



Forum for Nuclear Cooperation in Asia

Newsletter

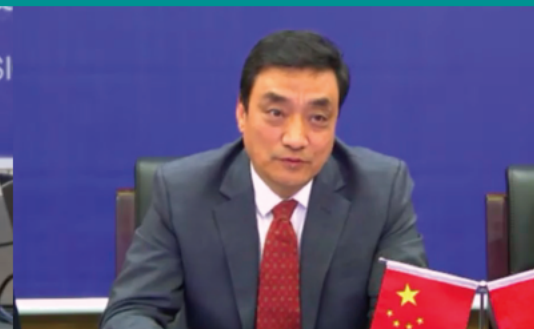
Aiming for Sustainable Development

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Photo on the upper left: Field visit to new rice variety IS21 developed in Malaysia
Photo on the bottom right: Launching ceremony of IS21 named from Prime Minister, Dato' Sri Ismail Sabri Yaakob (second from left)
(from report of Malaysia at FNCA Workshop on Mutation Breeding)



Discussion on Enhancing the Use of Research Reactors, Accelerators, and their Related Technologies

FNCA Ministerial Level Meeting Held Online

The Japan Atomic Energy Commission (JAEC) of the Cabinet Office held online the 22nd Ministerial Level Meeting (MLM) of the Forum for Nuclear Cooperation in Asia (FNCA) on December 9, 2021 in Tokyo. This meeting is an annual event to discuss state policies among the ministers in charge of nuclear science and other officials of the 12 FNCA member countries, with the aim of promoting regional cooperation in the peaceful use of nuclear energy.

Mr. KOBAYASHI Takayuki, Minister of State for Science and Technology Policy, delivered the opening remarks via a video message from Japan, noting that FNCA has made remarkable achievements in all important areas of peaceful use of nuclear energy since its establishment; the policy discussions at this meeting have to be reflected in FNCA's project activities; the results of such activities need to be disseminated to local communities; and nuclear science and technology will be reevaluated to realize a carbon-neutral society in light of the discussions and resolutions of COP26. He concluded by wishing for the early and complete revival of the FNCA projects, which have been stalled by the COVID-19 pandemic.

The keynote speeches were delivered by Ms. Aleshia Duncan, Deputy Assistant Secretary for International Nuclear Energy Policy and Cooperation, Office of Nuclear Energy, U.S. Department of Energy, and Steering Group Chair of the International Framework for Nuclear Energy Cooperation (IFNEC), on the theme of "IFNEC initiatives: peaceful use of nuclear energy and importance of regional development," and by Dr. UESAKA Mitsuru, Chairman of JAEC, on the theme of "Medical Isotope Production and Supply by Best Mix of Reactors and Accelerators". This was followed by a policy dialogue (round table discussion) on the theme

of the meeting, "Enhancing the Use of Research Reactors, Accelerators, and their related Technologies," with lead speeches from member countries. After the introduction of the winners of the FNCA Breakthrough Prize 2021, which was established as a special prize only for this year, and the commemorative speech by the winner of Best Researcher, country reports were given on the progress of nuclear energy policies and activities in each member country. The meeting concluded with the adoption of a Joint Communiqué that referred to the efforts to normalize the FNCA project activities, which have been stalled due to the COVID-19 pandemic, as well as the sharing of relevant information on the use of research reactors, accelerators, and their related technologies among the member countries.

Keynote Speeches

Ms. Aleshia Duncan explained the philosophy and objectives of IFNEC, and outlined the current organizational structure and activities of each group. She enumerated the following priority areas of activity that IFNEC aims to pursue in 2022 and beyond: 1) spread a correct understanding of nuclear energy across regions and generations through plain and clear communication; 2) establish finance to support and expand the peaceful use of nuclear energy, watching the possibility of inclusion in the taxonomy; 3) introduce and boost the gender balance, an issue being extensively recognized as crucial, in nuclear organizations; and 4) promote nuclear technological innovation, including small modular



Ms. Aleshia Duncan
IFNEC

reactors, in cooperation with regional and international organizations. She concluded by saying that it is primarily important to clearly recognize the climate change issue and the need to solve it; to share the knowledge and experience of nuclear energy and the resources on which they are based among the stakeholders; to disseminate the correct knowledge and understanding of nuclear energy in a simple and organized way; and to achieve unity among strategic partners who share these goals.

Round Table Discussion

As regards the theme of this meeting, "Enhancing the Use of Research Reactors, Accelerators, and Related Technologies", Thailand, Japan, and Australia gave lead speeches from the perspectives of national policy, technology, and practice (radioisotope production), followed by a question and answer session and discussion.

Commendation of Winners on FNCA Breakthrough Prize 2021

Due to the overall stagnation of project activities in FY2020 due to the COVID-19 pandemic and the variability in the activities of respective member countries, the selection and awarding of country-specific project teams with the most outstanding activities were suspended in FY2020. Instead, for this year only, the FNCA Breakthrough Prize 2021 was given to individual researchers who have produced the most commendable research results in the past five years. At the meeting, one best researcher and three excellent researchers were commended, and the best researcher gave an acceptance speech (See p12 for details).

Country Report

The representatives of each member country reported on their recent nuclear policies and progress in activities.

Refer to the following URL for more information on the outcome of the FNCA MLM: http://www.aec.go.jp/jicst/NC/sitemap/bunya15_fnca.htm

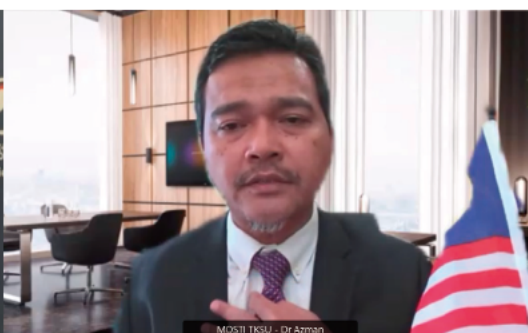
Joint Communiqué

As a summary of the meeting, a Joint Communiqué was adopted, including the following activity guidelines (excerpted).

- Maximize efforts to normalize FNCA research activities and hold regular meetings normally, based on the major premise of ensuring the safety and health of project members and complying with the health policies of each country.
- Anticipating that International Atomic Energy Agency (IAEA) will make necessary coordination with the relevant international organizations including World Health Organization (WHO), explore possible collaboration between FNCA and IAEA in combating zoonotic diseases including COVID-19.
- Continue to promote the expansion of radiation-based cancer treatment in the Asian region.
- In view of frequent occurrence of extreme weather worldwide in recent years, encourage the member countries to reinforce their cooperation on the issues of environmental protection and the countermeasures to climate change, and proceed with the related projects continuously.
- In accordance with the discussion on the "Enhancing the use of Research Reactors and Accelerators" at the Round Table Discussion of the 22nd FNCA Ministerial Level Meeting, promote information exchange on research reactors and accelerators as well as the mutual usage of facilities among the member countries.
- Encourage the member countries to allow end-users to utilize the outcomes of projects on mutation breeding, radiation processing, research reactor utilization, neutron activation analysis, and isotope production, taking into account the possibility of commercialization that will contribute to the welfare of society and the economy more effectively.
- Adopt "Building up public trust on nuclear science and technology" as the topic for discussion at the 2022 Study Panel to share information and case studies on confidence building, and make efforts to build up public trust on nuclear science and technology in the member countries and the Asian region.



