FNCA Newsletter No.6

Radiation Safety & Radioactive Waste Management

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Contents

The FNCA Workshop on Radiation Safety & Radioactive Waste Management (RS&RWM)

10th-13th July, 2012, Manila, Philippines

The FNCA 2012 Workshop on Radiation Safety and Radioactive Waste Management (RS&RWM) was held from July 10 to 13 2012, in Manila, Philippines. This workshop was co-hosted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan, and the Philippine Nuclear Research Institute (PNRI). Sixteen researchers and experts from eleven FNCA member countries, namely Australia, Bangladesh, China, Indonesia, Japan, Kazakhstan, Malaysia, Mongolia, Philippines, Thailand, and Vietnam participated in the workshop.

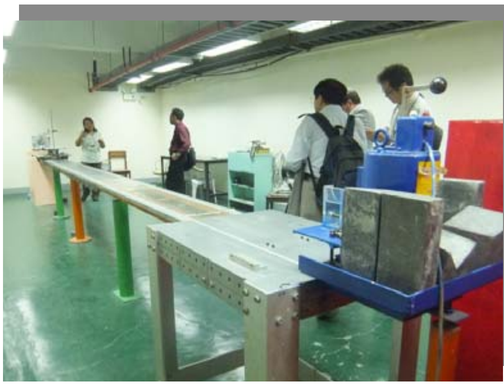
The 2012 RS&RWM Workshop Open Seminar

The first day was initiated with country reports from Australia, Bangladesh, China and Indonesia detailing the implementation of radiological protection for radiation workers in the respective countries as well as updates for the consolidated report on radiation safety drafted in 2010.

The open seminar on the progress of radiation safety control and radiation emergency response in Asia was held in the afternoon. It was attended by around 40 local participants from hospitals and governmental institutes such as PNRI, Food and Drug Administration (FDA), Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), Philippine Army (PA), and Bureau of Fire Protection (BFP). FNCA Participants from Philippines, Australia, Japan, Indonesia and Vietnam gave presentations on national radiation emergency plan, training program for radiation emergency response, and lessons learned from TEPCO Fukushima Daiichi accidents, followed by an open forum. A poster session was also held during the open seminar. Some leaflets related to RS&RWM, personal dosimeters, and survey meters from the member countries were displayed.

On the second day, Japan, Kazakhstan, Malaysia, Mongolia, Philippines, Thailand, and Vietnam also gave a report, respectively. At the session of Discussion on Safety and Security of Disused Sources, Philippines, Malaysia, and Japan delivered lead speeches, followed by discussion.

A technical visit at Philippine Nuclear Research Institutes (PNRI) located in Quezon City was conducted on the third day. A tour of the Institute's major facilities which include the the Emergency Response Centre, Nuclear Analytical Techniques laboratory, Co-60 Irradiation Facility, waste management facility, Secondary Standard Dosimetry Laboratory and the environmental monitoring laboratories was undertaken. After the visit, participants had a technical discussion for further improvement of RS&RWM in nuclear facilities.



Technical Tour and Discussion at Philippine Nuclear Research Institute

Discussions about the consolidated report on radiation safety which was drafted in 2010 were carried out on the forth day. Participants reviewed and compared report of each country suggesting areas for improvement as well as future plans. A discussion about project activities in 2012 and 2013 was also considered.

The workshop was officially closed with the remarks from Dr. Alumanda M. DELA ROSA, Director of the PNRI and Prof. Toshiso KOSAKO, UNIVESITY OF TOKYO.

Topics from Participating Countries

Australia

Mr. Lubi Dimitrovski

Australian Nuclear Science & Technology Organisation (ANSTO)

20,000kN Super Compactor Installed and Commissioned to Reduce the Volume of Low Level Solid Waste at ANSTO

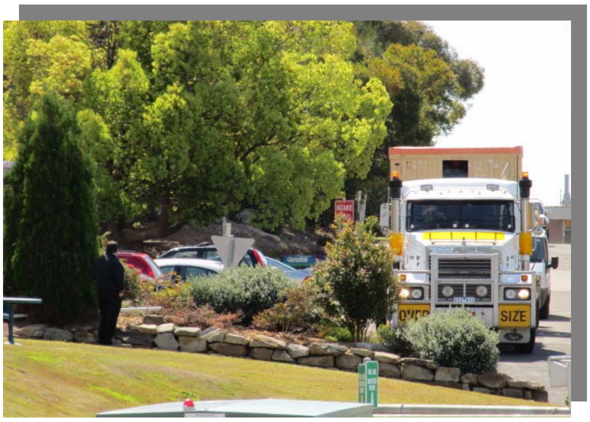
On the 14 September, 2012 ANSTO received its long awaited 20,000kN force super compactor for the long term management of low level solid waste. The process to manage ANSTO's low level solid waste will be aligned with proven international best practice by Lubi Dimitrovski, Manager, Waste Operations.

The super compactor will be an integral part of ANSTO's integrated

waste management facility which also houses the ANTECH S segmented Gamma Scanning Waste Characterisation equipment . Additionally, the facility also caters for the new waste cementation plant and other services to support these functions, all conceptualised by Dr Kapila Fernando.

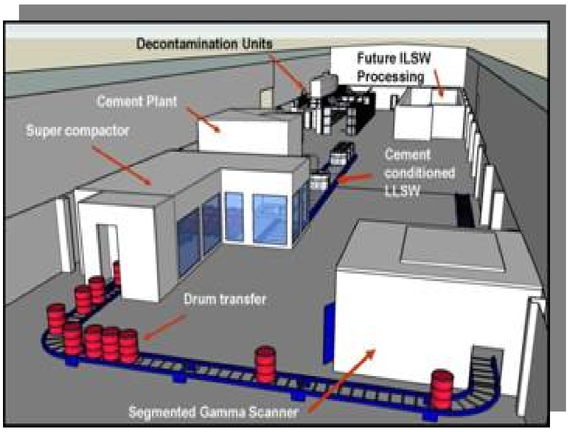
Construction of the super compactor took 2.5 years to complete with the contract being managed by ANSTO Major Projects Program Managers - Mr Michael Deura and Mr Lester Bemand.

The testing of the super compactor was conducted in the Netherlands at the Fontijne Grotnes factory and again at ANSTO. The testing comprised of a mandatory factory acceptance test and site acceptance test. The tests were conducted primarily to ascertain system functionality specifically, to ensure the compactor evaluated to the specification set by ANSTO. The specifications were inclusive of mechanical, electrical, HMI controls, safety interlocks, documentations and training/handover. Many test drums were successfully compacted with varied volume reductions depending on the nature of waste (approx. 60% reduction for concrete rubble and approx. 80% reduction for metal and soft waste).



