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Radiation Safety & Radioactive Waste Management

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Contents

The 2014 FNCA Workshop on Radiation Safety & Radioactive Waste Management (RS&RWM)

9-12 September, 2014, Astana, Kazakhstan

The FNCA 2014 Workshop on Radiation Safety and Radioactive Waste Management (RS&RWM) was held from September 9 to 12 2014, in Astana, Kazakhstan. This workshop was hosted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan and National Nuclear Center of Republic of Kazakhstan (NNC). Fifteen researchers and experts from Australia, Bangladesh, Indonesia, Japan, Kazakhstan, Malaysia, Mongolia, The Philippines, Thailand and Vietnam participated in the workshop.

On the first day, member countries gave a country report on nuclear/radiological emergency preparedness and response detailing regulatory framework, zonation, emergency classification, on-site and off-site response, and local government preparedness, training and education personnel and radiation monitoring plan.

Participants then discussed on framework of Consolidated Report on Nuclear/Radiological Emergency Preparedness and Response.

Fig1: The 2014 RS&RWM Workshop

On the second day, participants had a discussion on challenges faced by FNCA participating countries in the area of RS&RWM such as 1)radiation safety issues in uranium mining, 2)challenges in RS&RWM in RI facilities/nuclear power plant, 3)plans for NPP introduction, and 4)status and plans for low level waste disposal facilities/long term storage facilities.

An open seminar on Radiation Protection in Nuclear and Radiation Facilities was held at Nazarbayev University on 11 September. The opening remarks were made by Prof. Baigarin Kanat, Director, Institute of Innovative Technologies, Nazarbayev University and Prof. Toshiso Kosako, Nuclear Professional School, Graduate School of Engineering, The University of Tokyo. Four presentations were provided on each topic of radioisotopes application, IAEA safety standard and ICRP recommendation, basics of radiation safety, and FNCA activities and MEXT programs supporting HRD for nuclear energy and radiation utilization in Asian countries. In the afternoon, there were two roundtable discussion on safety management of NORM and safety management of radioactive sources in medical institutions with the participation of Mr.Timur Zhantikin, Deputy Chairman, Committee of Safety in Power and Nuclear Industry.

Fig2: Open Seminar at Nazarbayev University

On the last day, participants discussed future plans for the next three years. There was an agreement that member countries cooperatively work toward the completion of the first draft of the consolidated report on Nuclear/Radiological Emergency Preparedness and Response. With the closing remarks from Mr.Sergey Berezin, Deputy Director, National Nuclear Center of the Republic of Kazakhstan and Prof. Toshiso Kosako, the workshop was officially adjourned.

In the afternoon, A technical visit to Education and Research Complex, Institute of Nuclear Physics (INP) was conducted. Participants visited a heavy ion accelerator DC 60 and learned about the activities carried out by the complex.

Fig3: Technical Visit to Central Geological Laboratory

Australia

Ms Lynn Tan
Australian Nuclear Science & Technology Organisation (ANSTO)

ANSTO's Waste Upgrade Project in Support of the Australian Nuclear Medicine (ANM) Facilities

The ANSTO Nuclear Medicine (ANM) Project

Australia is set to become a major world supplier of radiopharmaceuticals with the announcement by the Australian government in 2012 for a new ANSTO Nuclear Medicine (ANM) facility. Situated in the ANSTO Lucas Heights site, the $168.8 million ANM Project includes a nuclear medicine manufacturing plant (Figure 1) and a waste treatment plant (Figure 2) to treat by-products for permanent, safe storage at a national waste repository.

Fig1: The ANM Mo-99 Production Facility

With more countries developing modern medical systems, the world's demand for nuclear medicine is growing. It is estimated that Molybdenum-99 (Mo-99) is used in around 45 million procedures worldwide each year and demand is growing particularly in the Asia-Pacific region. However the global (Tc-99m) used for the diagnosis of cancers, heart disease, muscular and skeletal conditions, is under a real threat.

