since August 2016. There are 52 Ministerial Regulations under this Act. The control of radioactive waste management facility and activity is written in this new Act. The challenges of the disposal options was given. She explained that at present, there is small amount of low level waste but large amount of disused sealed radioactive source. Therefore, the Thailand government will investigate which options of disposal shall be appropriated in the future.

12) Vietnam (Ms Doan Thi Thu Hien, Vietnam Atomic Energy Institute (VINATOM))

Since the beginning of the 20¬th century, nuclear techniques have been applied in Vietnam. In the past ten years, the nuclear techniques were intensively and broadly applied in the different branches such as: health care, industry, agriculture, geological survey and research. On the basic of Atomic Law (2008), the Government of Vietnam set the policy about the peaceful use of atomic energy and radioactive waste management. According to the evaluation of IAEA experts, up to now, Vietnam has completed one of three main Milestones in the development of a National Infrastructure of Nuclear Power and prepared for the second milestone: put Nuclear Power Plant out to contract. Management and treatment of radioactive waste is one of nineteen infrastructure issues, which are necessary to be prepared and completed. In general, the amount of RW in Vietnam are small, mainly they are arising from isotope application, the laboratory of uranium processing and the operation of research reactor. In 2003-2004, an State-level Project was carried out, the official studies on meteorological, geological and hydrogeological conditions of Vietnam show that on the territory of Vietnam, the only Coastal Region of South-Central Area might be considered as relevant and the most suitable region for construction of the future national near surface disposal facility of low and intermediate levels Radwaste. There are 3 most suitable candidate sites: Tu Thien village, Son Hai village, Ninh Phuoc district and Thai An village, Ninh Hai district, Ninh Thuan Province. We have some Challenges, Plans and Proposals of Radioactive Waste Management in Vietnam.

Session III: Discussion on Framework of Consolidated Report on Low-level Radioactive Waste Repository (Prof Toshiso Kosako, Emeritus Professor, the University of Tokyo)

Through the discussion in our FNCA workshop activities and FNCA Coordinator meeting discussions, the next project in Radiation Safety and Radioactive Waste Management become “Low-level Radioactive Waste Repository”. The radioactive waste has a wide variety; Categories of waste (Clearance, Low, Medium, high level waste), repository design (near surface, deep geological, bore hole etc.), environmental impact assessment, management system (legal frame work, stakeholder involvement, etc.). In this session, all these items will be discussed. We would like to do a mutual communication through these 3 years workshop activities.

Session IV: Special Lectures

1) Thailand (Ms Nanthavan Ya-anant, Thailand Institute of Nuclear Technology (TINT))

Ms. Nanthavan Ya-anant introduced the safe management of disused sealed radioative soures (DSRS) of category 3 – 5 by the innovative technologies; dismantling and conditioning of DSRS by encapsulation technique. The segregation and characterization of each DSRS were firstly performed. The radiation protection and safty aspects associated with the dismantling and conditioning operation were provided. Those DSRS from industrial uses, such as 60Co, 137Cs, 241Am/Be, 85Kr gauge sources and 241Am from consumer products were dismantling and conditioning and then placed into 200L drums zith shield for interim storage. The encapsulation in stainless steel capsules was to facilitate thei retrieval for final disposal options, such as a borehole disposal facility. The concrete was used for physical protection and security of the sources. Adequate shielding at the operation area must be provided for radiation protection reasons. The maximum activity per capsule multiplied by the number of capsules shall not exceed A1 limit values as set out in the IAEA transport regulations. The outcomes of this operation were that the volume reduction was about 5 times than before and the DSRS were packaged in the secure, safe and retrievable manner for the future disposal options.

2) Australia (Mr Duncan Kemp, Australian Nuclear Science and Technology Organisation (ANSTO))

Mr Kemp highlighted some of the mistakes that have been made and what would have prevented them. The basic problems came down to a lack of knowledge, both in the waste and the facilities that house it, lack of quality control and hence more problems in the future and unintended consequences because the change was not properly thought through. The lessons learnt can be used to reduce the amount of time and money spent on projects by properly understanding the waste form, the facilities and thinking through all the consequences of the project.

3) Indonesia (Mr Moch Romli, National Nuclear Energy Agency of Indonesia (BATAN))

Center for Radioactive Waste Technology (CRWT) of National Nuclear Energy Agency of Indonesia (BATAN) as the central of radioactive waste management in Indonesia, has 2 (two) main facilities namely Interim Storage for Spent Fuel (ISSF) to manage high-level radioactive waste in the form of nuclear spent fuel from research reactor and Radioactive Waste Treatment Installation (RWTI) to manage low & intermediate levels of radioactive waste. These two installations began operations in 1988. In order to ensure the safe operation of both facilities, a Hazard Operability Study (HAZOPS) was established as part of risk assessment and risk communication, as well as a medium of knowledge transfer from senior operators to the next generation. This risk assessment is conducted by assessing the critical parameters of the system, the anomalies that can occur, and providing efforts to prevent and control the risks. In addition, to ensure the adequacy of the 30-year-old facility, an ISSF aging assessment has been conducted. This assessment is used to develop the aging management program that aims to determine the planning and implementation of efforts that are systematic and adequate in managing the effects of aging on the structure, system, and components.