The 20,000kN super compactor was installed on site at ANSTO by its Dutch manufacturer, Fontijne Grotnes in collaboration with ANSTO's Major Project Delivery Office (MPDO). Overall, the installation and commissioning spanned seven weeks and was directed and supported by a comprehensive Project and Safety Management Plan created and managed by Senior Project Manager – Mr. Sriram Kannan meeting all ANSTO Safety Standards, Guides and other relevant industry standards. The installation was supervised by Mrs. Janina Cooper, Super Compactor Commissioning Manager and conducted in partnership with other ANSTO business units, ECP Development Works and Support Services Facilities Management Group and Safety Environment & Radiation Assurance units. These business units supported the project team with completion of fabrication, welding support, isolations and safety during the installation and commissioning process.

The super compactor has been specifically designed to manage the compacting process for ANSTO's low



level solid waste drums. The compactor also has the capacity to collect and manage any liquid by a solution collection system which forms part of the compacting process for any liquid waste that may be present in the low level solid waste drums.

The acquisition of the super compactor will streamline the process for the management of ANSTO's low level solid waste.

Internationally, the super compactor is considered to be best practice technology for both volume reduction and long term management of low level solid waste. The super compactor will now enable ANSTO to increase its standard in waste management operations.

Bangladesh

Dr. M. Moinul Islam and Dr. S.Ghose
Bangladesh Atomic Energy Commission (BAEC)

Characterization of spent ion-exchange resins originating from the Nuclear Facility

In Bangladesh, radiation sources have been used for many years in a wide range of application in the field of research, medicine, industry and agriculture. Radioactive wastes are residues that come from nuclear reactors, medical uses and various research studies that involve radioactive isotopes. Identification and characterization of radioactive wastes is one of the main technical issues from waste management point of view. The 3 MW TRIGA Mark-II research reactor of Atomic Energy Research Establishment (AERE) is a light water-cooled graphite reflected reactor designed for training, research and isotope production. An ion exchange purification unit is attached within research reactor, which produces reactor waste in the form of spent resin contaminated with activation products. A significant amount spent ion-exchange resins generated from the research reactor purification column. These wastes are collected in polythine bags and store in 200L plastic drums. Collected resins are dehydrated by air/sun light and finally transferred to the Central Waste Processing and Storage Facility (CWPSF) AERE, Savar for further management.

Since the waste activity concentration is one of the key parameters of waste characterization in the planning stage of waste management system. The aim of the study was to develop a procedure for the sequential determination of radioisotopes in the radioactive wastes.

Gamma-spectrometry

To analyse the spent ion-exchange resins which are safely stored in central waste processing and storage facility, were collected in 250 ml cylindrical geometry container. The surface activity of each container was recorded. For gamma analysis each sample has been weighed and measured on a calibrated HPGe detector with 40% relative efficiency coupled with Genie-2000 software. In order to calculate the activity of the resin sample the energy and efficiency calibration was done using ^{152}Eu standard source.

The dominant gamma lines have been found in the spectrums which were evaluated for activity concentrations. Four radionuclides e.g., ^{137}Cs, ^{54}Mn, ^{65}Zn, ^{60}Co have been identified in the spent ion-exchange resin samples. From the strong gamma lines the calculated specific activity concentration of ^{137}Cs ranging from 2.98 to 7.7 Bq/kg with an average value of 5.89 Bq/kg whilst the specific activity of the ^{54}Mn ranging from 109.05 to 2682.82 Bq/kg with an average value of 1037.21 Bq/kg. For ^{65}Zn the activity concentration ranging from 15 to 158.31 Bq/Kg. with an average value of 70.85 Bq/Kg. The activity concentration of ^{60}Co with gamma line 1173.2 keV found in the ranging from 259.06 to 4684.16 Bq/kg with an average 797.1 Bq/kg. On the other hand the activity concentration of ^{60}Co with gamma energy 1332.5 kev ranging from 250.53 to 4538.55 Bq/kg with an average value of 1710.93 Bq/kg.

Fig1. A full setup of HPGe detector system

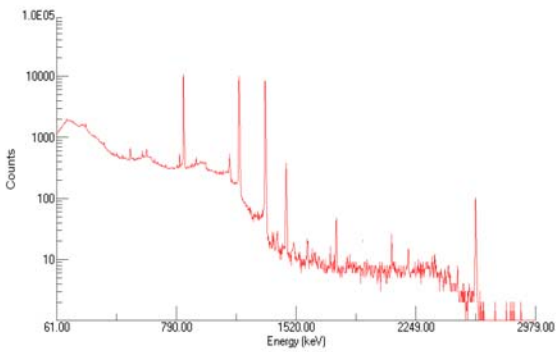


Fig2. Gamma spectrum of a spent ion exchange sample obtained from HPGe γ spectrum detector

Knowledge on the contents of γ-emitting radionuclides in radioactive wastes is an important parameter for choosing their appropriate storage mode as well as for further processing. In this context, this work represents an inevitable step in establishing a national radioactive waste management system.

Indonesia

Dr. Syahrir and Agus Gindo Simanjuntak
National Nuclear Energy Agency (BATAN)

Continuous and Centralized Monitoring System for Ambient Radiation and Meteorology in BATAN Serpong Indonesia

INTRODUCTION

Atmospheric releases of nuclear facilities in BATAN Serpong which consists of Multi Purpose Reactor 30 MW and Supporting Laboratories (MPR-SL) has been being monitored through on-line continuous and centralized system for environmentral radiation and weather (http://183.91.85.130:1169/radmon/) which is called an environmental radiation monitoring system. There have \been being 5 radiation ambient and one meteorological stations that send data to the processing unit. The system is independent from the facility source monitoring systems and is intended to support the available stack monitoring systems as an early warning systen in case of abnormal atmospheric releases. It also can be used to verify releases from sources other than MPR-SL (transboundary releases for example).

OBJECTIVES

The radiation monitoring system provides early protection to workers, public and environment against radiation hazards from the operational of MPR-SL at Batan Serpong.

GOALS

1. To obtain weather data and ambient radiation dose in- and off-site.
2. To detect abnormal atmospheric releases of BATAN Serpong stacks promptly

METHODOLOGY

- Sensors of the automatic weather system (AWS) are located at heights of 60 meters, 30 meters, 15 meters and 4 meters. The data such as wind direction, wind speed, temperature, relative humidity, air pressure, solar radiation and rain fall are used to determine atmospheric stability classes and wind rose. The meteorological tower station is about 600 meters from the reactor site. The data are reported routinely as part of the environmental monitoring report of BATAN Serpong.

- The monitoring of ambient radiation consists of three stations in-site and two stations off-sites. The results of monitoring data such as dose rates and accumulated doses are used as part of the environmental monitoring report of BATAN Serpong routinely.