Fig2: The ANM Synroc Waste Treatment Facility

As a signatory at the ministerial-level Joint Declaration of the security of Supply of Medical Radioisotopes, Australia's new Mo-99 manufacturing plant will play a major role in ensuring the long-term reliability of the radioisotope supply in an economically sustainable and proliferation-proof manner. Once fully operational, ANSTO will triple its production of Mo-99, enabling it to supply up to 25-30% of global demand.

ANM Waste Upgrade Project

An ANM Waste Upgrade Project was established to ensure that both the ANM Mo-99 Production Facility and Synroc Waste Treatment Facility are adequately supported by systems that have the capacity to safely manage the increased waste volumes, as well as new waste streams, that will be generated by both facilities. A review of ANSTO's existing waste management services and support infrastructure was undertaken and the following are just some of the items identified as requisite for safe, effective waste-end support for the ANM Project.

i. New Intermediate Level Solid Waste Bins

ii. New Intermediate Level Solid Waste (ILSW) Flask
iii. New Flask Transport Truck
iv. Enhanced shielding for the Spent Uranium Filter Flask
v. Upgrade of Hot Cells Safety Interlocks

New Retrievable Waste Bins

In the Synroc waste treatment facility, intermediate level liquid wastes from the Mo-99 production process is mixed, dried and calcined with Synroc precursors prior to being sealed in a specially designed can for hot isostatic pressing (HIP) at high temperatures. This HIPing process immobilises the radionuclides within a stable glass-ceramic matrix and provide substantial volume reduction of the final waste form. The cans before and after the HIPing process can be seen in Figure 3.

Fig3: Pre- (left) and Post- (right) HIPed cans

The existing waste bins will not be able to contain the HIPed cans from the HIP process, hence taller waste bins (Figure 4) were designed for the taller and heavier waste packages.

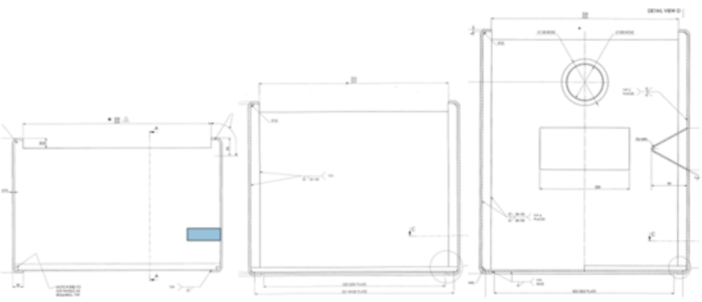

Fig4: Wastes bins of various heights designed for use by the ANM Facilities

New Intermediate Level Solid Waste Flask

The project also decided to design a new intermediate level solid waste (ILSW) flask to service the new facilities as the review of the existing flask, which was built in 1990s, revealed several operational, maintenance and safety issues which would require costly upgrades and extended downtime to rectify.

Furthermore, the existing flask could not accommodate the new taller waste bins required for the SYNROC process and the hoist system will not be able to reach ANSTO's new deeper waste storage pits. The existing flask control system is also not compatible with interlock requirements of th e ANM Mo-99 and Synroc facilities.

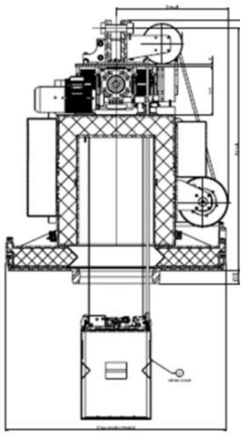

Fig5: A model of the new ILSW Flask with improved safety interlock system, designed to accommodate new taller waste bins and access deeper storage pits.

Hence a new ILSW flask with increased internal capacity to handle the larger Synroc waste bins was designed for manufacture (Figure 5). The new flask will have a Dangerous Goods Rated hoist with a 10 m useable reach cable, an increased lead shield thickness to 130 mm, and fitted with a Safety Integrity Level 2 programmable logic controller. The control system will interface smoothly with the new ANM Mo-99 and Synroc facilities, with no major infrastructure upgrades to existing buildings necessary for its use.

