

**FNCA Progress in 2007 and Future Direction**  
**— Nuclear Application for Sustainable Development in Asia —**

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**Introduction**

The FNCA launched by the Ministerial Meeting in Bangkok in 2000. It aims the socioeconomic development by the use of nuclear technology through increasing regional partnership. The FNCA has now 10 participating countries, implementing 12 projects (one terminated March 2007) and one panel in the fields of agriculture, health care, industry, energy and environment as shown in Table 1.

**Table 1: FNCA Activities**

<b>Research Resactor Utilization</b>	<b>Industrial Application</b>
·Tc-99m Generator (terminated March 2007)	·Electron Beam Accelerator
·Neutron Activation Analysis	<b>Radioactive Waste Management</b>
·Research reactor Technology	<b>Nuclear Safety Culture</b>
<b>Application for Agriculture</b>	<b>Public Information of Nuclear Energy</b>
·Mutation Breeding	<b>Human Resources Development</b>
·Bio-fertilizer	
<b>Application for Medical Care</b>	<div style="border: 1px solid black; padding: 5px;">Panel on " Roles of Nuclear Energy for Sustainable Development in Asia "</div>
·Radiation Oncology	
·Cyclotron and PET in Medicine	

**1. Application of Research Reactor Technology**

Effective use of research reactors for nuclear science and technology is of importance.

**(1) Neutron Activation Analysis (NAA) for Efficient Monitoring Environmental Pollution**

Airborne particulates samples collected in urban and rural areas were analyzed by the NAA using Ko method, which improves efficiency of NAA and has been transferred to FNCA countries through the project. The results of NAA measurements of airborne particulates have been considered for planning of environmental control by the governments. Monitoring pollution of sea coasts marine sediment and/or biota using NAA, has been also implemented in **Indonesia**, Malaysia, and Viet Nam.

New focus of the project is using NAA for exploration of mineral resource and monitoring contaminants of foods for improving food safety.

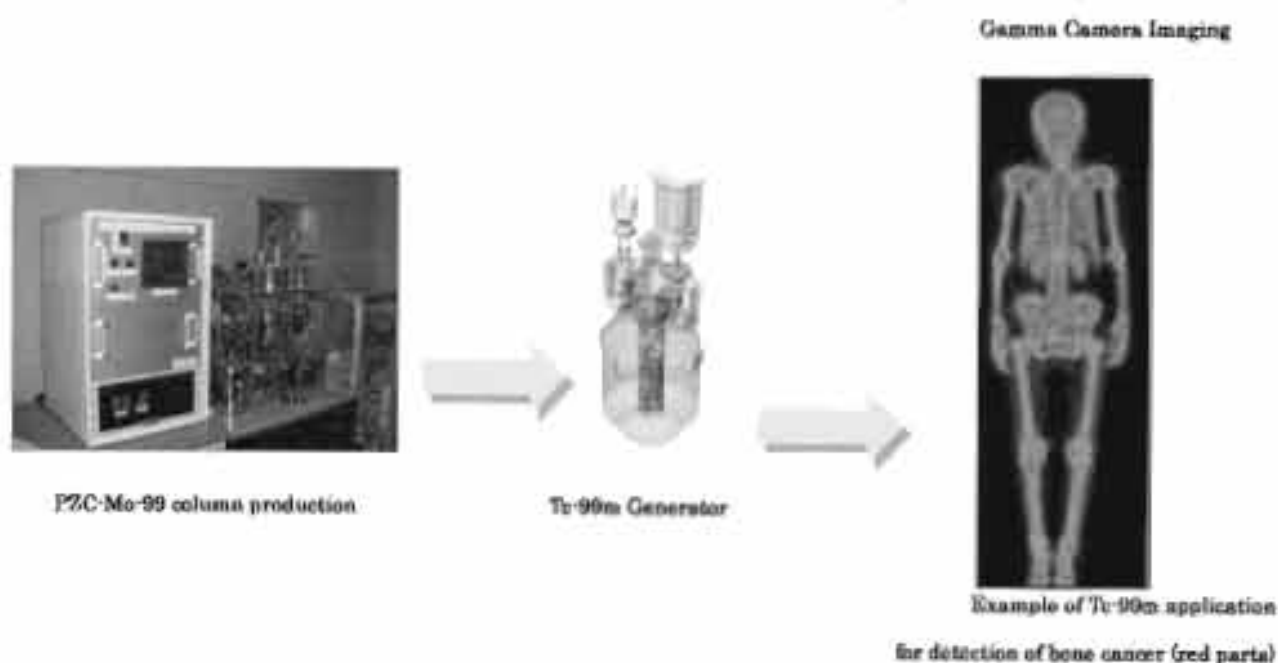
## (2) New Production Technology for Tc-99m Generator