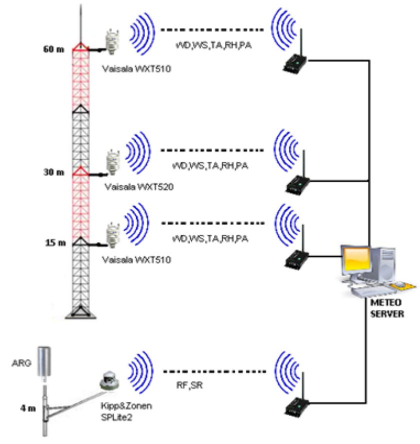
- The transmission of wheater dan radiation exposure data conducted with wireless radio modem from each stasion to data processing center.

- The processing data use the Projex Measurement Information System software.

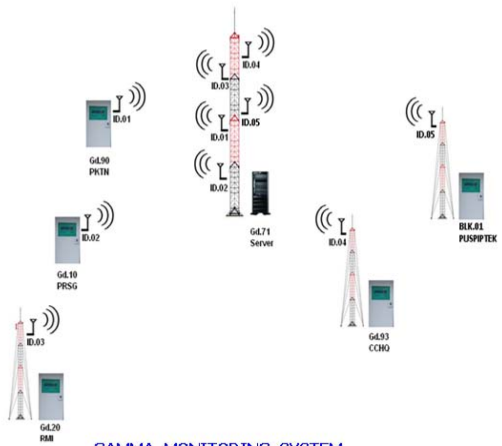
SPECIFICATIONS

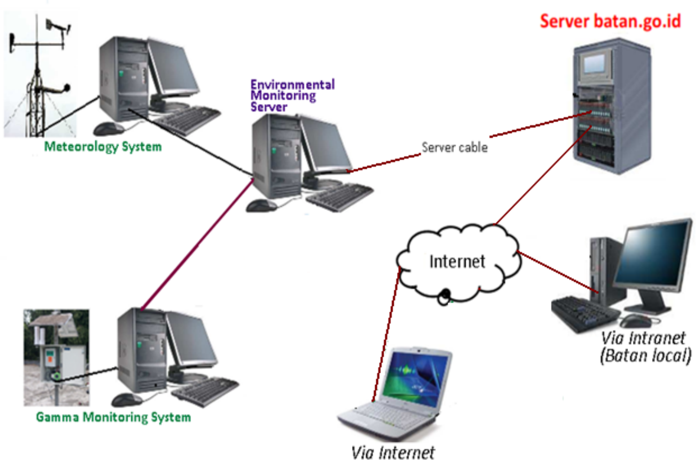
1. Meteorology System :
   - Sensor Combo WXT-520 Vaisala : WD, WS, Temp, RH, and Bar.
   - Sensor SPLite2 Kipp & Zonen : Solar radiasi
   - Sensor Rain Gauge ARG : Rain fall
2. Gamma Monitor :
   - Detector type: GM tube; range: 50 nSv/h - 1000 mSv/h.
   - Radio modem frequency: 900 MHz – 2.4 GHz.
   - Solar panel power: 21 W, 17.4 V, 1.21 A.