New Waste Transport Truck

The improved design and shielding resulted in the increased overall weight of the ILSW flask, thereby necessitating the purchase of a higher carrying-capacity truck. A specially designed tray with anchor points for securing the 10 ton flask during transport will be mounted to the truck. The dimensions of the new truck (Figure 6) were reviewed to ensure access to existing buildings, as well as the new ANM facilities, for waste collection and storage, are maintained.

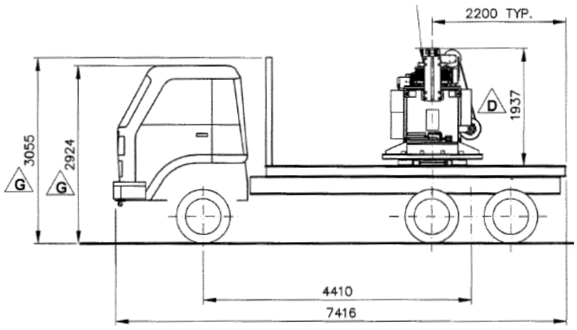

Fig6: A new truck was purchased to transport the new heavier ILSW flask, sized to ensure access to existing and future facilities.

Enhanced shielding for SUF Flask

The Spent Uranium Filters (SUF) from the Mo-99 production process are transported using the SUF flask to the Building 41 hot cells for encapsulation prior to being transferred to the retrievable storage pits for interim on-site storage.

The existing adaptor that is used to align the flask during positioning by the building crane above the vertical posting port of the loading platform lacks shielding. A new adaptor (Figure 7) was therefore designed to provide lead shielding at the transition between the flask and the loading platform to compensate for any shielding weakness during the transfer of the SUF cups out from the flask.

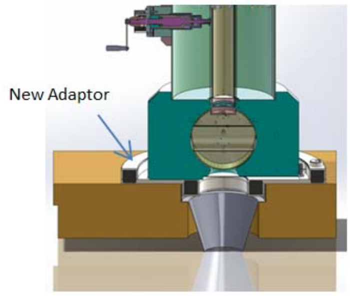

Fig7: Shielded adaptor for the vertical posting port to reduce shine path caused by the existing design of the SUF Flask

Upgrade of Building 41 Hot Cells Safety Interlocks

The encapsulation of the Spent Uranium Filters takes place inside the Building 41 hot cells. Multiple entries into the hot cells are required throughout the process for decontamination, equipment setup and other interventions.

The project designed a safety upgrade system for the existing hot cells (built in the 1960s) to commensurate the increased risks posed by the increased operational activities expected in these hot cells from the new ANM Mo-99 production facility.

The proposed upgrades to the hot cells include a captive key interlock system for the building overhead crane for use with the various waste flasks. This is to prevent accidental lifting of the flasks during waste transfers causing exposure to staff.

Radiation monitors will also be mounted inside the hot cells to prevent opening of a rear cell doors when unsafe level of radiation is detected inside the hot cells.

Interlocks will also prevent the opening of the inter-cell doors when the rear cell door of an adjacent hot cell is open, which usually coincides with staff working in the adjacent cell. An interlock between the inter-cell doors and the in-cell crane will also be available to prevent damage from accidental closing of the door onto the crane. The rear cell posting port (Figure 8) will also be interlocked to prevent concurrent opening of both the internal and external doors.

Audible and visual alarms will be provided at the rear of cell area and all entry points into the rear cells area when a radiation level set-point is exceeded.

This hot cell interlock system is controlled by an Allen Bradley Guard Logix PLC and a display panel will be provided at the front and back of the cells to allow control and operator feedback of the status of the Hot Cell interlock system and radiation monitors.

Fig8: Hot Cell posting port to be fitted with a safety interlock.

More information on the ANM Mo-99 and SYNROC project can be found on the ANSTO's website.