New technology of producing Tc-99m generator using Mo-99 produced by  $(n, \gamma)$  reaction and poly-zirconium compound (PZC) adsorbent has been developed. Plant for remote loading Mo-99 adsorbed on PZC was installed in Indonesia and operated successfully (Photo 1). Results of quality assurance test of Tc-99m generator using the Mo-99-PZC loaded column have led satisfactory results in hospital tests in Indonesia.

The new technology is better than the conventional method using Mo-99 produced by the fission of enriched uranium in terms of radioactive waste management and non-proliferation of nuclear materials.

The production cost of the column using the new technology has been estimated to be much cheaper than imported columns. Viet Nam, the Philippines and Indonesia are planning the setting up of facilities for commercial use. Expert mission to advise commercial plant construction has been sent to Indonesia, Malaysia, Philippines and Vietnam in 2007 and 2008.

Photo 1 Tc-99m generator production by PZC-Mo-99 technology



## (3) Research Reactor Technology

In order to improve reactor core management for safe and stable operation the use of SRAC and MVP codes have been disseminated to experts of member countries, which is useful for core design to use neutron for applications, such as isotope production, silicone doping, and coloring gemstones.

In 2008 and 2009 the application of COOLOD and EUREKA for assurance of reactor safety will be implemented, and SRAC and MVP application will be followed up for better core management in production of isotopes, coloring gemstones and neutron doping in silicone.

## 2. Productive and Sustainable Agriculture

### (1) Mutation Breeding

The project on "Mutation Breeding" has developed new varieties of drought-tolerant sorghum and soybean in China, Viet Nam and Indonesia.

The mutation breeding of insect (thrips) resistant orchid by Thailand and Malaysia is being implemented (photo 2).

Development of disease (Fusarium, banana bunchy top virus) resistant banana is going on in the Philippines, Malaysia and Viet Nam using radiation mutation and tissue culture technique.

Mutation breeding of rice started in 2007 with participation of all FNCA member countries to change content of amylose, protein and color of rice. The utilization of heavy ion beams may be facilitated by JAEA (Japan Atomic Energy Agency) for the project to produce new mutants not obtained  $\gamma$  radiation.

Photo 2 Mutation breeding of orchid and banana



Orchid (infested by thrips)



Banana

### (2) Biofertilizer for Yield Increase

Biofertilizer using micro-organism, such as Rhizobia and Micorrhiza is environmentally friendly fertilizer to increase plants yields by replacing chemical fertilizers polluting environment. Field demonstrations for ground nuts in Viet Nam, corn in the Philippines, soybean in Thailand, oil palm in Malaysia, and wheat in China have been conducted to show excellent effects of the biofertilizer in 2003 to 2007. Plant yields increase by 2 to 122% (photo 3). In 2008 activities developing multi-functional biofertilizer effective for both plant yields increase and insecticides will be focused.

Sterilization of carriers for the production of biofertilizer inoculants is more efficiently carried out using radiation than by high temperature and pressure steam. Therefore this radiation processing application should be transferred to agriculture sector by collaboration of nuclear institutes.

The strategy for extension of biofertilizer application is being formulated in each country for implementation in 2008.