BLOCK DIAGRAM



METEOROLOGY SYSTEM


GAMMA MONITORING SYSTEM

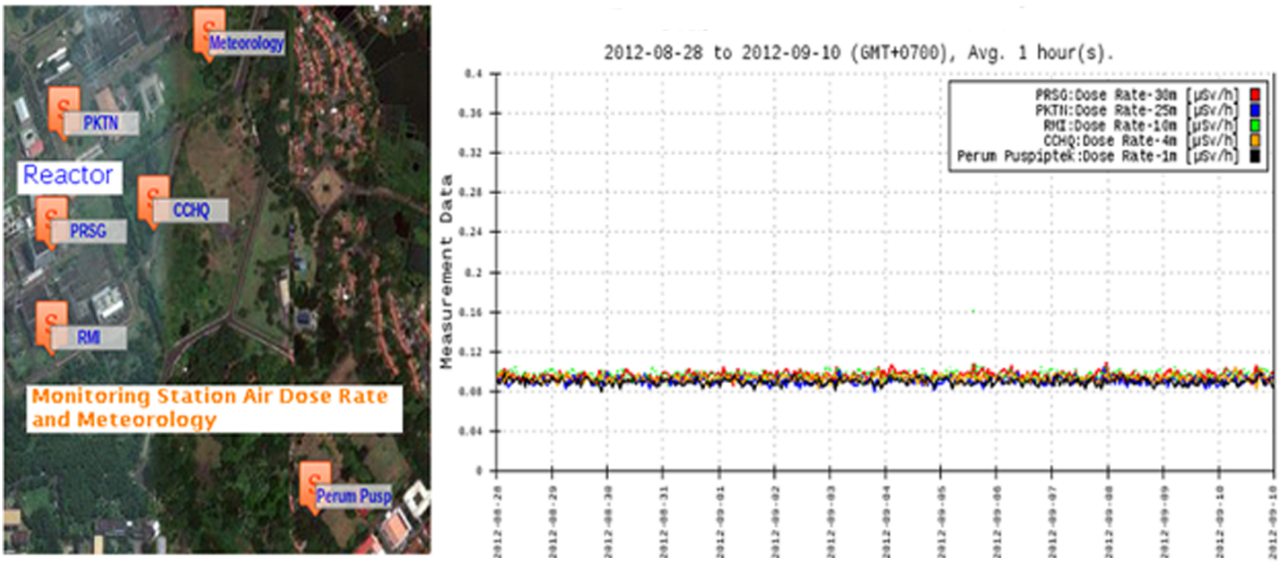


ENVIRONMENTAL RADIATION MONITORING SYSTEM

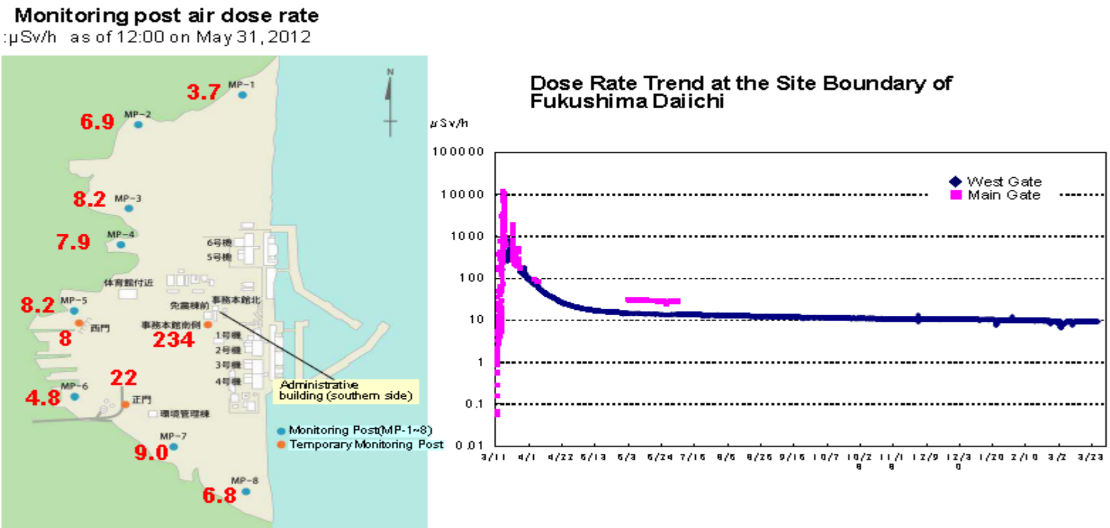
RESULTS AND DISCUSSION

The results of dose rate measurements were obtained from five stations around the site on the August, 28 to September, 10 with average equals to 93 nSv/h. The alarm setting for BATAN Serpong site is 250 nSv/h. This average equals to background radiation levels around the area. Below the comparison to Fukushima gamma dose rate around the accident area.

Monitoring Stations and Dose Rate outputs



Monitoring Data (at Site Boundary of Fukushima Daiichi)



Japan

Prof. Toshiso Kosako,
University of Tokyo,
Dr. Yuji Matsuzoe,
Fuji Electric Co., Ltd.

Fukushima No.1 Nuclear Plant Accident and the Monitoring of Radiation

The Great East Japan Earthquake (magnitude 9.0) struck northeast Japan on March 11, 2011. Seismic intensity of magnitude 7 was recoded in Miyagi prefecture, while intensity of magnitude 6-plus was recorded in the prefectures of Fukushima, Ibaragi and Tochigi (Fig. 1). A massive tsunami triggered by the quake then struck the Pacific coast of East Japan. In the prefectures of Fukushima, Iwate and Miyagi, the inundation height of the tsunami was not less than 20 m in many areas. The tsunami also killed more than 19000 people (Fig. 2).

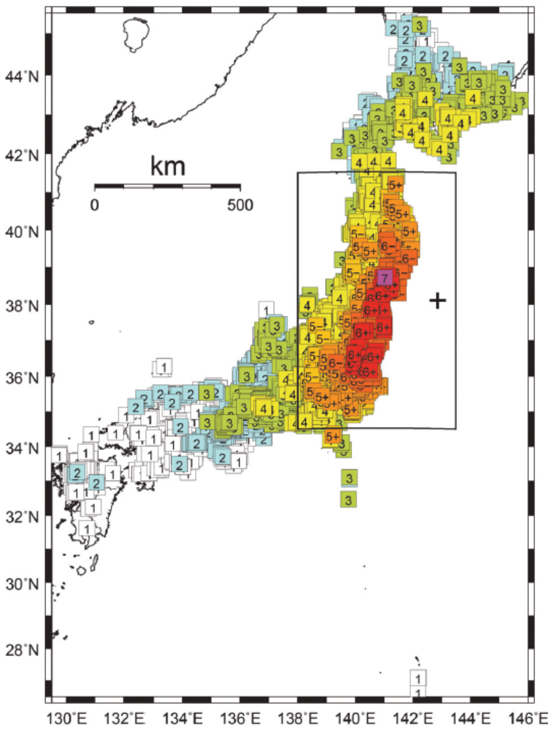


Fig1. Seismic intensity of Great East Japan Earthquake on 11th March

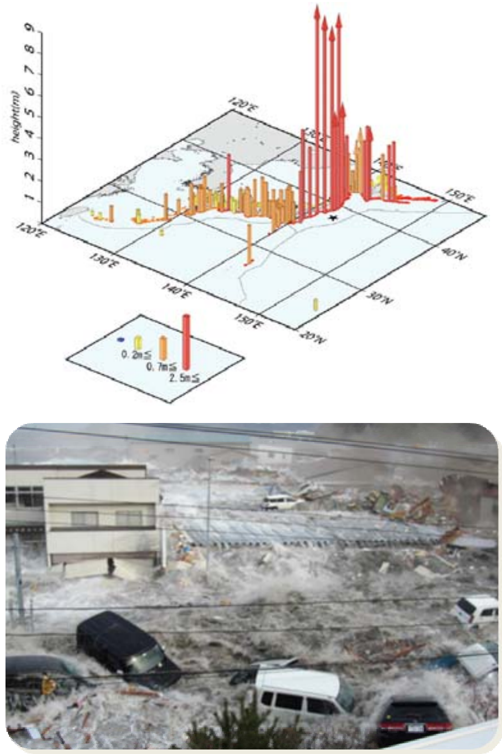


Fig2. Height of TSUNAMI and disaster
Reference: The Tokyo Electric Power Company, Inc.

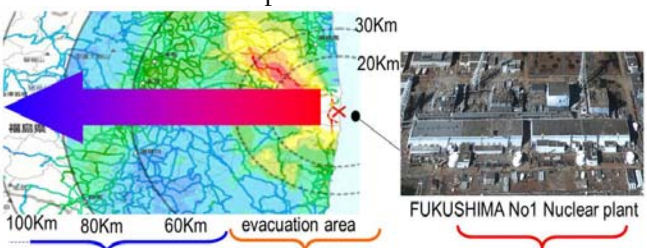
The Fukushima No. 1 nuclear plant has six nuclear reactors (Fig. 3) and is located 220 km north of Tokyo. On March 11, 2011, the Fukushima No. 1 nuclear plant was operating nuclear reactors Nos. 1, 2, and 3. The other nuclear reactors were being inspected at that time. Figure 3 shows the Pacific Ocean at the top, with the flooded areas indicated in blue. The entire region surrounding the Fukushima No. 1 nuclear plant was flooded. Figure 4 shows the plant before and after the hydrogen explosion and subsequent fire. First, the emergency D/G and seawater pumps failed to operate due to the tsunami. Secondly, the nuclear reactor building was damaged by the hydrogen explosion and fire, and the portion housing the nuclear reactors was destroyed.

Fig3. Damage of FUKUSHIMA 1 by TSUNAMI

← from left side Unit 4,Unit3,Unit2,Unit1

Fig4. Before and after of Hydrogen explosion and fire

Figure 5 shows a map of the contamination at Fukushima and the relation between the distance from the Fukushima No. 1 nuclear plant and the necessary radiation monitoring system and instruments. Within a radius of 30 km from the Fukushima No. 1 nuclear plant, a mass of debris caused by the tsunami is polluted with radioactive material generated by the hydrogen explosion. Therefore, treatment of the polluted debris is very difficult. The area is classified by distance from the Fukushima No. 1 nuclear plant into three areas, that is, inner circumference of the plant, the evacuation area and outside of the evacuation area. In addition, the monitoring system and instruments are classified into the personal dose, environmental monitor and pollution monitor. As shown in Fig. 5, the need for each monitoring system and instrument is based on distance from the Fukushima No. 1 nuclear plant.