4) Japan (Dr Hideki Kawamura, mcm japan)

Japan has more than six decades of history of Low Level Waste (LLW) management. In the initial stage,, we conducted sea dumping from 1955 to 1969. After the London Treaty, our LLW programme moved towards land disposal, with required treatment infrastructure. The main target of LLW land disposal was focused on the waste from operation of commercial Nuclear Power Plants. The initial LLW waste stream (Level-2 waste) was disposed at the Rokkasho site, based on overseas concepts for near-surface disposal. At that time, utilities established their own waste specifications, without any consideration of optimization. For the implementer of this disposal, getting a license for operation of this LLW disposal facility was the first priority. Consequently, such waste streams led to over-design and high costs compared to other countries. Associated regulations were defined corresponding to this LLW project and requirements for treatment and disposal were very strict with little consideration of cost / benefit of resultant performance.

These historical wastes resulted in loss of flexibility in terms of implementation of future technology and advanced concept development. Research and technological development stalled following initiation of initial waste management, with many testing facilities being dismantled. However, the severe accident of

Fukushima Daiichi will produce much more complicated wastes and we now have to consider optimized "Waste Streams" based on lesson learned from disposal to date, but with more flexibility and emphasis on cost/benefit optimisation. This experience could be also useful for any other countries who are considering new waste streams.

5) Republic of Korea (Dr Hyuncheol Kim, Korea Atomic Energy Research Institute (KAERI))

Radio strontium is an important radionuclide with environmental radioactivity monitoring aspects owing to its high fission product and bioavailability. National authorities have monitored 90Sr in seawater for national public health safety, as have many laboratories. The demand increased for a reliable and efficient method for determining radio strontium in seawater. We have developed the analytical method for 90Sr in seawater using an automated separation system, which can be employed for the routine monitoring and emergency preparedness. For a routine analysis, 90Y being equilibrium with 90Sr is separated from the sample using DGA resin and analyzed by LSC. For an emergency preparedness, 90Sr is purified from 100 ml of seawater sample using cation exchange resin and Sr resin. The above operations are controlled by a computer, thereby saving the analytical time and labor.

6) Malaysia (Dr Mohd Abd Wahab Yusof, Malaysian Nuclear Agency)

In Malaysia, sealed radioactive sources (SRSs) are used extensively in agriculture, industry, medicine and various research areas. Predominantly small physical size but many sources contain very high concentrations. Disused sealed radioactive sources (DSRS) shall be managed safely and securely. Nuklear Malaysia has been collecting more than 14,000 DSRS since 1985 and these DSRS are stored in an interim storage facility. Due to safety and security concern, Malaysia is planning to dispose of the DSRS into borehole disposal facility. DSRS are characterized and conditioned at Nuklear Malaysia facility. Until April 2016, 12,928 units of DSRS are already conditioned. Malaysia has also identified a site for borehole disposal facility and site characterization has also been done. Safety assessment and safety case is being prepared for long-term post closure safety. Present and future work including issues and challenges for this project are explained in detail.

7) The Philippines (Mr Edmundo P. Vargas, Philippine Nuclear Research Institute (PNRI))

The Borehole disposal project is currently being undertaken by the Philippine Nuclear Institute with financial and technical assistance from the IAEA Technical Cooperation Program for the purpose of managing and disposing disused sealed radioactive sources(DSRS) stored in the temporary radioactive waste facility located in Quezon City, Philippines. The proposed borehole project site is located in northern Luzon some 500 km north from temporary radwaste facility. The site is isolated in far from population center, far from an active fault. The site, however, is located on top of a plateau and subject to erosion. The site is co-located with the proposed near surface waste disposal facility. Characterization of the site consists of environmental baseline data collection, geological, hydrological/hydrogeological mapping, geophysical resistivity measurements, and drilling. All of the available data are being used for safety assessment and development of the safety case and environmental impact assessment. A total of 6 boreholes have been drilled in the area and is monitored for hydrology. The borehole disposal for the

DSRS is planned to be disposed at a depth between 100 to 200 m depth below the water table. At least 50 stainless steel capsule containing about 1860 DSRS based on current inventory will be disposed. Current activities for the project include monitoring of boreholes and site set-up of meteorological station, refining of geological/hydrogeological model, survey and development of access road, and soil erosion studies Preparation and review of 1st iteration of the Post Closure Safety Assessment. Challenges so far include socio-political acceptability issues and inadequate funds.