Photo 3 Field test of bio-fertilizer of Rhizobium



### 3. Health Care by Nuclear Technology

#### (1) Cancer Therapy by Radiation

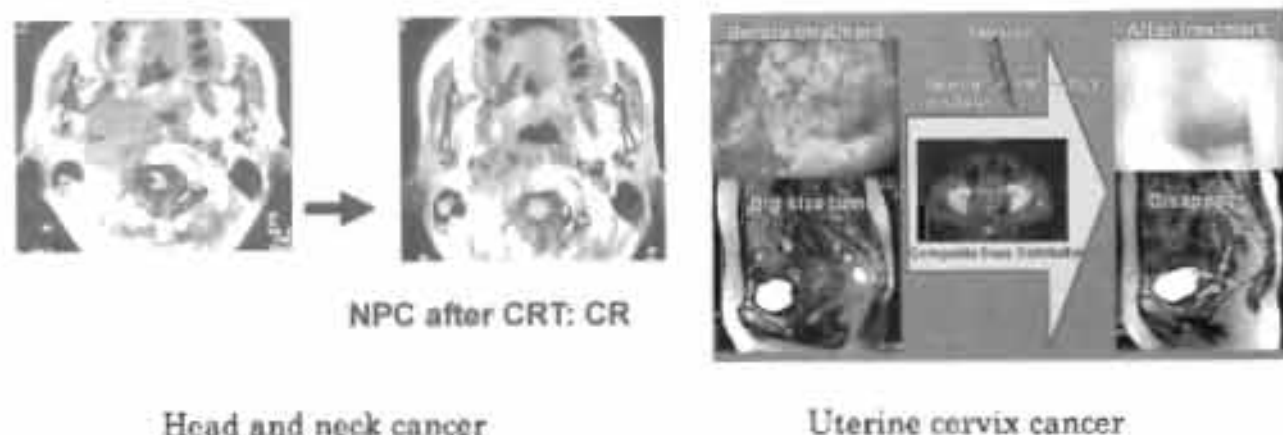
The radiation therapy of uterine cervix cancer has achieved 210 clinical tests in FNCA countries using the FNCA protocol. Survival rate for the stage III-B patients at 5 years after treatment is 52.5% and the local control rate of tumor is 81.5%. For further improvement of treatment of uterine cervix cancer by hyper-fractionated radiation therapy, clinical test was started in 2000 and has shown excellent survival rate of 73% at 5 years after treatment in 2005. Clinical test of chemo-radiotherapy of cervix cancer started in 2004 using Cisplatin (anti-cancer drug).

Clinical tests of chemo-radiotherapy for head and neck cancer (Nasopharyngeal Cancer) have been carried out in 2006 and 2007 with 60 patients showing disappearance rate of 84 % at 6 months after treatment (photo 4). This test will be continued in 2008-2010.

The improvement of QA/QC of radiation therapy has been achieved by expert mission of medical physicists visiting hospitals in member countries.



Photo 4 Radiation therapy of head and neck cancer and uterine cervix cancer



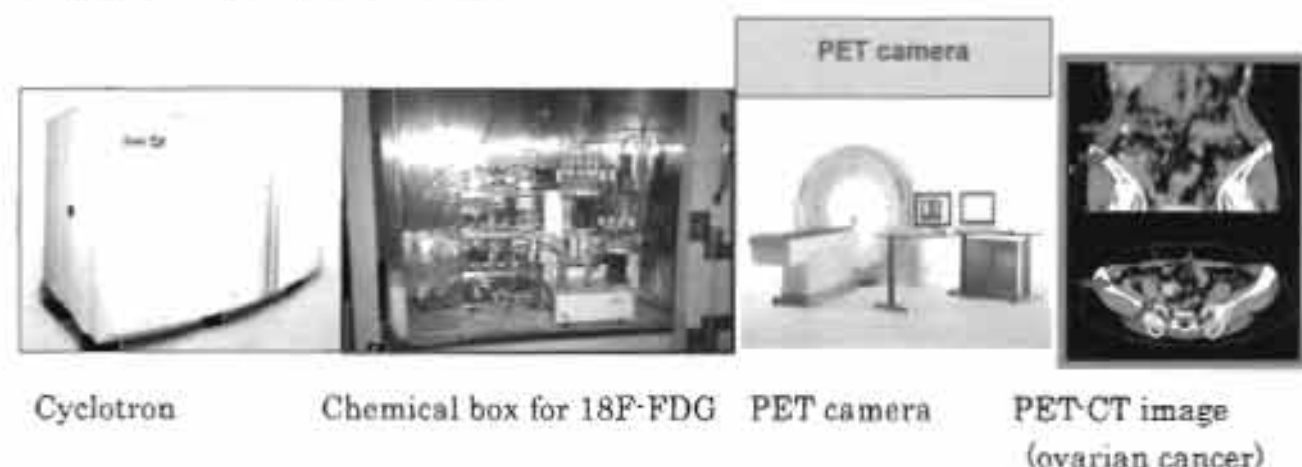
The protocol developed by this project has been disseminated to RCA countries through training courses. Protocol study is expected to be more actively participated by RCA countries. The crucial challenge of radiotherapy in developing countries is to increase installations of therapy machines to treat increasing number of patients.