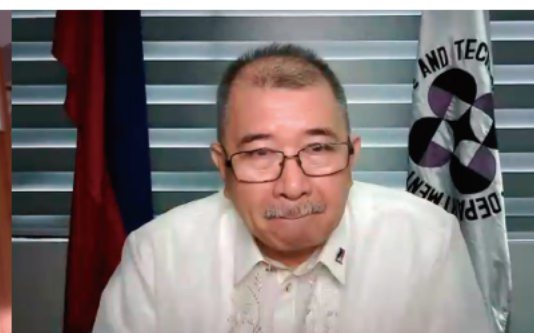
Mr. Kwon Hyunjoon
Director-General,
Space and Nuclear Energy Bureau,
Ministry of Science and ICT



Ts. Dr. Mohd Nor Azman Bin Hassan
Deputy Secretary General, Ministry of
Science, Technology and Innovation



Mr. Manlaijav Gunaajav
Secretary of the Nuclear Energy
Commission and the Head of
the Executive Office



Prof. Fortunato T. de la Peña
Secretary (Minister),
Department of Science and Technology



Assoc. Prof. Dr. Thawatchai Onjun
Executive Director,
Thailand Institute of Nuclear Technology



Dr. Tran Ngoc Toan
Vice President,
Vietnam Atomic Energy Institute

Mr. SANO Toshio

Commissioner, Japan Atomic Energy Commission

■ Fukushima Recovery and Reconstruction and White Paper on Nuclear Energy 2020

At the time of the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi Nuclear Power Station, extremely high levels of radiation were measured in various parts of Fukushima Prefecture. Today, however, radiation levels are almost the same as those in major cities abroad, such as New York, London, and Paris, except for the immediate vicinity of the power station. The evacuation orders have been lifted except for the Restricted Area. A report of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) implied that radiation-associated health effects were unlikely to be discernible among the residents of Fukushima Prefecture. New standards for radiation-associated effects on agriculture, forestry, and fisheries have been established, with the world's strictest limit of less than 1 mSv per year for radiation detected in food. Owing to various and tremendous efforts by all people concerned, no food has been found to exceed this limit since 2018, except for a very few items. However, about 36,000 people are still displaced from their homes, and the lifting of the evacuation order for the Restricted Area is not yet clearly foreseen. The market value of agricultural products has not recovered to pre-disaster levels, and the industrial sector, including agriculture, forestry, fisheries, and tourism, continues to suffer from unfounded rumors and reputational damages that lack proper scientific understanding.

Within the site, significant improvements in the environment in and around the power station have been achieved, and several improvements in the organizational culture and institutional frameworks have been made over the past decade. Examples include the restructuring of nuclear regulatory agencies, establishment of new safety standards, and creation of private safety organizations. However, there is still a long way to go to complete the decommissioning work, which has a target period of 30 to 40 years for completion. The Japan Atomic Energy Commission (JAEC) has sorted out the contents of its 10-year investigation and published the essentials in a white paper so that these efforts will remain in the minds of people concerned. We must keep them in mind when considering the use of nuclear energy.

■ Current Status of the ALPS Treated Water Stored at Fukushima Daiichi Nuclear Power Station

In April 2021, the Japanese government announced its basic policy of discharging the water treated with the Advanced Liquid Processing System (ALPS) stored at the Fukushima Daiichi Nuclear Power Station into the sea. The oceanic discharge will take place in line with international practice



only when TEPCO complies with the regulatory standards set forth based on recommendations by the International Commission on Radiological Protection (ICRP). In addition, the IAEA will review the safety aspects of the oceanic discharge of the ALPS treated water into the sea. Thorough measures are being taken to minimize adverse impacts on reputation, and we will continue to provide information to the international community.

■ The 6th Strategic Energy Plan

A new Strategic Energy Plan was published in October 2021 in view of achieving net-zero carbon dioxide emissions by 2050 and a new greenhouse gas reduction target for 2030. Promotion of renewable energy and the restart of existing nuclear power plants are set as main policies up to 2030. The plan also clearly states that Japan will promote research and development to accelerate innovation. Furthermore, the government has for the first time clearly announced the maximum use of renewable energy in this plan. With regard to research and development on nuclear energy, four types of advanced nuclear technologies are being studied: fast reactors, small modular reactors (SMRs), hightemperature gas-cooled reactors, and nuclear fusion. We continue to research these technologies by participating in international cooperation projects.

■ NEXIP Program

Japan launched the Nuclear Energy x Innovation Promotion (NEXIP) program in 2019 to help accelerate the development of innovative nuclear technologies in the private sector through funding, access to research and development facilities, and human resource development initiatives.

■ Radioisotope Applications

Regarding the application of radioisotopes, the Japanese government formulated a growth strategy in June 2021, clearly stating plans to produce radioisotopes using research reactors. This is an indication that Japan, which relies on imports of radioisotopes from abroad, intends to shift to domestic production. An advisory committee established in November 2021 for the implementation of practical research is to formulate an action plan by April 2022 on the production and use of radioisotopes for various purposes including medical applications.

Mr. Dong Baotong

Vice Chairman, China Atomic Energy Authority

In 2020, Chinese President Xi Jinping announced the goal of turning carbon dioxide emissions into decline by 2030 and a vision of achieving net-zero emissions by 2060. Accordingly, the Chinese government formulated a policy of proactive and orderly nuclear power development on the basis of ensuring safety. Currently, there are 51 nuclear power units in mainland China, with an additional 18 under construction. In recent years, China has made remarkable progress in the development of nuclear energy, including the operation of the first indigenous "Hualong One" nuclear reactors both at home and abroad. In order to ensure the safe and healthy development of the nuclear industry, China is constantly

improving its radioactive waste management capabilities. Since 2020, nuclear technology has played a significant role in the fight against COVID-19, including radiation sterilization using electron beams to kill viruses on refrigerated food packages and in medical wastewater. In addition, there are more than 7,000 particle accelerators in China, which are widely used in medicine, health care, agriculture, public safety, and industry. Meanwhile, more than 20 research reactors have been built in China, which are being used for the production of isotopes, equipment for Boron Neutron Capture Therapy (BNCT), and heating systems.

Mr. Kwon Hyunjoon

Director-General,

Space and Nuclear Energy Bureau, Ministry of Science and ICT

The Republic of Korea is developing and utilizing various nuclear reactors, accelerators, and their application technologies, and is actively cooperating with the Asia-Pacific region countries through IAEA and the Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific (RCA). Korea has developed HANARO, a multipurpose research reactor, and SMART, a small modular reactor (SMR), and is also developing a next-generation SMR model called innovative SMR (i-SMR) with the aim of entering the global SMR market in the 2030s. Plans are also underway to build a new research reactor for the production of radioisotopes, with the target of its completion in 2027.

In addition to promoting the use of a third-generation synchrotron light source called the Pohang Light Source (PLS) and the X-ray Free Electron Laser (XFEL), Korea has started building a multipurpose fourth-generation

synchrotron accelerator, which is scheduled for completion in 2027. Korea has also been building RAON, a large-scale research facility, for accelerating various heavy ions to produce rare isotopes for advanced basic science research.

Korea supports the development of innovative nuclear systems in other countries and promotes information sharing by holding dialogue forums. Korea also cooperates with IAEA and its member states through the sharing of research and development facilities, and operates the "RCA e-learning campus" for the Asia-Pacific region countries.

Korea will continue to contribute to the development of reactors and nuclear research and development, and will share its achievements with the international community for mutual prosperity through nuclear science and technology.

Mr. Manlaijav Gunaajav

Secretary of the Nuclear Energy Commission and the Head of the Executive Office

Facing with the problem of COVID-19, 2021 continues to be a challenging year for the FNCA member countries. Mongolia is also facing difficulties in achieving its goals in nuclear energy activities, with most social events being postponed. Mongolia is planning to amend its Nuclear Energy Law, and activities related to the amendment are underway. We ratified the Treaty on the Prohibition of Nuclear Weapons in October 2021.

