FNCA 2009 Workshop on Human Resources Development

Open Symposium on Strong Linkage with Asia ~ The Role of Fukui Region for Human Resources Development in Asia~

June 22nd, 2009　13:30～16:30
Fukui International Activities Plaza (Fukui city)

Hosted by Ministry of Education, Culture, Sports, Science and Technology　of Japan (MEXT)

Supported by Fukui Prefectural Government, University of Fukui, the Wakasa Wan Energy Research Center

FNCA 2009 Workshop on Human Resources Development
Open Symposium on Strong Linkage with Asia
-The Role of Fukui Region for Human Resources Development in Asia-

Programme

Welcome address & Opening remarks	
13:30-13:50	Mr. Nobuaki ASAHI (Fukui Prefectural Vice-Governor)
	Dr. Shigeki SAKURAI (Ministry of Education, Culture, Sports, Science and Technology (MEXT))
1. Special Lecture	
13:50-14:10	"MEXT and FNCA activities on Nuclear Development and Human Resources Development in Asia" Dr. Sueo Machi (FNCA Coordinator of Japan)
2. Lectures -Present situation of education and research activities open to Asia-	
14:10-14:30	1) "Nuclear Safety Training Activities open to Domestic and International researchers, Present Status and Future Vision of Nuclear Safety Training Activities" Dr. Hideyuki Nakagawa (Vice President of University of Fukui)
14:30-14:50	2) "Formation of International lodgment area in Fukui" Dr. Toshikazu Takeda (Director of Research Institute of Nuclear Energy, University of Fukui)
14:50-15:10	3) "Proton cancer therapy Institution accepting Domestic and International patients" Dr. Kazutaka Yamamoto (Department of particle beam therapy, Wakasa Wan Energy Research Center)
3. Panel Discussion -The expected role of Fukui region for Human Resources Development in Asia -	
15:10-16:30 (10 min.) (10 min.) (60min.)	[Keynote Presentations] -Research activities and achievements by Asian researchers in Fukui on MEXT Nuclear Researchers Exchange Program- 1) "Basic Research on the Imaging Physiological and Pathological Functions by Means of Cyclotron and Positron Emission Tomography (PET)" Mr. SARASAMKAN Jiradanai (University of Fukui/Thailand) 2) "Description about the Research Activities" Mr. LE Ngoc Trieu (Wakasa Wan Energy Research Center/Vietnam) [Discussion] Moderator: Dr. Sueo Machi (FNCA Coordinator of Japan) Panelists: Dr. Hideyuki Nakagawa (Vice President of University of Fukui) Dr. Toshikazu Takeda (Director of Research Institute of Nuclear Energy, University of Fukui) Dr. Katsumi Kuruba(Executive Director, Wakasa Wan Energy Research Center) Ms. Rabiah Binti ABU HASSAN (Malaysian Nuclear Agency)

	Ms. Percedita Tumbokon CANSINO (Philippine Nuclear Research Institute)

Lecturer & Panelist introduction

Dr. Sueo Machi (FNCA Coordinator of Japan)

Dr. Hideyuki Nakagawa (Vice President of University of Fukui)

Dr. Toshikazu Takeda (Director of Research Institute of Nuclear Energy, University of Fukui)

Dr. Kazutaka Yamamoto (Department of particle beam therapy, Wakasa Wan Energy Research Center)

Dr. Katsumi Kuruba(Executive Director, Wakasa Wan Energy Research Center)

Mr. SARASAMKAN Jiradanai (University of Fukui/Thailand)

Mr. LE Ngoc Trieu (Wakasa Wan Energy Research Center/Vietnam)

Ms. Rabiah Binti ABU HASSAN (Director, Human Resource Development Division, Malaysian Nuclear Agency)

Ms. Percedita Tumbokon CANSINO (Senior Science Research Specialist, Philippine Nuclear Research Institute)

MEXT and FNCA activities
on Nuclear Development and Human Resources Development in Asia

Sueo Machi
FNCA Coordinator of Japan
Former Commissioner of the Atomic Energy Commission of Japan

Preface

FNCA (Forum for Nuclear Cooperation in Asia) is a nuclear cooperation network of ten East Asian countries (China, Bangladesh, Indonesia, Japan, South Korea, Malaysia, Philippines, Thailand, Vietnam, and Australia) led by the Ministry of Education, Culture, Sports, Science and Technology and the Cabinet Office (Atomic Energy Commission) of Japan. The FNCA has been producing tangible results, with its member countries forming a partnership and using nuclear technology to ensure that nuclear technology will contribute to social and economic development. In addition, the Ministry of Education, Culture, Sports, Science and Technology has been offering various programs to help member countries develop human resources. These programs include nuclear research exchange, nuclear safety seminar, and instructor training program.