	Outside of evacuation area	evacuation area	FUKUSHIMA NO1 NP
Personal dose	-	● Personal Dose Rate Meter for Resident (Low level) ● Whole Body Counter	● Personal Dose Meter for Worker (High level) ● Whole Body Counter
Environmental Monitoring	● Environmental Monitoring Post	● Environmental Monitoring Post	● Environmental Monitoring Post
Radioactive contamination monitoring	●Food and water contamination monitoring ●Vehicle contamination monitoring ●Vehicle Watching system	●Radiation survey-meter ●Body surface monitor ●Vehicle contamination monitoring	●Radiation survey-meter ●Body surface monitor ●Vehicle contamination monitoring

Fig5. Contamination map and relation between the distance from FUKUSHIMA No.1 nuclear plant and the needed radiation monitoring system and instrument

Figure 6 shows the personal dose meter used for workers working near the nuclear reactors and performing decontamination work. The dose meter detects the charge generated by ionization of the depletion layer of a semiconductor detector as a signal of the radioactive rays. The dose meter is equipped with low-cost semiconductor photo sensors and micro cells. The dose meter is characterized by compact and lightweight.

Fig6. Personal DOSE Meter for Worker

Figure 7 shows the personal dose rate meter used for residents in the evacuation area. The intended purpose of this dose meter is to manage the exposure to residents in daily life and to search for contaminated areas. This dose rate meter employs the same method of detection as the other dose meter. The dose rate meter offers high sensitivity in measuring radiation dose (mSv) and dose rate (mSv/h), are compact in size, and feature a rechargeable battery.

Fig7. Personal DOSE Rate Mater for Resident

Figure 8 shows the environmental monitoring post, from which the space dose of radioactivity is measured. The environmental monitoring post transfers data via FOMA every 10 minutes, using a solar battery as its power source.

Fig8. Environmental Monitoring Post

Figure 9 shows the food contamination monitoring. After the nuclear plant accident, it became necessary to ensure the security and safety of food produced in Fukushima and neighboring prefectures. In particular, this resulted in an urgent demand to quickly inspect any radioactive material contained in the food. The food contamination monitoring (Fig.9) can inspect leafy vegetables, rice, and beef stored in cardboard boxes, thereby enabling easy and continuous screening measurement.
Radiation monitoring equipment and systems contribute to the safety of daily life for the residents of Fukushima and its surrounding neighborhood.

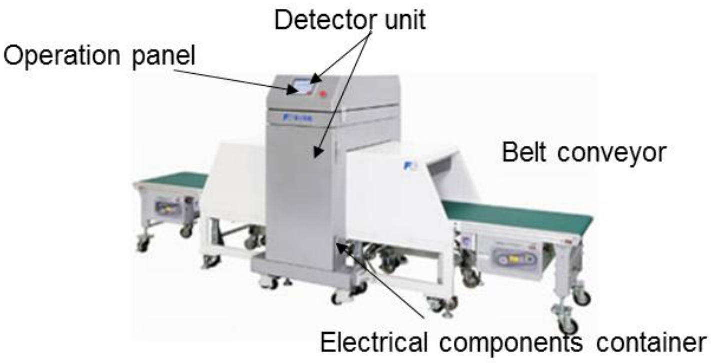


Fig9. Food Contamination Monitoring

Malaysia

Dr. Mohd Abd Wahab Yusof
Malaysian Nuclear Agency

Nuclear and Radiological Safety at Reactor TRIGA PUSPATY

1. Introduction

Malaysian Nuclear Agency or Nuclear Malaysia, which was established in early 1970's, is an institution that develops, promotes and enhances the peaceful uses of nuclear technology in agriculture, medical, manufacturing, industry, health and the environment. In order to enhance research and development activities, a TRIGA MARK II research reactor, called Reaktor TRIGA PUSPATI (RTP), was built. It came into operation in 1982 and reached its first criticality on 28 June 1982.

The reactor was designed to effectively implement the various fields of basic nuclear science and education. It incorporates facilities for advanced neutron and gamma radiation studies as well as for application, including Neutron Activation Analysis (NAA), Delayed Neutron Activation Analysis (DNAA), radioisotope production for medical, industrial and agricultural purposes, neutron radiography and Small Angel Neutron Scattering (SANS).

2. RTP Technical Specifications

RTP was supplied by General Atomic of the USA and installation programme was started on 9 November 1981. RTP is a pool type reactor where the reactor core sits at the bottom of 7 metre high aluminium tank which is surrounded by a biological shielding made of high density concrete (see Figure 1). The reactor uses solid fuel elements in which a zirconium-hydride moderator is homogeneously combined with enriched uranium. Demineralised water acts both as coolant and neutron moderator, while graphite acts as reflector. The following are brief descriptions of RTP:

- Type: TRIGA Mk II, pool type
- Fuel: Uranium Zirconium Hydride Alloy
- Coolant: Light Water
- Moderator: Light Water
- Reflector: Graphite
- Control Rods: Boron Carbide
- Status: Operating
- Operational Mode: Steady State (1MW)
- Operation: 6hrs/day weekdays

Fig1. Nuclear Malaysia's Reactor TRIGA

3. Safety Objective

Since established, the promoting safety of RTP operation is a prime concern of the management and the staff of Nuclear Malaysia. These include during operation, repair and maintenance, radiation doses to workers, radioactive waste management and environmental management. The fundamental safety objective is to protect people, both individually and collectively (workers and public at large) and the environment from harmful effects of ionizing radiation. However, this should been achieved without unduly limiting the operation of facilities or the conduct of activities that give rise to radiations risks. In order to achieve the fundamental safety objective, Nuclear Malaysia has implemented the ten safety principles formulated by International Atomic Energy Agency (IAEA) on the basis of which safety requirements are developed and safety measures are to be implemented [1].

4. Organisation and Management of Safety

4.1 Nuclear Malaysia's Occupational Safety, Health and Environment Policy Statement

Nuclear Malaysia, an agency who responsible for the promotion, development and application of nuclear technology and nuclear related technology for the national development, is committed to continually improve and prevent pollution, incidents, accidents and occupational illness in its operation. This is the commitment of the management in ensuring safety at Nuclear Malaysia complex. Toward this end, Nuclear Malaysia will:

- Comply with all applicable environmental, occupational safety and health, legal and other requirements.
- Minimize release of pollutants to air, water, land and promote waste minimization through reduction, recycling and reusing activities.
- Optimize the use of materials and natural resources.
- Ensure that all radiation exposures are kept as low as reasonably achievable.
- Ensure that all other occupational hazards and risks are prevented, where practicable, and controlled and managed through the adoption of proper management measures.
- Stress on environmental, occupational health and safety aspects in our facilities operation, equipment, field work, building construction and modification through appropriate assessments at the planning stage.
- Promote environmental, occupational health and safety awareness among employees, contractors, vendors and visitors.
- Ensure that all employees, contractor, vendors and visitors on site comply with Nuclear Malaysia's environmental, occupational health and safety requirements at all times.