The Mongolian government is making tremendous efforts to provide modern health care to the population through the reform of the current framework and the introduction of innovative technologies. In these efforts, application of

nuclear technology is expected to play a significant role in the modernization of medical services. Mongolia is in the process of preparing for the commercialization of confirmed uranium deposits, and the main challenge is to ensure the efficiency, economy, profitability, human health safety, and environmental friendliness of projects related to the extraction and processing of radioactive minerals by using advanced technologies. To achieve this goal, the government is actively seeking solutions to improve environmental monitoring and strengthen the regulatory system related to uranium extraction.

Genetic Resources Development Using Radiation

Contributing to Sustainable Development of Agriculture in Asia

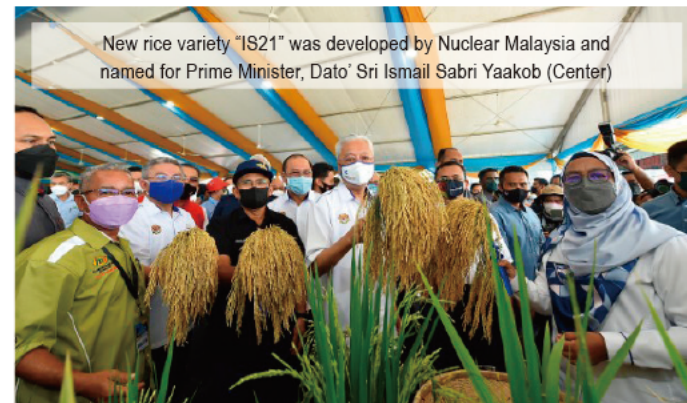
The Mutation Breeding project has been advancing its activities with the objective of developing new varieties of sorghum, soybeans, orchids, bananas, rice, and other crops in high demand in the Asian region by breeding techniques using irradiation with gamma rays, ion beams, etc., to contribute to the increase in food production and improvement in the quality of crops in the Asian region.

In FY2013, the project team launched an activity targeted at rice, the most important crop in Asia, focused on responding to the problem of climate change, which is drawing increased global attention, and contributing to sustainable agriculture. As a result, new varieties of rice that are excellent in terms of various resistance to environmental stress, including disease, drought and salt resistance, have been developed many member countries.

In FY2018, the target was expanded beyond rice to include other staple crops much in demand in member countries; the project started an activity aimed at contributing to promotion of sustainable agriculture by developing new varieties that are adapted to various environmental changes caused by climate change, and raise high yields even with a low input of chemical fertilizers and agrochemicals.

The project teams in some member countries pursue research to develop varieties more suited for cultivation by using local varieties inherently adapted to the local environment, and resolving their problems, such as low yields, long cultivation periods, and long plant heights, while keeping their good properties.

The FY2021 workshop was held online with participation from 10 countries; the online meeting was on January 18, 2022, and discussions via email were made from January 19 to February 1, 2022. Through its



activities so far, the Mutation Breeding project has attained remarkable results in development of genetic resources and related techniques, which have had a great effect not only on development of mutation breeding R&D in member countries, but also on development of the regional social economy. These results are being disseminated through open seminars and publication of achievement reports. The project also contributes to human resources development through the publication of Mutation Breeding Manual, exchange of information at workshops, and on-site visit.

Under the FNCA Awards created in 2017, prizes have been given to Bangladesh (Best Research Team prize in 2018), Malaysia (Excellent Research Team prizes in 2017 and 2020, and Excellent Researcher Prize under the Breakthrough Prize in 2021), and Vietnam (Excellent Research Team Prize in 2019). Their research has attracted a lot of interest from, and is highly evaluated by, member countries, and it is expected that this project activities will contribute to sustainable development in the Asian region in the future.

Wide Utilization of Radiation Processing Aiming to Develop New Products

in the Agricultural, Medical and Environmental Fields

The Radiation Processing and Polymer Modification project pursues activities aimed at promoting development and practical use of new products in the agricultural, environmental, and medical fields, through wide utilization of radiation processing with electron beams and gamma rays. Member countries have advanced practical use of various products meeting their own needs. In the field of agriculture, plant growth promoters and super water absorbents based on materials derived from natural resources, and biofertilizers have been developed and put to practical use. It is expected that these results will contribute to promotion of sustainable agriculture, and help respond to climate change, as well.

Based on findings gained through R&D of plant growth promoters, growth promotion of farmed fish and chickens is also investigated.

In the field of medicine, wound dressing, 3D cell culture substrates, hemostats, etc., are developed. In the environmental field, radiation processing serves a wide variety of purposes in people's daily life, including metal absorption, removal of harmful metals, and wastewater treatment.

The 2021 Workshop was held online from 29 to 30 November with representatives participating from 10 countries.

This fiscal year is the last year of the current activity phase (FY2018 to FY2021) of the Radiation Processing and Polymer Modification project. At the workshop, the results of its past activities were summarized and the plan of activities for FY2022 to FY2024 was discussed.

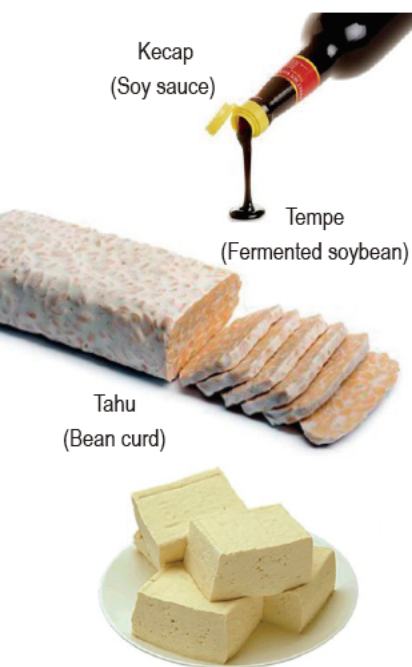
It was agreed in the new activity plan of the project that 1) radiolysis-degraded chitosan to animal feed, 2) hydrogels for medical



Super water absorbent using cassava starch

application, 3) environmental remediation, 4) synergistic effect among plant growth promoter, super water absorbent, and biofertilizer, 5) plant growth promoter and super water absorbent inclusive process development, 6) mutation breeding of biofertilizer microbe using radiation, 7) sterilization and sanitization using radiation, and 8) recycled plastics. It was proposed that several themes should be chosen and discussed at every workshop, according to the status of progress of member countries' R&D.

Under the FNCA Breakthrough Prize 2021 honoring researchers who have attained the most remarkable research results in the past five years, the project leader of Thailand who has developed and put to practical use a super water absorbent using cassava starch and sugar cane bagasse (residue after juice extraction) received the Best Researcher Prize.



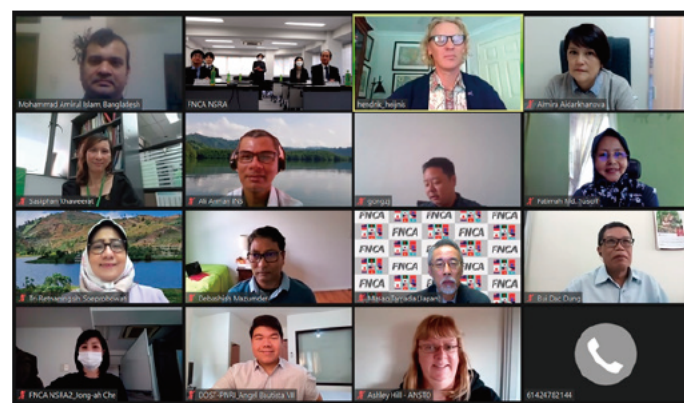
Participants of Workshop

Contributing to Climate Change Research through Experiments and Analyses Using Radionuclides and Stable Isotopes

The Climate Change Science Research project, aimed at better understanding the mechanisms and processes of past and present climate change, conducts experiments and analyses with use of nuclear technology and isotopes to elucidate why and how past climate changes have occurred, and ensures that new knowledge obtained and technologies used for such elucidation are shared.