Noticeable Accomplishments of the FNCA

1. Environmental-Friendly Agriculture - Radiation Breeding, Biofertilizer, and Growth Promotant

Food security is essential to human life. Therefore, the FNCA is conducting breed improvement projects to improve agricultural productivity. These programs include breed improvement research on “disease-resistant bananas,” “pest-resistant orchid species,” and “high-quality paddy.” The radiation technology-based biofertilizer project succeeded in reducing the usage of chemical fertilizers and increasing the yields of many crops such as soy bean, peanut, and corn by taking advantage of the microbial effect. Another project successfully developed materials that promote crop growth by using radiation technology to decompose natural macromolecules (such as crab and shrimp shells).

2. For Better Healthcare – Diagnosis and Treatment of Cancer

Surgery-free radiation therapy is a patient-friendly treatment and is thus required in all Asian countries. The FNCA developed a more effective “radiation therapy for cervical cancer and head and neck cancer” and conducted a cooperative clinical trial with participating countries to ascertain its effects. The FNCA has been promoting the therapy since then. The

FNCA is also conducting a clinical trial to improve the effectiveness of therapy, which combines radiation and anticancer drugs. In the project on "Positron Emission Tomography (PET)" which aims to make early diagnosis of cancer, the FNCA strives to establish an image analysis method and a technology to maintain cyclotron and PET camera.

3. Nuclear Safety and Waste Treatment and Disposal

Safety is the basic premise of nuclear energy utilization. The "Research Reactor Safety Culture" project is conducted to ensure that member countries check and improve their research reactor safety culture and management conditions each other. To ensure safe treatment, management and disposal of radioactive waste, facility visits and review meetings are organized to improve technology.

4. Fast-growing Energy Consumption and Introduction of Nuclear Power Generation in Asia

Stable energy supply is indispensable for Asian countries to pursue continued economic growth. Nuclear power generation plays an extremely important role in that respect. Vietnam, Indonesia, and Thailand aim to introduce nuclear power generation by around 2020. At FNCA, the ministerial-level meeting agreed on the importance of nuclear power generation. Subsequently, FNCA began helping member countries build the basic infrastructure required for the introduction of nuclear power generation.

Human Resources Development in Developing Countries – Creation of a Solid Foundation of Human Resources

1. Exchange and Development of Nuclear Researchers and Engineers

Human resources development required for the promotion of the use of nuclear power is a major issue in developing countries.

The Ministry of Education, Culture, Sports, Science and Technology recognized the issue early on and have been inviting 70 engineers from Asian countries to participate in a one-year program every year since 1985. These engineers engage in nuclear research with Japanese engineers to improve their capabilities. The program has accepted a total of 1,495 trainees, of which 97 have occupied important positions such as that of a department director, center president, and nuclear energy commissioner, and are active in their own countries.

2. Training of Instructors

Training facilities and instructors are necessary for developing countries to develop human resources in their own countries. The Ministry of Education, Culture, Sports, Science and Technology invite and train people who are going to become instructors after returning home. In addition, the ministry sends experienced instructors to developing countries to

provide training courses in cooperation with developing countries.

3. Asian Nuclear Training and Education Program (ANTEP)

The FNCA launched the Asian Nuclear Training and Education Program (ANTEP) two years ago to ensure effective human resources development in individual countries through exchange and training of scientists and engineers. For that purpose, ANTEP facilitates the use of educational and research facilities and human resources of individual member countries.

Conclusion

In what is often said to be the “age of Asia”, the Ministry of Education, Culture, Sports, Science and Technology will have to make further efforts to train researchers and engineers who are fundamental to nuclear development and conduct joint research with the FNCA, with a view to contributing to the growth of developing countries.