## (2) Positron Emission Tomography (PET) for Early Diagnosis of Cancer

The PET is an advanced nuclear medicine to make diagnosis of early stage cancer (Photo 5). In view of clear trend to increase PET installations in FNCA countries, this project was started in 2005 by the initiative of Malaysian Government. Project implementation plan has been formulated in the workshop in 2006. The objectives of the project are research and training on image reading, operation/maintenance of cyclotron and PET camera, and FDG radiopharmaceutical preparation.

At the last workshop in Malaysia Nov. 2007, joint collection of images with interpretation to compile "Atlas of PET Images" was agreed with strong commitment of participants as a major activity in 2008. The QA/QC of PET camera and chemical synthesis of FDG and other radiopharmaceuticals are being implemented by active participation of China, Thailand, Viet Nam, the Philippines and Japan.

Photo 5 PET for nuclear medicine



#### 4. Radiation Processing of Natural Polymers

In 2007 the project focuses on specific application of radiation processing for conversion of natural polymers, namely carageenan, chitosan, and starch to value added products such as hydrogels for medical use in Malaysia, ROK and the Philippines, plant growth promoters in Viet Nam, Indonesia and Thailand and super water absorbent in Viet Nam and Japan.

The project is focused on activities approaching commercial applications of the products by improving product properties and optimizing process. Large scale production of the plant growth promoter from chitosan will be carried out in BATAN using existing Co-60 radiation facility and reactor with participation of experts from Vietnam and Japan in order to distribute the product to member countries for their field tests in 2008 and 2009 in collaboration with RCA.

#### 5. Low Level Radioactive Waste Management (RWM)

To improve safety of RWM, this project focuses on survey and information exchange of status of RWM in FNCA countries, of which results have been published in the compiled reports. The expert team on "TENORM" (Technologically Enhanced Naturally Occurring Radioactive Materials) visited Viet Nam, Thailand, China, Malaysia, and Australia to assess the safety management of TENORM in 2003 to 2004 to suggest possible improvement.

Expert team on management of wastes from decommissioning of nuclear facilities visited the Philippines and Indonesia in 2005, and Australia and Malaysia in 2006 to exchange views on the decommissioning strategy. The IAEA's new guideline of clearance level of wastes was reviewed by experts of the team and host governments.

Project workshop in 2007 was held in Bangkok 19-23 Nov. focusing on safety assessment of disposal facilities, design concept of shallow disposal facilities and management of medical radioactive wastes.

The project may be remodeled to include radiation protection in connection with waste management.

#### 6. Nuclear Safety Culture (NSC)

Self-assessments of research reactor safety culture were published. The peer reviews of **safety culture** have been carried out for the research reactor of BATAN in Yogyakarta, Indonesia in 2005 and for the MINT reactor in Malaysia in April 2006 (Photo 6). Comments and recommendations made for both BATAN and MINT have been well taken into account for improvement by member countries.

In March 2008 project workshop was held in China to review outcomes and to formulate possible future activities.

Table 2: Peer Review of Nuclear Safety Culture

<i>Progress of Peer Review &amp; Follow-up</i>					
	<i>FY 2002</i>	<i>FY 2003</i>	<i>FY 2005</i>	<i>FY 2006</i>	<i>FY 2007</i>
<i>Viet Nam (1<sup>st</sup>)</i>	<i>Peer review Recommendations 16 items</i>	<i>Follow-up Improvements 5 items</i>	<i>Follow-up Improvements 7 items (Total 12 items)</i>	<i>Follow-up Improvements 2 items (Total 14 items)</i>	<i>To be reported</i>
<i>Korea (2<sup>nd</sup>)</i>		<i>Peer Review Recommendations 15 items</i>	<i>Follow-up Improvements 12 items</i>	<i>Follow-up Improvements 1 item (Total 13 items)</i>	<i>To be reported</i>
<i>Indonesia (3<sup>rd</sup>)</i>			<i>Peer Review Recommendations 14 items</i>	<i>Follow-up Improvements 6 items</i>	<i>To be reported</i>
<i>Malaysia (4<sup>th</sup>)</i>				<i>Peer Review Recommendations 16 items</i>	<i>To be reported</i>
<i>China (WS)</i>					<i>To be reported</i>