In this project launched in FY2017 based on a proposal by Australia, 11 FNCA member countries have been sharing information and cooperating in sampling and analysis of radionuclides and stable isotopes in sediments, corals, soils, etc., in the natural world, so that the member countries can study changes in the past global environment. Specifically, the member countries take samples of sediments in lakes and rivers, blue carbon and sediments in mangrove forests, coral and shellfish fossils, forest soils, etc., and analyze them after precise pre-processing.

For soil carbon analysis, the Japan Atomic Energy Agency (JAEA) published the "Practical Guide on Soil Sampling, Treatment, and Carbon Isotope Analysis for Carbon Cycle Studies" in 2020, recommending a wide range of practical techniques for soil sampling and sample treatment, fractionation of soil organic carbon, and measurement and analysis using isotope ratio mass spectrometry and accelerator mass spectrometry. The guidelines, which enables Asian countries' research teams to explicate the carbon cycle on their own, was highly evaluated, and Japan team won the 2020 FNCA Award for the Best Research Team of the Year. In addition, the Philippine researcher investigating coral fossils was awarded the Excellent Researcher Prize under



Workshop participants

the FNCA Breakthrough Prize 2021. This project is attracting considerable interest and has a high-level reputation with the member countries as global attention is increasing regarding measures against climate change risks. The FY2021 Workshop was held online from November 11 to 12, 2021. Representatives from 10 countries participated in the workshop and reported their activities and results of research. Australia announced that it would start activities for launching a new Food Provenance and Quality Authentication Project. In order to proceed with research on the theme of provenance investigation and safety of food, Australia decided to send out questionnaires to the member countries to identify analytical capacity, priority food items, and stakeholders which will be able to collaborate with in promoting the new project.



Above : Dr. Angel T. Bautista VII, Excellent Researcher of the FNCA Breakthrough Prize 2021, and his research team (The Philippines)

Below : Coral sampling in the Philippines



Above : Radiocarbon analysis by Accelerator Mass Spectrometry (AMS) in JAEA

Left : Soil sampling

Improving Radiation Oncology in the Asian Region by International Joint Clinical Trials

The Radiation Oncology project aims to improve the level of radiation therapy in the Asian region by establishing optimal treatment protocols for uterine cervix cancer, nasopharyngeal cancer, and breast cancer, all of which are highly prevalent in the region. It has been carrying out joint clinical trials, with 11 member countries, on radiation therapies for more than 20 years. Protocols established through the joint clinical trials are used at hospitals in the member countries.

For international clinical trials to proceed successfully, it is important that radiation therapies are properly conducted in respective countries. In this project, Japanese medical physicist members played a central role in starting the "Dosimetry Quality Assurance and Quality Control (QA/QC) Activity for External Beam Radiotherapy" to uniformize dosimetry for therapies. Dose audits for external beam radiotherapy were performed on 46 LINAC beams (devices for external beam radiation treatment) at 16 facilities in 11 countries from 2006 to 2012, using the "LINAC output dose evaluation method with a radiophotoluminescent glass dosimeter" developed by the National Institute of Radiological Sciences (currently known as the National Institutes for Quantum Science and Technology (QST)). Both the average and the standard deviation of relative deviations between measured and intended doses showed high uniformity for multi-country data, which confirmed the quality of international joint clinical trials of this project. There was one beam exceeding the tolerance level of error, but the cause was investigated and the problem was solved.

These audits were highly evaluated because they were successfully completed despite the large variations in medical devices and staff levels among countries and hospitals. The paper summarizing the findings was published in an international journal in 2016.

In addition, it was confirmed through this activity that external audits are important to ensure that reliable radiation therapies are conducted.



In 2018, the project started treatment using an advanced technique, "3D-image guided brachytherapy (3D-IGBT)," as its fifth clinical trials of therapy for uterine cervical cancer. A special water phantom measurement system (*see picture below) was developed by Japanese members in order to verify doses delivered in the advanced method using CT and MRI. After a feasibility study, dose audits started in 2019, and field surveys finished so far at a total of 6 hospitals in Japan, Korea, China and the Philippines, produced good results. It is expected that the audits will be resumed when the COVID-19 pandemic is over.

The "QA/QC Activity for Radiation Therapy" is highly evaluated, especially for its recent activities and their achievements, and Dr. MIZUNO Hideyuki (QST) was awarded the Excellent Researcher Prize under the FNCA Breakthrough Prize 2021 that honored researchers who had conducted excellent research activities. Dr. Mizuno has been participating in this project as the main member of the QA/QC Activity since 2006. It is expected that this activity will further contribute to improvement of the quality of radiation therapy in the Asian region.

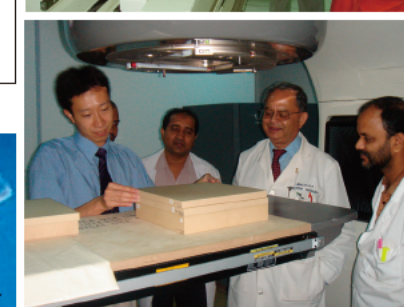
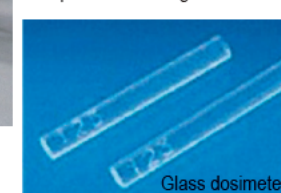
The news of the prize was reported in the online workshop on November 26, 2021.



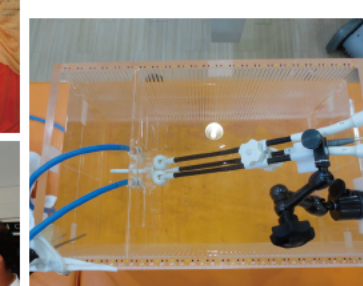
Mr. WADA Tomoaki, Coordinator of Japan, (left) handing the FNCA Breakthrough Prize trophy to Dr. MIZUNO Hideyuki



Paper summarizing the results



*Water phantom (Below): A water tank to be used for radiation dosimetry based on the assumption that the water is a patient. Dosimetry is performed with an applicator and a dosimeter placed in the tank.



Left: External radiation dose audits (Above: Cipto Mangunkusumo Hospital in Indonesia, 2007; Below: Delta Hospital in Bangladesh, 2010)

Building a Network for Further Utilization of Research Reactors in Asian Countries



OPAL Multi-purpose research reactor (Australia)

Research reactors have been operating in a lot of Asian countries for many years, and they are utilized in a variety of fields. In the Research Reactor Utilization (RRU) project, countries share information on characteristics, usage status, etc., of their research reactors with aims of improving the research base and technical skills of researchers and engineers in FNCA member countries. The RRU project covers a wide range of topics, and workshops held every year represent good opportunities for network building.

Among types of Neutron Activation Analysis (NAA), Instrumental NAA (INAA) is a method that allows a large number of elements to be analyzed and quantified at the same time in a non-destructive way. It is an analytical method taking advantage of the highly penetrating nature of neutrons. Its ability to analyze all solid samples is a good characteristic not seen in other analytical methods, and this method is actively used in many countries. Since 2017, the NAA group has been analyzing Suspended Particulate Matters (SPMs), which cause air pollution, and mineral samples containing Rare Earth Elements (REEs). Radioisotope production is a very interesting topic for member countries. The stable supply of medical isotopes is important to Asian

countries as well. The Australian Nuclear Science and Technology Organisation (ANSTO) built a new facility for producing ^{99}Mo (molybdenum) in 2017, which supplies ^{99}Mo to domestic and overseas markets. After making efforts to comply with the new regulatory requirement in Japan, Japan Research Reactor No.3 (JRR-3) was finally permitted by the Nuclear Regulation Authority for its operation in February 2021.

Its utilization began in July, and ^{198}Au (gold) and ^{192}Ir (iridium) irradiated at JRR-3 are shipped to be used for radiation therapy.