Nuclear Safety Training Activities open to Domestic and International Researchers, Present Status and Future Vision of Nuclear Safety Training Activities

Hideyuki Nakagawa
Vice president of University of Fukui

The Nuclear Human Resource Development Concerned Parties Conference, Japan Atomic Industrial Forum, Inc. has issued a report on the extensive findings of the survey and data on nuclear human resources. This report clarifies the present status and issues of nuclear human resource development and presents recommendations for the future policy. In the view of the need to promote energy and environmental education at elementary and secondary education levels, clarification of the appeal of nuclear industry, establishment of educational infrastructure at universities, development of young researchers, and human resources who will take an active role in the international arena, and construction of systems to ensure continuous capacity-building through industry–government–academia collaboration, this report suggests the directions for future actions to be taken in various fields.

In FY2004, Fukui Prefecture formulated the Energy Research and Development Hub Creation Plan on the basis of four pillars of ensuring safety and security, reinforcement of R&D function, development and exchange of human resources, and creation and advancement of industries. Fukui Prefecture set the promotion index and began implementing the plan in FY2005. The central government, prefectural government (public organizations), business operators, and universities formulate and implement specific measures separately within the framework of human resources development, which include technical training for corporate engineers; reinforcement of the system for nuclear and energy education at universities; enhancement of nuclear and energy education at elementary, junior high, and senior high schools; establishment and operation of an international nuclear information and training center; acceptance of trainees from abroad; and invitation for international conference. The progress of individual measures is checked and updated every year. In FY2006, the University of Fukui (UF) and the Japan Atomic Energy Agency (JAEA) signed a comprehensive agreement according to the hub creation plan mentioned above. Efforts have been made to overcome issues concerning human resources development, which led to many positive outcomes. The Hub Creation Plan Promotion Policy for FY2008 cited the establishment of “nuclear safety training facility” in FY2012 as one of the priority measures to be taken. Its “development concept” was formulated in March 2009. The formulation of a

plan to construct the training facility is scheduled for FY2009, which will be followed by detailed design in FY2010, the start of construction in FY2011, and the start of operation in FY2012. I will explain the concept of nuclear safety training facility in the second half of this lecture.

According to the development concept of nuclear safety training facility, the Japan Atomic Power Company (JAPC) will establish a facility to provide employee training required for the construction progress of Tsuruga 3 Reactor and Tsuruga 4 Reactor. However, the concept was formulated in such a way so as to enable the facility to function as a core training facility and will be used to train not only JAPC employees but also other trainees. The training facility is designed to (i) continue, improve, and hand down safety culture and technology; (ii) utilize the state-of-the-art 3 dimensional plant simulator that analyzes reactor core characteristics and thermal hydraulics of both boiling-water reactor and pressurized-water reactor; (iii) provide access to engineers of local companies, students, universities in Fukui, and engineers at home and abroad; and (iv) offer advanced and substantial training by making the most of local characteristics of Fukui where there are a variety of nuclear-related facilities. The training programs consist of 30 desk study subjects and 19 laboratory work subjects, including laboratory work with plant simulator and mockup device and maintenance skill practice. These subjects will be combined to provide a total of 29 basic training courses. In addition, there will be a course for overseas trainees for which lessons will be conducted in English. A special course will also be available for students of educational institutions after due consideration. These training programs provide off-the-job training and are different from training for the JAPC employees (on-the-job training). Therefore, they are not designed with any specific nuclear plant in mind.

To develop nuclear human resources, it is necessary to provide thorough training and education to the different types of trainees at different levels, such as graduate students, undergraduate students, junior college students, higher professional school students, senior high school students, junior high and elementary school students, businessmen, corporate engineers, and engineers in electricity business. In the meantime, it is important to promote exchanges between the different types of trainees. It is necessary to promote exchanges between researchers, engineers, and trainees from abroad especially with a view to develop ideas about the peaceful use of nuclear energy from an international perspective.