This safety policy statement is displayed at all notices boards within the Nuclear Malaysia premises to inculcate safety culture to all staff and contract workers, and to show that management is serious in managing safety.

4.2 Safety Management System

In ensuring the above safety policy implemented in daily work, Safety, Health and Environmental Management System (SHE-MS) Committee was established in year 2005 to review all aspects of safety, including occupational, nuclear and radiological safety. This committee is responsible to report all safety activities in Nuclear Malaysia to the highest management committee headed by the Director General. Safety Audit Team performs auditing functions and reports its finding to the SHE-MS committee on a regular basis.

The RTP is headed by a Reactor Manager whose is directly report to the Director of Reactor Technology Division. To maintain high level of safety, the operation and maintenance of RTP are supported by the other groups such as Radiation Safety and Health Division, Waste Management Centre, Mechanical and Electrical Unit and Physical Security Unit.

5. Safety Analysis Report

Safety analysis report (SAR) is an essential document when talking about safety in nuclear installations. Nuclear Malaysia's first SAR document for RTP was prepared in 1982. Since then, the document had not been revised until 2007 when the new SAR document was prepared in accordance with the IAEA safety standards and recommendations [2]. The SAR document has been approved by the regulatory body.

6. Quality Assurance Programme

Quality Assurance Programme (QAP) is very important in running nuclear reactor and it is not exceptional with RTP. Some of the content of the QAP are Operational Control, Emergency Response and Preparedness, Safety and Health, Physical Security, Infrastructure Maintenance, Reactor Maintenance, Experiment and

Modification, Measurement and Monitoring Device Control, Human Resource Management, Waste Management, Special Nuclear Material Counting Control and refuelling. The regulatory body i.e. Atomic Energy Licensing Board will do inspection twice a year to ensure that Nuclear Malaysia comply with all safety requirements stipulated in the act, regulations and licence conditions.

7. Radiation Protection Programme

Radiation exposure is set-out in the safety manual approved by the SHE-MS Committee. It is based on the Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010 [3] and IAEA safety documents. In the manual, radiation exposure is managed using radiation protection principles such as policy on As Low As Reasonable and Achievable (ALARA), annual dose limit, classification of area, personal dosimetry etc.

All radiation workers are provided with TLD badges for personal monitoring which are assessed on monthly basis. Staff working with unsealed sources or using hand on more of their work wear wrist and finger TLDs as well. On the other hand, area monitoring using TLDs is performed at all control areas. Medical surveillance of radiation workers are also carried out at least once in two years.

Environmental samples such as water, sediments, soils, vegetables from areas surrounding Nuclear Malaysia complex are collected and analysed. Whilst external radiations from the nuclear installation are monitored using TLDs which are changed on monthly basis.

8. Emergency Preparedness and Response

Emergency preparedness means being ready to reacts or response to a broad range of emergency situations that can occur at any time and anywhere. Widespread use of nuclear technologies in application as diverse as industry, medicine, agriculture etc. in Malaysia, means that more possibility of accident can happen. In recent year, most countries including Malaysia are very concern about emergencies arising from malicious use of radioactive material or ‘dirty bomb’.

In Nuclear Malaysia, emergency preparedness and response are given very top priority by the top management. On-site Emergency Response Plan (ERP) is in place and recently has been revised. On the other hand the off-site emergency plan is under the jurisdiction of the regulatory body which is the lead technical agency to handle any radiological emergency at national level under the Directive No. 20, National Security Council. Emergency drill is performed at least twice a year.

9. Operation and Maintenance

Without a doubt, a good design, manufacture and construction of reactor are pre-requisites for high levels of safety. However, the ultimate responsibility for safe operation lies with the operating organization. Therefore, Nuclear Malaysia is really emphasized on this issue. RTP reactor building, equipment and facilities are well maintained, generally clean and tidy and in good condition. The annual and semi-annual maintenance are carried out in June and December respectively. Any change in operation and maintenance plan must be approved by Reactor Supervisor. However any unplanned maintenance works must be approved by the Reactor Manager upon recommendation of the Reactor Supervisor.

10. Radioactive Waste Management

Nuclear Malaysia is committed to minimize release of pollutants to air, water, land and promote waste minimization through reduction, recycling and natural resources. All precautions are taken into account to minimise the generation of unnecessary activation radionuclides to minimise waste generation. This is evaluated when request for irradiation is received.

There also has a specific procedure for collection, control and treatment of radioactive waste activities as specified in the Nuclear Malaysia's safety, health and environment manual. The Waste Treatment Centre, an organization within Nuclear Malaysia, is given responsibility to manage radioactive waste and chemical waste. In this centre, radioactive wastes are categorised and separated based on their types, solid or/and liquid and according to the standard classification of radioactive waste established by the IAEA and Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011. With respect of spent fuel, until now, Nuclear Malaysia has no spent fuel at all. However, the RTP was designed in such away that it can be used as a storage facility for spent fuels before these spent fuels are sent back to the supplier.

11. Education and Training

As safety is a prime concern of Nuclear Malaysia, therefore education and training on nuclear and radiological safety to staff are very important. For a new staff, they are required to attend an induction course while the other staff are encouraged to attend a radiation safety awareness training course conducted by Nuclear Malaysia. Nuclear Malaysia is also sent their staff to, either local institutions or a broad for updating their skills and knowledge.

For a reactor operator, there is a training programme which is based on the guidelines issued by the AELB where Nuclear Malaysia is responsible for conducting the course while the examination and issuance of operator licence are managed by the AELB. The reactor operator licence can only be renewed after the licensed operators have successfully undergone a refresher course.

12. Regulations and Licensing

Principle 2 of the safety objectives is clearly stated that there shall be an independent regulatory body in each country to control and supervise all atomic energy activities. Therefore, to maintain independency, Nuclear Malaysia is licensed by the Atomic Energy Licensing Board (AELB), which is independent body established under the Atomic Energy Licensing Board 1984 (Act 304). This is to ensure that the safety is kept in high standard and consistent with the IAEA's nuclear safety standards. The AELB regularly inspects RTP to ensure that all requirements under the law and regulations are complied.