The FY2021 Workshop of the RRU project was held online from November 24 to 25, 2021, and 11 countries participated. The RRU group exchanged information on radioisotope production (including production of new isotopes and Quality Assurance and Quality Control (QA/QC) for their practical use) and new research reactors, while the NAA group, on environmental monitoring with INAA and other measurement techniques, targeting a variety of samples, such as air pollution substances and other pollutants in soils, rivers, lakes, and oceans.

Safer Handling of Radiation and Radioactive Waste in the Asian Region

The purpose of the Radiation Safety and Radioactive Waste Management Project is to promote safer management of radiation and radioactive waste in FNCA member countries. This is achieved by exchanging and sharing information and experience-based knowledge regarding handling of radiation and radioactive waste.

Through the activities of this project over more than 20 years, member countries have shared information on safety management of spent radiation sources, decommissioning and clearance, and emergency preparedness and response for nuclear and radiological facilities, as well as data on accidents that have occurred in connection with nuclear facilities and radiation. Mutual understanding has been deepened regarding approaches to radiation safety and management of radioactive waste at facilities. In this way, the project has contributed to fostering safety culture in radiation and radioactive waste management in the member countries.

These experiences and shared information are also compiled by the project, and reports on various themes are published and released to the public on the FNCA website.

Project results in recent years include the "FNCA Consolidated Report on Nuclear/Radiological Emergency Preparedness and Response" published in 2017 and the "FNCA Consolidated Report on Low Level Radioactive Waste Repository" published in 2020.

One future plan for the project is to thoroughly discuss naturally occurring radioactive materials (NORM) and technologically enhanced naturally occurring radioactive materials (TENORM), which are



Workshop participants

to become a serious social problem in many Asian countries, and compile a consolidated report.

NORM/TENORM are radioactive materials more complex and difficult to manage than previously handled radioactive wastes, and the situations and issues involved are completely different depending on the country. Therefore, it will be vital to share a broad spectrum of knowledge among the member countries, carry out fact-finding surveys based on an international consensus, and consider what sort of response will be necessary.

At this fiscal year's workshop, held online on November 9 to 10, 2021, there were 23 participants from 10 countries. The participants gave presentations and exchanged views on the current situations, problems, and future plans relating to NORM/TENORM in their own countries.



Atmospheric suspended dust sampling (Indonesia)



Radioactive waste storage facility in Thailand

NORM sampling in the Philippines

Inspection tour of radioactive waste storage facility of ANSTO (2018 workshop, Australia)

Promoting Capacity Building for Strengthening Nuclear Security and Safeguards in the Asian Region

The Nuclear Security and Safeguards project has been advancing its activities since FY2011 with the aim of strengthening nuclear security and safeguards and promoting capacity building in the Asian region through sharing experiences, knowledge and information about nuclear security and safeguards and exchanging opinions about policies, strategies and frameworks among FNCA member countries.

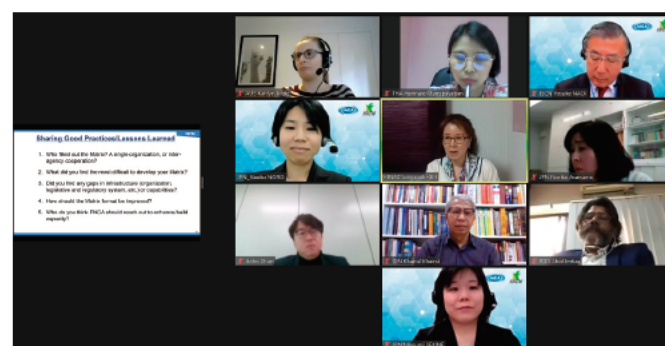
In recent years, participant countries have shared results of their latest efforts and held detailed discussions about future initiatives and cooperative and collaborative activities through workshops and other opportunities under the following themes: in the field of nuclear security, development of a regional collaboration system for nuclear forensics, and promotion of development of human resources needed to maintain the nuclear security system; and in the field of safeguards, steady fulfilment of state's obligation on export controls required by the IAEA's Additional Protocol (AP).

Nuclear forensics is a technical method that is used to analyze the composition, physical and chemical form, and other attributes of nuclear and radioactive materials that have been confiscated or sampled by investigative authorities to determine the origin, transportation route, purpose, and other details related to the materials. If nuclear forensic capabilities are put in place, they will support law enforcement agencies in their investigation activities, which will lead to a deterrent against acts of nuclear terrorism. Nuclear forensics is a subject that FNCA member countries would like to focus on addressing in the future. In the FY2019 Workshop, Table Top Exercise (TTX) for nuclear forensics was conducted, where participating countries shared ideas of a domestic system required for building nuclear forensic abilities and proper ways of cooperation among relevant responsible

agencies.

In a new activity starting in FY2021, the project aims to promote human resources development for nuclear security by preparing a matrix of stakeholders to enable member countries to get an overall picture of the nuclear security regime and to make clear what kinds of human resources are needed to strengthen their nuclear security.

In terms of safeguards, at the FY2020 Workshop an online exercise related to complementary access available to IAEA under the AP was conducted. Through the exercise, participating countries shared ideas of what would be done through the complementary access and what preparation had to be made. The FY2021 Workshop was held online, where presentations and discussions were made under the themes of human resources development for maintaining a nuclear security system, regional cooperation for nuclear forensics, and export controls required by AP. An online exercise for export control was also conducted.



Sharing about stakeholder matrix (2021 workshop)



Dr. Phiriyatorn Suwanmala of RPPM Project wins FNCA Breakthrough Prize 2021



Best Researcher Prize

Dr. Phiriyatorn Suwanmala



Project Leader of Thailand,

Radiation Processing & Polymer Modification (RPPM) Project

Deputy Executive Director,

Thailand Institute of Nuclear Technology,

Ministry of Higher Education, Science, Research and Innovation

Our project on "Radiation Processing and Polymer Modification for Agricultural, Environmental and Medical Applications Project, Thailand" has benefited from the partnership with FNCA. The FNCA project was very useful for member countries that wanted to share knowledge and techniques on application of nuclear technology for peaceful purposes. The project helped me to develop products and use manuals and guidelines to achieve objectives of scaling up acceptance and application of nuclear technology for peaceful purposes in Thailand.

Under the FNCA Project, my research team and I developed a Super Water Absorbent (SWA) - a product prepared by radiation processing. It can absorb large amounts of water and slowly release it to the plant and soil. This product is therefore very useful for agriculture in dry areas of Thailand. It can help farmers increase their yields and therefore increase their incomes. We used cassava starch and sugarcane bagasse as the starting materials. They are renewable resources and are abundant in Thailand. The product degrades easily after one-and-a-half years in the soil. It does not cause environmental damage and does not damage the soil compared with the commercial petroleum-based products.

The field tests for baby corn, rubber trees and sugarcane showed, respectively, 43%, 40% and 52%, increases in yield with the application of



the SWA.

The impact of the research cuts across economic and environmental aspects of Thailand's economy. Rubber production is a key industry in Thailand. Increasing rubber output will create jobs and lead to economic growth. The country can expand its agricultural output through growing crops in semi-arid or seasonally arid parts.

Furthermore, we have worked on improving SWA processing to save on energy used in drying and increasing the swelling ratio by using spherification techniques. We will disseminate knowledge on the use of nuclear technology towards the goal of promoting public acceptance of the technology.

Through various stages of research, partnerships with government and the private sector, publication of results in an international journal and other communication media, I received two international awards in 2016.

My research team and I are grateful for the support and partnership with FNCA. We have benefited from our collaboration and the experience that we have gained will help us to continuously innovate to make nuclear technology an important modality to address some of the country's agricultural, cultural, environmental and industrial development solutions.



Excellent Researcher Prizes

The Prizes were presented to the three researchers listed below in recognition of their outstanding achievements after the Best Researcher.