Formation of International lodgment area in Fukui

Toshikazu Takeda
Director of Research Institute of Nuclear Energy, University of Fukui

The University of Fukui opened the Research Institute of Nuclear Engineering on April 1, 2009. Under the basic policy to ensure “safety and harmonious coexistence,” the institute aims to contribute to the realization of Nuclear Power Nation Plan of Japan by conducting unique, world-leading human resource development and R&D activities, and contribute to the construction of a world that has a sustainable and environmentally sound energy supply infrastructure by developing human resources around the world and especially in Asia.

As an inter-university research institute, we offer shared use of our facilities to university officials in Hokuriku, Chukyo, Kansai block, etc. In FY 2011, we will move to Tsuruga-shi with many nuclear facilities to further improve our research and educational capabilities.

There are various types of nuclear power plants in Fukui and especially in the Reinan area. These plants include Monju and Fugen of Japan Atomic Energy Agency, pressurized-water reactor (PWR) and boiling-water reactor (BWR) of Kansai Electric Power Co., Inc., and that of Japan Atomic Power Company. There are also many research centers including Wakasa Wan Energy Research Center, Institute of Nuclear Safety System, Incorporated, and Fugen Decommissioning Engineering Center. We are committed to conduct nuclear education and research by taking advantage of our geographical location.

We will conduct world-leading nuclear research with a focus on fast reactor, new reactor, reactor fuel and reactor decommissioning by making the most of local characteristics. To achieve that purpose, we must continue to accept and train researchers with top-level knowledge and technology in the nuclear field. We are committed to form an international hub of nuclear research by promoting international cooperation with countries such as the US and France, with an eye to improving sustainability, safety, economic efficiency, and nuclear proliferation resistance of nuclear energy with a focus on fast reactor and establishing a reliability of nuclear plant.

In the meantime, we will actively implement shared use of facilities, joint human resources development, joint research and acceptance, dispatch and exchange of students in cooperation with other universities and research institutes in Hokuriku, Chukyo, and Kansai block. We would like to contribute to training and reeducation of professionals who will play

an active role in the international arena.

Proton cancer therapy Institution accepting Domestic and International patients

Kazutaka Yamamoto
Department of particle beam therapy, Wakasa Wan Energy Research Center

As indicated in the Figure 1, effect of exogenously irradiated X-ray for common radiation therapy peaks around shallow subcutaneous layer, then, it becomes weakened as it goes deeper into the body. However, proton beam can produce its peak (Bragg peak), when it reaches and stays in stable depth in accordance with its energy level, giving significant effect. This Bragg peak can be widened to form Spread Out Bragg Peak (SOBP) to create treatment field, which matches the cancer lesion.

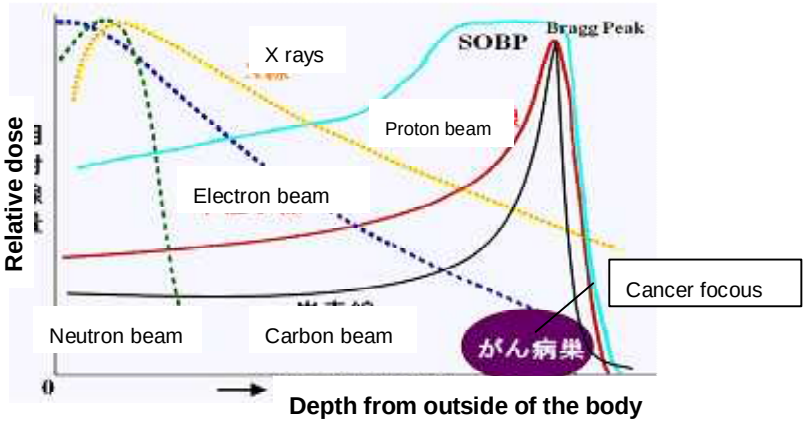
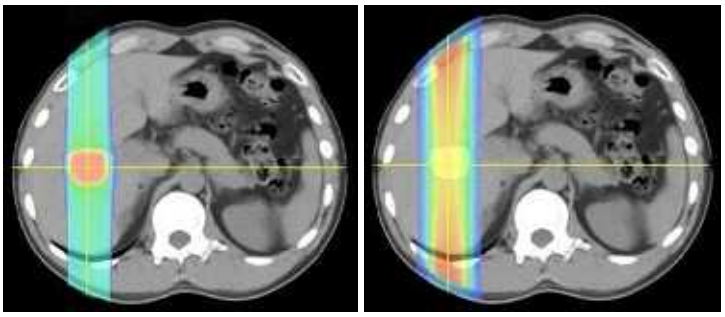


Fig. 1 Depth in water and relative dose



The left shows irradiations of proton beam and the right shows irradiation of X-ray. Both of them are irradiation from two directions (front and back). It is observed proton irradiation focused on cancer lesion with less irradiation to surrounding tissue compared to X-ray.