Alongside inspections, yearly dialogue and direct meeting between the Nuclear Malaysia and AELB are made to exchange information and resolution of issues raised. This meeting is alternately chaired by the Director General of AELB and Director General of Nuclear Malaysia. A part of that, the AELB is reviewing their regulations and guidelines related with nuclear safety in accordance to the latest IAEA's safety standards and guidelines.

13. The way forward

For almost 30 years of RTP operation, considerable attention had been paid to the safety of RTP. However, no matter how well an organization is currently performing safety, it always needs to consider how it could improve further. Therefore, nuclear safety will continue to give cause for serious concern and the RTP operation will continue to meet national and international safety standards.

Ageing Management

Although has regular maintenance, Nuclear Malaysia management is very concern on RTP ageing components which suffer degradation of its physical properties due to operational condition. Regular maintenance of RTP will be continued. A programme to assess the implications of ageing of components and systems will be established.

Fostering Safety Culture

Developing, improving and fostering safe culture in organization is the essence of nuclear or radiological safety. Therefore, Nuclear Malaysia will keep continue its safety programme to promote safety culture.

Knowledge management

Most of the members of seniors' staff at Nuclear Malaysia are going to retire within a few years. Their skill, knowledge and experiences need to be transferred to the young staff. Nuclear Malaysian will continue its knowledge management programme to ensure that the knowledge gained by senior staff is transferred to the young staff.

Developing Staff Skill and Knowledge

Most of Nuclear Malaysia staff are new and were appointed to replace senior ageing staff. They need to be trained to enhance their skill and knowledge on nuclear and radiological safety. The present platform, e.g. IAEA, Ministry of Education, Culture, Sports, Science and Technology (MEXT) will be used for that purpose. Beside that, the new staff are also encourage to do further study i.e. Master degree and PhD.

14. Conclusion

Nuclear Malaysia will continue to maintain, improve and strengthen safety within its organization. The management is very committed in promoting safety and senior officers are really seen to devote time and resources to safety and react as a role model for their staff with their action clearly matching their words. Work procedures are in place and implemented properly. However, there is still room for improvement as improvement is a continuous process and Nuclear Malaysia is committed for it.

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The Philippines

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Status of the On-Going Drilling Program for the Disposal of Disused Radioactive Sources

The Philippines through the Philippine Nuclear Research Institute (PNRI) and its collaborators has been investigating intensively a proposed site for the disposal of disused radioactive sources generated over the years and in the future by hospitals, industries, and research institutions including the PNRI. Borehole drilling is being carried out for investigation purposes, but with an option to develop it into a disposal borehole at a later stage of the program.

The primary objective of the drilling campaign would be to drill down to a depth of approximately 100 meters to establish the subsurface soil, rock and water characteristics. Ideally, it is expected to intersect a monolithic block of intact rock formation suitable for deep disposal of canisters containing the radioactive sources. Confirmation of the site's suitability requires the presence of a host formation characterised by a sufficiently low hydraulic conductivity and hydraulic gradient, absence of groundwater aggressive to the engineered barriers, and good sorption properties.

Initially, a site topographic survey covering an area of 40 hectares at 1.0 meter interval was conducted in April 2012. A plan view of the digital terrain model showing the location of the deep boreholes (DDH-5 and DDH-6) that are currently being drilled along with 2 other shallow boreholes is presented in Figure 1.

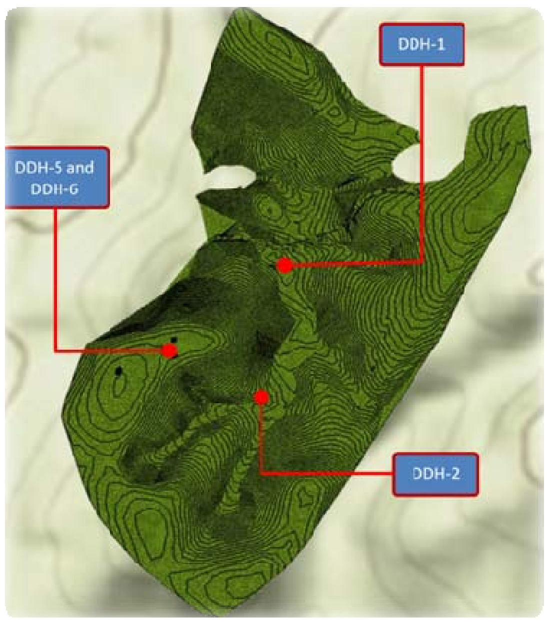

Fig 1. Topographic map of the site (plan view of the digital terrain model)

Fig 1. GIS equipment used to create the topographic map of the site

The advanced geographical information system (GIS) survey equipment used in undertaking the site topographic survey is shown on Figure 2.

The borehole designated as diamond drilled hole-5 (DDH-5) is located at PTM coordinates of 2,002,878.1600 N, 579,637.3700 E at an elevation of 361.835 meters above sea level. However, due to mechanical problems encountered by the equipment (Figure 3) during drilling operation, DDH-5 collapsed. DDH-6 which is 1-m east of DDH-5 at same elevation has to be drilled using a different drilling equipment (Figure 4). The 100-meter deep borehole is expected to be achieved in the next few days. Geologic logs and interpretations both for DDH-5 and -6 have been recorded.

Fig3 and Fig4. The drilling equipment (the initial and currently on use)

Preliminary drilling results and geologic log intersected a thick soil and highly weathered rock from the surface down to 15 meters depth. The section from 15 meters down to 39 meters in depth consist of highly altered andesitic pyroclastic breccia (probably, lapilli breccias is medium sized (5 millimeters – 64 millimeters), volcanic fragments (probably, andesite). Cores are below the residual cover and fractures are oxidized with red tinges, while the deeper core recoveries are grey, with white streaks and highly fractures. The red coloured cores are silicified but most of the matrix is clayey (probably consisting of expansive clays). At depth 17.8 to 21 (elevation 344-341) meters below ground level a tuff layer described in the log as reddish brown andesite (pyroclastics without clasts or fragments) was recognized. This fine grained facies may indicate an interface or boundary between a younger and older pyroclastics deposit. The younger pyroclastics deposit is the layer from the surface down to 18 meters while the older layer from the deeper pyroclastic layer from 21 to 39 meters with the tuff as indicator of another volcanic explosion regime. Other pyroclastic layers may be encountered at the deeper levels. If these pyroclastic flow layer interface intersect the ground surface, these may act avenues for groundwater flow and manifest as springs and consequently, as sources of contaminant leakage.

The drilling of DDH-6 to a final depth of 100 meters is expected to be completed within the month of October 2012. Further site characterization, including preparation of geologic maps and the development of hydrogeologic model is currently on-going.

The lapilli breccias is highly fractured. Core recoveries vary from 96 to 46 percent. Rock quality is 10 to 46 indicating a highly fractured rock mass. Groundwater level was not encountered at this stage of the drilling. Other conditions noted during drilling included very slow drilling penetration, loss of water circulation and jamming of the core bit during advance. Loss of drilling water in some portions of the drilling advance indicates zones of high permeability in high fractured sections with low RQD.