Dr. Sobri Bin Hussein, Malaysia
Mutation Breeding Project



Dr. Angel T. Bautista VII, the Philippines
Climate Change Science Research Project



Dr. Mizuno Hideyuki, Japan
Radiation Oncology Project



Key staffs involved in the project

From left: Dr. Thitirat Rattanawong, Dr. Phiriyatorn Suwanmala, Ms. Pattra Lertsarawat, Dr. Kasinee Hemvichian

Agreed on Efforts to Quickly Normalize Project Activities Stalled by the Impact of COVID-19

The Cabinet Office of Japan as the secretariat of Atomic Energy Commission, in collaboration with the Ministry of Education, Culture, Sports, Science and Technology of Japan, held the 21st FNCA Coordinators Meeting in Tokyo on June 30, 2021.

The meeting was attended by representatives from 12 FNCA member countries: Australia, Bangladesh, China, Indonesia, Japan, Kazakhstan, Republic of Korea, Malaysia, Mongolia, the Philippines, Thailand, and Vietnam.

■ Summary of the meeting outcome

The outcome of the meeting is summarized as follows:

- In line with the new direction of FNCA as stated in the Joint Communique of the 21st FNCA Ministerial Meeting, the Coordinators Meeting ("the meeting") agreed to further promote activities related to agricultural development, food security, environmental protection, health, nuclear security, and human resources development; and to make utmost efforts to normalize FNCA's project activities as soon as possible, which have been stalled due to the impact of COVID-19, while paying due attention to the health and safety of project researchers and other participants and complying with the

health and security policies of the member countries.

- The representatives of the current seven FNCA projects provided summary reports on the annual activities of individual projects. It was confirmed that activities have been steadily conducted with efficient cooperation among the member countries.
- The meeting implemented end-of-project evaluation on four projects completed in March 2020, namely a) Radiation Oncology, b) Research Reactor Utilization, c) Radiation Safety and Radioactive Waste Management, and d) Nuclear Security and Safeguards. As 2020 was set aside as a year to prepare for the next phase of activities due to the impact of COVID-19, it was agreed to launch a new three-year phase for the four projects starting in 2021.
- The meeting agreed to make efforts to strengthen cooperation with relevant international organizations, including the IAEA and the Organisation for Economic Co-operation and Development / Nuclear Energy Agency (OCED/NEA), in the FNCA projects.



Discussion on Climate Change Research Using Nuclear Isotopic Technology

The Cabinet Office of Japan as the secretariat of Atomic Energy Commission held the 2021 Study Panel in Tokyo on March 3 to 4, 2021. The meeting was attended, through an on-line conference system, by experts in the fields of nuclear isotope technology and climate change from Republic of Korea, Slovakia, and Japan, in addition to representatives from 11 FNCA member countries: Australia, Bangladesh, China, Indonesia, Japan, Kazakhstan, Malaysia, Mongolia, the Philippines, Thailand, and Vietnam.

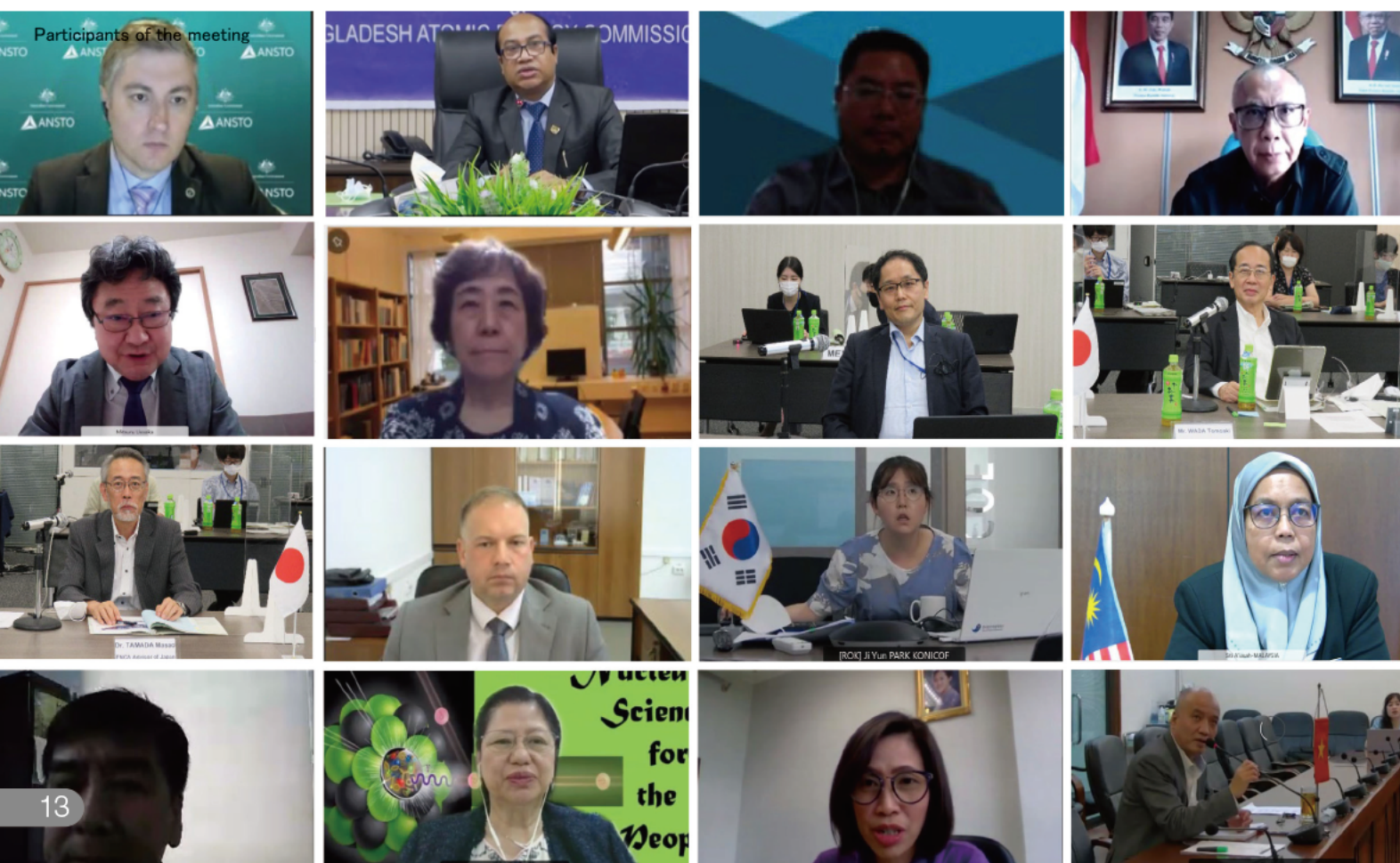
With the theme of the meeting being "Nuclear Isotopic Technology and Climate Change", the participants deepened their knowledge and understanding of the following aspects: nuclear power generation has the potential to make a significant contribution to the mitigation of global warming; the technology of radioisotopic measurement, data analysis, and monitoring provides a very effective means of scientifically investigating the causes of climate change; and the latest analytical method using radioisotopes to determine the origin of food can lead to the development of sustainable agriculture.

Through the lectures given by domestic and international experts, the participants have learned that in order to correctly predict future climate change, it is important to collect and analyze high-quality radionuclide data to accurately understand past climatic changes and to better understand the relationship between human activities and natural action.

■ Summary of the meeting

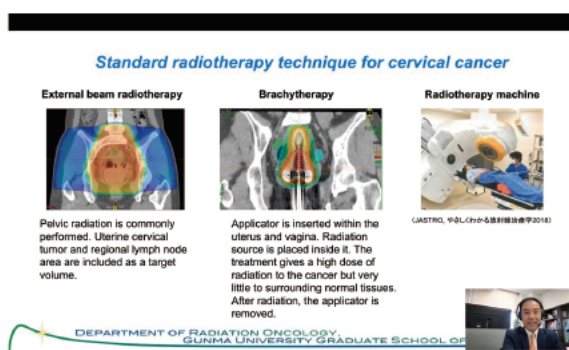
The chair of the meeting, Mr. SANO Toshio, Commissioner of the Japan Atomic Energy Commission (JAEC), made the following remarks.