## 7. Public Information (PI) for Acceptance of Nuclear Power and Radiation Applications

Effective dissemination of information to the public on nuclear technology and its application is essential to gain better understanding and acceptance.

The FNCA project on public information has 4 major ongoing activities, (1) improvement of public information strategy through exchanging experiences in participating countries, (2) strengthening communication with media, (3) training of nuclear communicators, (4) supporting national seminars for the public.

In November 2007 the project workshop was held in Kuala Lumpur partly in cooperation with the IAEA. The public seminar on nuclear power jointly was organized with Nuclear Malaysia and FNCA participated by about 200 people. In conjunction



with the workshop, Dr. Machi, FNCA Coordinator of Japan was interviewed by Malaysia TV/Radio station to be broadcasted for 15 minutes (photo 7).

Major concern of the public and media for nuclear power is safety assurance and radioactive wastes management, though they recognize the roles of nuclear power for reduction of carbon dioxide and improving energy security.

Opinion survey will be carried out in 2008 or 2009 for acceptance of nuclear power in connection with energy security and Global Warming.

**Photo 7 Public Information workshop in Malaysia, Nov. 2007**



Malaysian TV interview on nuclear power



Open seminar for the public in KL

## **8. Human Resources Development (HRD)**

The importance of HRD was stressed at the 5<sup>th</sup> FNCA Ministerial Meeting. The setting up of regional network for HRD in research, development and application through training and education under the FNCA was carefully studied in 2005 by the HRD workshop. The workshop proposed to establish ANTEP (Asian Nuclear Training and Education Program) and the 6<sup>th</sup> FNCA Ministerial Meeting strongly supported the proposal. The HRD project leaders meeting in August 2006 held in China has formulated plan of pilot implementation of the ANTEP for 49 selected specific cases based on survey of specific HRD needs. Twenty one cases out of 49 have been implemented in 2007. In 2007 workshop held in Indonesia 50 cases of training have been identified to be matched with programs to be implemented in 2008 and 2009. FNCA countries are requested to make the best effort for in-kind contribution such as fellowships, training programs and lodgings.

## **9. Panel on “Role of Nuclear Energy for Sustainable Development in Asia”**

The third and the last meeting of the Panel was held with the participation of 8 countries in November 2006 to adopt the final report of the Panel which has been submitted to the 7<sup>th</sup> Ministerial Meeting in 2006.

Major points on the roles of nuclear power are summarized follows:



1. Under rapid growth of energy demand in FNCA countries, to enhance security of energy supply is the most important political challenges while 85% of energy is from fossil fuel,
2. A balanced energy mix including nuclear power will improve assurance of energy supply security,
3. Climate change and air pollution are global concern, which can be mitigated to certain extent by introduction and expansion of nuclear power which does not emit CO<sub>2</sub> and SO<sub>x</sub>,
4. Introduction of nuclear power requires the infrastructure such as safety regulation, human resource development, public acceptance, and nuclear non-proliferation.

A proposal of the last panel to imitate the 2<sup>nd</sup> phase activities on "Study Panel for Cooperation in the Field of Nuclear Energy in Asia" (2007-2008) endorsed by the 7<sup>th</sup> Ministerial Meeting.

The first meeting of the new panel was held in October 30-31, 2007 focusing on possible cooperation in the human resource development for nuclear power. Draft Joint Communiqué suggesting inclusion of nuclear power in the CDM of Kyoto Protocol was extensively discussed and agreed.

Having received the draft of Joint Communiqué, 8<sup>th</sup> Ministerial Level Meeting studied carefully and adapted the Communiqué in December 2007.