While drilling campaign is taking place, the PNRI, which is the proponent of this project, is continuously doing information campaign at the project site and its vicinities. Figure 5 shows some of the photos taken during the project presentation at the Department of Science and Technology Regional Office in Tuguegarao City. The meeting seminar was attended by representatives from the local government units and key officials of the regional office. An IAEA expert was also present during the stakeholder forum.

Fig5. IAEA Expert and PNRI Technical Team during the project presentation at DOST Regional Office II, Tuguegarao City, Cagayan

Thailand
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The 50th Anniversary of the Operation of Thai Research Reactor and The 2nd Asian Symposium on Material Testing Reactors was held in Bangkok During October 11th-12th, 2012

The 2nd Asian Symposium on Material Testing Reactors was held from October 11th to 12th, 2012 in Bangkok, Thailand. The objective of this symposium is to exchange the information among each test and research reactors for mutual understanding of status of each reactor, and to discuss the Asian network construction of testing reactors. This symposium is jointly organized by Thailand Institute of Nuclear Technology (TINT) and Japan Atomic Energy Agency (JAEA).

Fig1. The 2nd Asian Symposium on Material Testing Reactors Participants

TECHNICAL PROGRAM

Presentations were performed in the following areas;

- Status and future plan of test and research reactors
- Utilization of test and research reactors
- Research and development of Irradiation tests include RI and Si semiconductor production technology
- Research and development of PIEs
- Nuclear Human Resource Development
- Radiation safety and radioactive waste management of activated materials in material testing reactors
- Safety and Public acceptance of test and research reactors

In this symposium, human resource development including development of training infrastructure and construction of the Asian network for testing reactors was also discussed as the town meeting.

There were about 30 participants from Argentina, China, Malaysia, Indonesia, Japan, Korea, Kazakhstan, Vietnam and Thailand. Participants are nuclear engineers, researchers, professors, research reactor operators, from several research institutes, universities, nuclear industry companies and regulatory body.

Professor. Dr. Toshiso Kosako, who is the FNCA project leader from Japan was invited to give the presentation on “Evaluation for Radioactive Inventory of Structural Materials in Nuclear Power Plant Induced by Neutron Activation.”

Fig2. Prof.Toshiso Kosako, The University of Tokyo

CONCULSION

The participants acknowledged the co-operation of Asian countries, especially the JAEA and the TINT for their efforts to strengthen the Asian network construction of Material Testing Reactors, as well as the safety and security of Nuclear Reactor, and to support the upgrading of Material Testing Reactor management in Asia.

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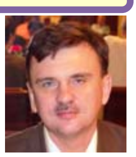

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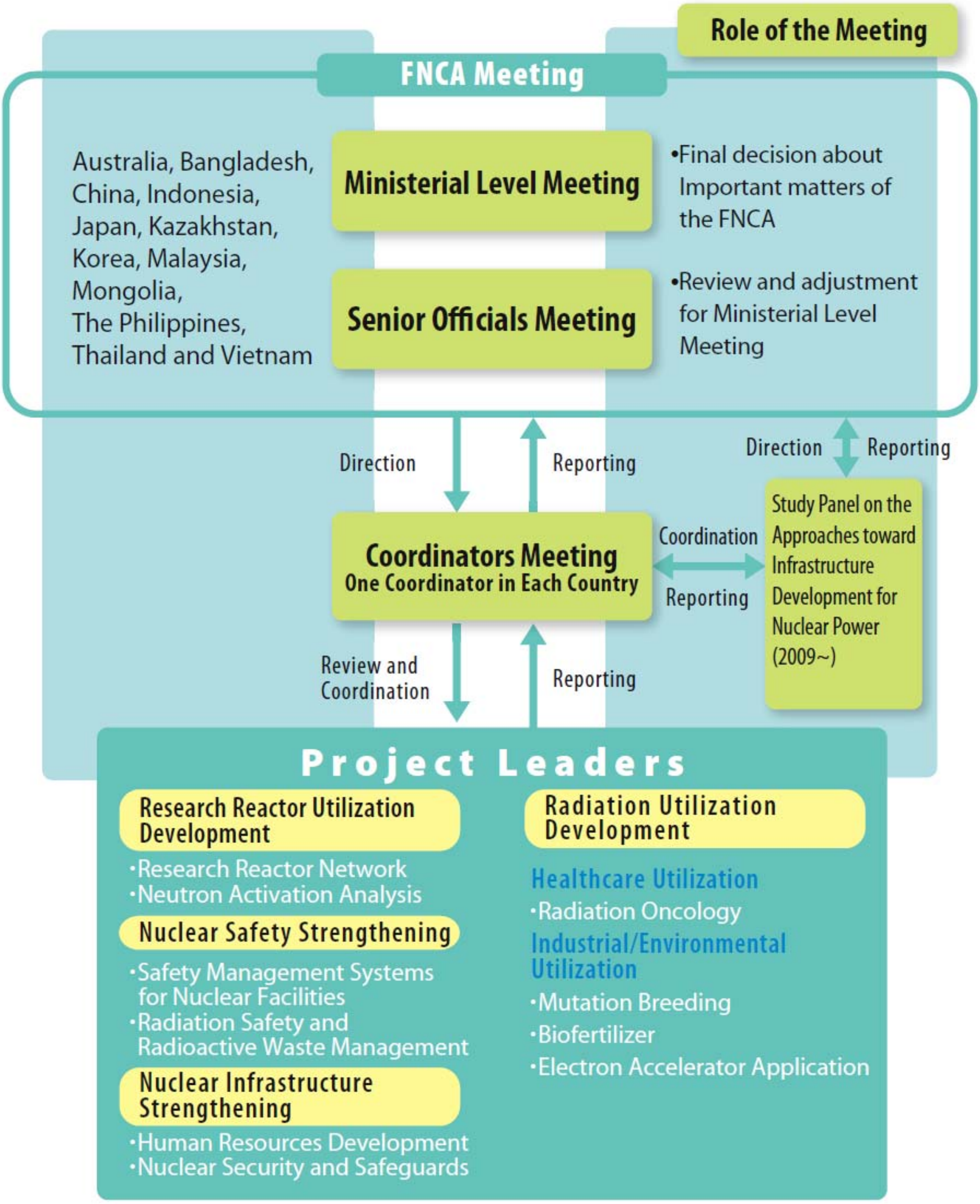
The FNCA Framework



FNCA Consolidated reports on RS&RWM and Task Group Reports are available on FNCA Website.
[URL]: http://www.fnca.mext.go.jp/english/rwm/e_projectreview.html