- The valuable knowledge and experience gained from the speakers and moderators, the ideas and practical examples from the reports of the member countries, and the exchange of opinions among the participants, including the country representatives and experts, have been all beneficial to the participants and can be applied to the daily activities of FNCA.
- It is hoped that those involved in the FNCA Climate Change Science Research Project will continue to play a strong leadership role in promoting efforts to improve the global environment and contributing to sustainable socioeconomic growth in Asia.



Activities		Date	Venue
22 nd FNCA Ministerial Level Meeting		December 9, 2021	online
22 nd FNCA Senior Officials Meeting		June 30, 2021	online
2022 Study Panel		March 9, 2022	online
21 st FNCA Coordinators Meeting		June 30, 2021	online
Radiation Utilization Development	Mutation Breeding WS	January 18 - February 1, 2022	online Q&A and discussion via e-mail
	Radiation Processing & Polymer Modification WS	November 29 - 30, 2021	online
	Climate Change Science Research WS	November 11 - 12, 2021	online
	Radiation Oncology WS	November 26, 2021	online
Research Reactor Utilization Development	Research Reactor Utilization WS	November 24 - 25, 2021	online
Nuclear Safety Strengthening	Radiation Safety and Radioactive Waste Management WS	November 9 - 10, 2021	online
Nuclear Infrastructure Strengthening	Nuclear Security and Safeguards WS	February 22, 2022	online

FNCA Open Seminar



FNCA open seminar (Radiation Oncology Project)

In usual years, FNCA holds open seminars at the sites of its workshops, in which it attempts to disseminate what the activities of its projects are and their results to local people. In FY2021, due to the COVID-19 pandemic, all project workshops were held online. To continue their past efforts on open seminars, seven FNCA projects video-recorded the presentations about their respective activities.

The presentations are as follows, and their recordings are available on the following FNCA websites:

<https://www.fnca.mext.go.jp/>

Project	Title of Presentation
Mutation Breeding	Molecular characterization of the mutations induced by gamma rays and carbon ions
Radiation Processing & Polymer Modification	The FNCA Breakthrough Prize 2021 Outcomes and Research Achievements from 2016-2021
Climate Change Science Research	Iodine-129 for reconstructing past nuclear impacts and tracing earth and environmental processes
Radiation Oncology	Toward Standardization of Radiotherapy for Cervical Cancer
Research Reactor Utilization	Utilization of GA Siwabessy Reactor for Radioisotope Research and Production
Radiation Safety and Radioactive Waste Management	Outline of NORM Guidelines in Japan
Nuclear Security and Safeguards	International Trends and Framework for Nuclear Security

Message from FNCA Coordinator of Japan



FNCA has been greatly contributing to the Asian region for more than 20 years since its establishment. Its contributions in the field of radiation utilization include a remarkable increasing of yields realized with new rice varieties developed by mutation breeding, great improvements of 5-year survival rates for cancers such as uterine cervical cancer which is highly prevalent in Asia achieved through radiation therapy, and raising of plants resistant to environmental changes based on development of plant growth promoters and super water absorbent hydrogels.

In the field of research reactors, analytical techniques in member countries, especially in neutron activation analysis, have been improved. In the field of radioactive waste management, safety measures for radiation management have been enhanced. In the field of nuclear security, efforts are currently under way to improve the level of nuclear forensic techniques in member countries.

On the other hand, the COVID-19 pandemic has made a great impact on the FNCA projects; in some member countries, the number of days or hours of research has been limited, and research entailing human travel, such as field studies, has been greatly restricted, as well. Project meetings have had to be held online for two consecutive years. It is because of the mutual trust and network built so far that these meetings have been realized. In these meetings, there is no time to deepen discussions and talk about new research elements. I strongly hope that all FNCA meetings will be held face to face in 2022 and subsequent years.

WADA Tomoaki, FNCA Coordinator of Japan

Message from FNCA Advisor of Japan

I was appointed as FNCA Advisor of Japan in April 2021. Until then, I had been involved in FNCA activities for ten years and more as Project Leader of the Electron Accelerator Application project (since 2018, renamed the Radiation Processing and Polymer Modification project). Making good use of my past experiences, I would like to work on FNCA activities with the aim of producing socio-economic results for member countries.

In this fiscal year, the Senior Officials Meeting and the Coordinators Meeting were held online in June, and the Ministerial Level Meeting was also held online in December. At these meetings participating countries expressed their wish for face-to-face meetings. Workshops of seven projects were held online as well, where participants shared current status in member countries and confirmed the future plans. However, since it was difficult for them to exchange opinions as actively as in face-to-face workshops and to observe sites in technical visits, many of them expressed their desire for face-to-face meetings. Emergence of a



new variant of COVID-19 has made it difficult to expect the pandemic to be contained any time soon. Travel abroad has been restricted for more than two years to prevent the spread of infection. I sincerely hope that vaccinations and oral medicines will end the pandemic, resulting in lifting of travel restrictions, and that real face-to-face meetings will make FNCA activities more effective and efficient again.

TAMADA Masao, FNCA Advisor of Japan

Australia

Australia values the significant role of the FNCA in developing and promoting the peaceful uses of nuclear science and technology in the Asia-Pacific region. Through the Australian Nuclear Science and Technology Organisation (ANSTO), Australia is pleased to play a prominent role in the work of the FNCA and Australian researchers value the significant collaboration with their regional counterparts that is enabled through participation in FNCA activities.



Ms. Catherine Kelleher
Government Affairs Manager,
ANSTO

Bangladesh

During 2021, despite COVID-19 outbreak throughout the country, Bangladesh worked hard to improve socio-economic growth using nuclear technology applications. Satisfactory progress has been achieved for the construction of Rooppur Nuclear Power Plant. Substantial cooperation has been made in the field of human health, agriculture and environment with the online workshops arranged by FNCA. Bangladesh ensures it is strong commitment to work with FNCA Member Countries for the regional development utilizing Nuclear Science and Technology.



Dr. Sanowar Hossain
Chairman, Bangladesh Atomic
Energy Commission

Kazakhstan

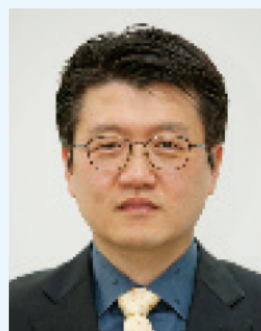
Participation of Kazakhstan in the FNCA activity since 2010 became beneficial for sharing of knowledge and information under FNCA project activity in agriculture, industry, environment and other areas. Special contribution should be emphasized in the healthcare sector i.e in improving radiation treatment techniques. In the light of the COVID-19 pandemic, it is necessary to ensure the compliance of safe measures and maintenance of the full-fledged activities of the Forum for the sustainable development of cooperation and work of scientists. I avail myself of this opportunity to express my appreciation and thanks to the FNCA staff for the active contribution in promoting social and economic well-being of the FNCA member countries.



Prof. Erlan G. Batyrbekov
Director General, National Nuclear
Center of the Republic of Kazakhstan

Korea

My sincere gratitude goes to all FNCA member countries who have worked tirelessly with their best efforts to improve the people's quality of life and the prosperity for all by utilising nuclear technology in the face of challenges posed by the COVID-19. With the global pandemic threatening the world's sustainable development and coprosperity more than ever, the Republic of Korea will continue to share its advanced nuclear science and technology and work closely with the member countries in order to realise humanity's universal value as well as protect lives and preserve a safe environment.