Fig.2 Dose Distributions for Liver Cancer

As discussed above, physical character of proton beam enables focused irradiation to the aimed cancer lesion and reduced irradiation to healthy surrounding tissues, which can result in improved outcome and reduced adverse reactions. In fact, excellent outcomes as surgical operation have been reported with head and neck tumors, lung cancer, hepatic cancer, prostate cancer, and some others. Furthermore, proton beam irradiation causes almost no physical-taxing and patients do not need hospitalization. Additionally, patients can keep their physical form and function, which enable them to keep good quality of life (QOL). However,

proton therapy requires various expensive, large sized, and complicated devices such as accelerator, gantry, radiation field formation system, and radiotherapy planning system, and various medical specialists such as radiation oncologist, medical physicist, and clinical radiological technologist who can efficiently utilizes the devices.

In Fukui prefecture, proton therapy facility is being set up in Fukui Prefectural Hospital to be opened in March 2011. The Fukui Prefectural Hospital is a hospital complex with 668 beds and 20 departments and it is considered the hospital can not only support domestic patients but also can provide hospitalization and treatment for international patients requesting proton therapy from countries in Asia. Additionally, The Wakasa Wan Energy Research Center in Tsuruga City has already joined “Human Resources Development Programmes for Particle cancer Therapy” being conducted by The Ministry of Education, Culture, Sports, Science and Technology. The center is reinforcing its system further for fundamental training and researches on development of proton therapy. It is expected that comprehensive support for training request from Asian countries will be given by the close cooperation of the research center and the new proton therapy facility.

Fig. 3 Final image: Proton Therapy Facility in Fukui

Basic Research on the Imaging Physiological and Pathological Functions by Means of Cyclotron and Positron Emission Tomography (PET)

At Biomedical Imaging Research Center, University of Fukui, Japan

Jiradanai Sarasamkan
National Cyclotron and PET Centre,
Chulabhorn Cancer Centre, Thailand

Cancer is one of the leading causes of morbidity and mortality in developed countries. An estimated by American Cancer Society 12 million people worldwide has cancer in 2007 and 7.6 million were died. Many cancers can be prevented by avoiding exposure to common risk factors, such as tobacco smoke. In addition, a significant proportion of cancers can be cured, by surgery, radiotherapy or chemotherapy, especially if they are detected early.

Biomedical imaging techniques are employed in variety of fields to yields information in vivo and in situ on the physiological and functional aspects of living organisms. It has become indispensable to the practice of oncology for screening, diagnosis, staging, early response measurement, and tumor surveillance. Anatomical imaging techniques like Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are widely used in all phases of cancer management. However, both techniques have their own limitations because they rely on morphological changes which tend to occur very late in the course of disease. Functional imaging modalities like Single-Photon Emission Tomography (SPECT), Positron Emission Tomography (PET) and Magnetic Resonance Spectroscopy (MRS) rely on functional and metabolic changes which are valuable guide for cancer imaging. They are however limited by the paucity of suitable radiolabeled ligands (radiopharmaceuticals), in particular displaceable radiopharmaceuticals to study the physiological and pathological functions of diseases.