Mr. Kim Kiseok
Director, Nuclear and Fusion
Energy Cooperation Division,
Ministry of Science and ICT

Malaysia

The collaborative framework that FNCA provides for the member states had benefited Malaysia in further enhancing its R&D activities that are internationally recognized. Nuclear science and technology have been progressing well in Malaysia and positively contributed to the national socio-economic development. Malaysia believes that FNCA will continue to be an important platform to promote and strengthen stakeholders' involvement in response to the relevant developmental priorities in nuclear science applications.



Dr. Rosli Darmawan
Deputy Director General,
Malaysian Nuclear Agency

Mongolia

The Government of Mongolia has been making great efforts to provide modern medical care to the inhabitants through reforming the current framework and introducing innovative technologies. In these efforts, nuclear technology applications are expected to play a major role in healthcare services modernization.

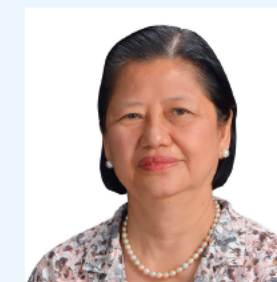
Thus, we aim at enhancing more active and extensive cooperation with FNCA.



Mr. Chadraabal Mavag
Head,
Nuclear Technology Department,
Nuclear Energy Commission

The Philippines

For the period that I have been the Philippine Focal Person to FNCA, I have seen the many benefits of this Japan-led cooperation among Asian Member States especially in the area of information exchange among scientists and researchers. This information exchange has made a solid impact on the direction of nuclear research particularly in the Philippines through the diversified applications of nuclear energy in our country. Thus, I would like to extend my sincerest thanks to the officials and staff of FNCA who have tirelessly made this happen.



Dr. Lucille V. Abad
Chief,
Atomic Research Division,
Philippine Nuclear Research
Institute

Thailand

The 1st Forum for Nuclear Cooperation in Asia in Bangkok in 1999 co-sponsored by the Ministry of Science, Technology and Environment of Thailand and the Atomic Energy Commission of Japan is still in our remembrance as if it had just passed. Since then, the participating countries has been enjoying the sharing of not only expertise but close friendship through the FNCA projects. Thailand would like to thank all the FNCA fellow countries for working hand in hand to develop the advancement of nuclear and radiation technology and most importantly to magnify the outcome of the FNCA projects to other sectors. We look forward to the new areas of cooperation and many more international networks with the FNCA for the benefit of our region.



Ms. Kanchalika Dechates
Head of International Cooperation
Section, Thailand Institute of
Nuclear Technology

Vietnam

Despite the heavy consequences of COVID-19 pandemic, the research reactor in Viet Nam has been even effectively operated with increasing time of operation up to 100 hours per week, and satisfied 80% of domestic demand for some essential radioisotope productions. Other facilities such as irradiation facilities also contribute significantly in response to the Pandemic. This proves that the application of nuclear technology has played a more and more important role in socio-economic development in Viet Nam.



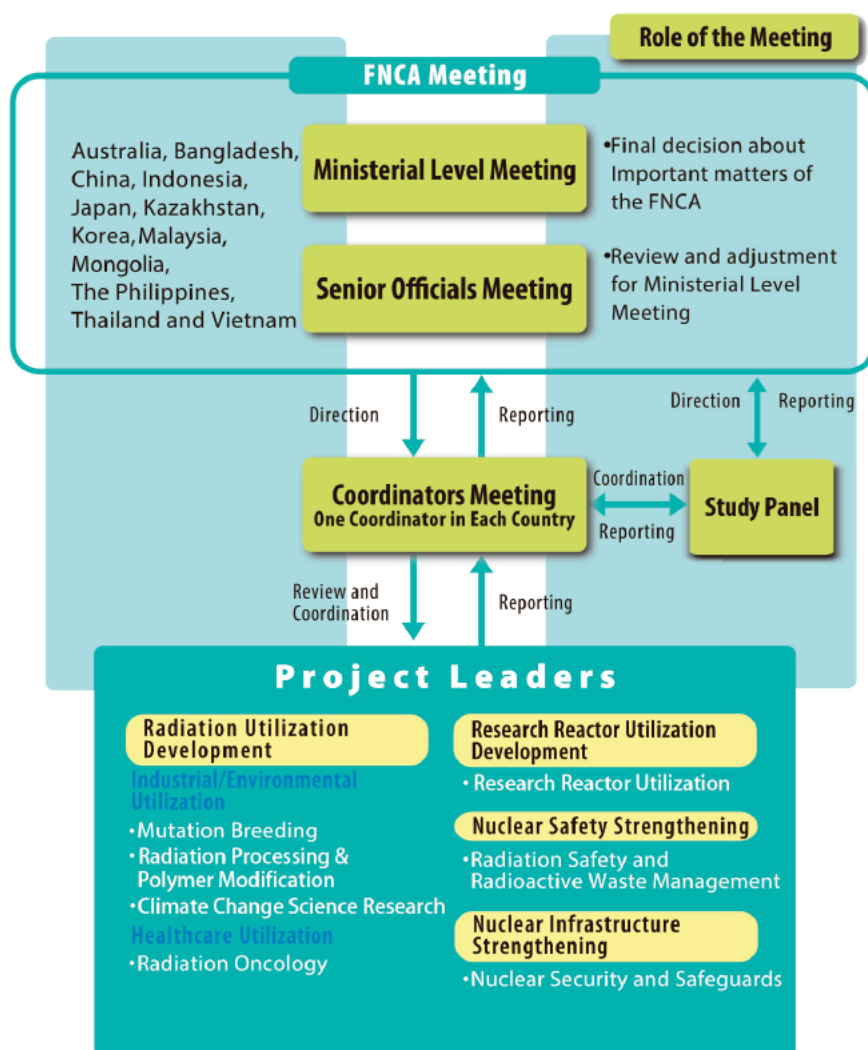
Dr. Tran Ngoc Toan
Vice President, Vietnam Atomic
Energy Institute

What's FNCA?

What is FNCA (Forum for Nuclear Cooperation in Asia)?

FNCA is a framework for international cooperation for the peaceful use of atomic energy, led by the Cabinet Office and Ministry of Education, Culture, Sports, Science and Technology of Japan. Twelve countries, i.e. Australia, Bangladesh, China, Indonesia, Japan, Kazakhstan, Korea, Malaysia, Mongolia, The Philippines, Thailand, and Vietnam, are conducting collaborative activities under equal partnership for joint research on nuclear science and technology, information exchange, and support for nuclear power infrastructure development.

The FNCA Framework



FNCA Ministerial Level Meeting

A meeting of ministerial level representatives who are in charge of science and technology policy and supervising nuclear energy and radiation uses. FNCA's cooperation policies and nuclear energy policies of the member countries are discussed in this meeting.

FNCA Senior Officials Meeting

Senior officials from member countries have preliminary discussion on the agenda for the Ministerial Level Meeting.

FNCA Coordinators Meeting

A coordinator is appointed for each member country to oversee FNCA project activities in various nuclear fields. Coordinators gather to assess the progress of individual projects and discuss their results, evaluations, future policies and general management of FNCA.

Study Panel

In the Study Panel, senior officials and experts from the FNCA member countries discuss on nuclear policy/technical matters of both power and non-power areas of nuclear energy with a view to applying such knowledge to domestic and international activities.

Projects

For seven projects in four areas associated with radiation utilization and nuclear power infrastructure, the FNCA member countries take turns holding a workshop or an open seminar to discuss achievements and the plans of activities.

FNCA

Forum for Nuclear Cooperation in Asia

NSRA



International Affairs & Research Dep.,
Nuclear Safety Research Association (NSRA)
5-18-7, Shimbashi, Minato-ku, Tokyo, 105-0004 JAPAN
TEL: +81-3-5470-1983 / FAX: +81-3-5470-1991

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