In the design and development of new radiopharmaceuticals, my current research focuses on designing and synthesizing new chemical structures of pharmacological interest (functional biomolecules) that can be labeled with positron-emitting radionuclides. Study the biochemical and biophysical properties of the synthesized biomolecules. Radiolebeling the biomolecules-based compounds like peptide derivatives, antibodies, antibody fragments or small organic molecules with positron-emitting radionuclides, especially fluorine-18. Quality control testing of prepared radiopharmaceuticals using the analytical chemistry techniques

such as Thin-Layer Chromatography (TLC), Gas Chromatography (GC) and radio-High Performance Liquid Chromatography (radio-HPLC), etc. Biological evaluation and pharmacological studies of radiopharmaceutical on cell lines, animal studies and clinical trials carried out in human. My ongoing research includes the radiosynthesis and quality control testing of ^{18}F-Fluoroacetate (^{18}F-FAC), ^{18}F-Fluorothymididine (^{18}F-FLT) and ^{18}F-Flouro-dimethytestosterone (^{18}F-FDHT). Importantly, it also includes the development of new methods of efficient and ultra-rapid radiosynthesis. These methods make it possible to radiolabel a range of chemical functions with optimal yield in very short times.

The exciting developments in all areas in the radiopharmaceuticals filed are contributing to transforming nuclear medicine to a preferred modality for diagnosis and therapy of many diseases including cancer, neurodegenerative disorders and cardiovascular diseases.

Description about the Research Activities

At Wakasa Wan Energy Research Centre, Japan

Le Ngoc Trieu
Centre for Applications of Nuclear Techniques in Industry (CANTI),
Vietnam Atomic Energy Commission (VAEC), Vietnam

After being trained on Nuclear safety, I understand about the Law concerning prevention of Radiation Hazards and how to apply these knowledge to real situation of WERC when research on radiation breeding. I have the opportunities to study and practice using the tandem and synchrotron accelerators, beam lines from synchrotron accelerator to the rooms, X-ray device and other facilities like laser confocal microscope… on plant radiation breeding. By document investigation the and learning the experience via asking and discussion with the experts, a lot of knowledge was achieved such as knowledge about radiation breeding in general, the plant physiological base of the irradiation effects on plant and the methods and techniques to irradiate; to determine range of doses; to prepare and arrange the samples; to observe and determine the changes or mutants after irradiation.

The knowledge above are used to do propagation and take care greenhouse to make materials for irradiation experiment and participate to the execution of some researches about effects of radiation on plants like Research on the internal debudding effect of Proton beam to variegated Petunia, of X-ray to variegated Nemesia, Research on initial effect of X-ray on the new variety of periwinkle and Research on initial effect of X-ray and carbon beam on chamomile dry and bloat seeds. Via these researches with the assistances from researchers of biology group, some generally achieved results are:

- Structure of shoot merisrem in stock plant was determined. Survival rate and structure of shoot meristem in variegated Petunia after irradiation by proton beam are investigated and the conclusion is dose of 20Gy to 30Gy are suitable for application to reorganize or combine the structure of stratified shoot apices in variegated Petunia.

- The dependence of lethal rate and percentage each phenotype of shoots on irradiation dose by X-ray was realized

- The dependence of aberration in the leaf shape at initial stage before irradiation; lethal rate; blooming rate on dose are recorded. The formed flowers have no difference between irradiated and non-irradiated.

- Effects of X-ray and Carbon beam on germination rate of bloat and dry chamomile seeds are determined. The effects of radiation to bloat seeds are stronger than to dry seeds. The dependence of survival, abnormal leaves, height rate and the equability of plant on the dose are shown.

During the term of course, I've got the opportunities to take part in irradiations to materials from plant, animal, microorganism and human by proton beam, carbon beam and X-ray.

The above research activities have been performed and still continue.

Maybe my research activities is very small comparing the whole research in the Wakasa Wan Energy Research Centre, but through these activities, my knowledge about radiation breeding has been improved so much. The achieved knowledge is very useful and can help me in particular and my country in general so much to establish, orient for research and operate one new complex for radiation breeding in Vietnam safely and effectively, also for application research results to the fact. I hope that my host organization in Vietnam and The Wakasa Wan Energy Research Centre will have the good cooperation on related fields in near future.

FNCA Secretariat：Nuclear Safety Research Association
Address： 5-18-7 Shinbashi Minato-ku Tokyo, 105-004 JAPAN
TEL：03-5470-1983　FAX：03-5470-1991
FNCA Website：http://www.fnca.mext.go.jp/english/index.html
ANTEP Website：http://www.fnca.jp/antep