Bangladesh

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Bangladesh Atomic Energy Commission (BAEC)

Establishment of Atomic Energy Centre, Chittagong

Safety of food and environment is the demand of all nations and taking necessary measures to ensure that the individuals, society and environment are protected from the harmful effect of ionising radiation. The Government of the People's Republic of Bangladesh in a Gazette Notification declared that radioactivity test is mandatory for all imported foodstuff according to Nuclear Safety and Radiation Control Act 1993 & Rules-1997 which has been replaced by Bangladesh Atomic Energy Regulatory Act 2014 and Rules. Since Bangladesh has to import a sizeable amount of food materials from different countries, therefore it is necessary to control and regulate the levels of radioactivity in all food materials for safety of the pubic from harmful effects of radiation. To support implementation of the regulatory requirements, Radioactivity Testing and Monitoring Laboratory Facility was established in the port-city of Chittagong. However, the gradual increase of routing work in peaceful application of atomic energy and considering importance of radio ecological research, environmental monitoring and assessment of pollution induced by aquatic and air borne radioactivity around the marine & coastal areas, Establishment of Atomic Energy Centre Chittagong, project was included in the ADP for the year 2005-2006. Consequently, Establishment of a modern Atomic Energy Centre at Chittagong has become an important task for future development of the country.

In July 2006, the Ministry of Science and Technology of Government of Bangladesh (GOB) approved the Establishment of 'Atomic Energy Centre, Chittagong, project, under ADP of GOB. The Government of the People's Republic of Bangladesh allocated budget to implement the project in the port city of Chittagong within the time frame from July 2006 - December 2013.

Fig1: Two storied laboratory building

Fig2: Atomic Absorption Spectrometer

The target of the project is to establish a modern centre with state-of-art laboratories for the routine, research and development activities on problems of natural resources, protection of human and environment using nuclear and radiation technology. The main purposes of the centre are:

- Radioactivity analysis of imported food and environmental samples, which is an important component of public exposure control
- Radioactivity analysis of exportable food and allied materials
- Radioecological research, environmental monitoring and assessment of pollution induced by aquatic and air borne radioactivity
- Promotion of R&D on naturally occurring radioactive materials (NORM)
- Measurement of radiation level of scrap materials
- Radiation protection services to the industries
- Safety measures during transportation of the imported radioactive/nuclear materials
- Providing service to Sea Port and Customs Authorities in examination of consignment containing radioactive materials
- Air particulate monitoring for radiological pollution
- Support to the law enforcing agencies to protect illicit trafficking/transit of nuclear and radioactive materials
- Emergency service during radiological incidents/accidents
- Surface water hydrology using nuclear technology
- Marine and coastal environment radioactivity study
- Education and teaching: which will help enhancing indigenous R&D capabilities and in ongoing different courses/training on radiation safety and creating awareness

The inauguration took place on 23 October 2013, marking the start of operations of the facilities. Under the Establishment of Atomic Energy centre, Chittagong project construction of a two storied laboratory building has been equipped with a number of laboratory facilities e.g., HPGe Detector, Portable Gamma-ray Spectrometers, Double Beam Atomic Absorption Spectrometer (AAS) etc.

As a result of the successful implementation of the project, it has been possible to achieve sustainable program for radioactivity analysis of imported and exportable materials, radio ecological research, and environmental pollution study and radiation protection service. The newly built Atomic Energy Centre at Chittagong will function under ordinance promulgated for the BAEC.

Through the testing and fixing up of the radiation level for imported and exportable food items population of the country will be benefited. The project has strengthened the research and service related facilities on radioactivity analysis of food and environmental samples, which will impact on socio-economic development of the country.

Indonesia-①

Dr Budi SETIAWAN
National Nuclear Energy Agency
(BATAN)

Siting Program for Radwaste Disposal in Jawa Island-Indonesia

INTRODUCTION

Research activities and nuclear application on industrial and medical sectors has been generated radwaste in a wide range of activity levels, and an introduction plan of NPP in Jawa Island in near future is predicted contribute more radwastes. Moreover public awareness to radwaste management program especially on the disposal program raises the environment safety concern. BATAN as the executive body on the application of nuclear science and technology in Indonesia should assure to public on the safety aspects upon the impacts on its activities and a safe location for dispose radwaste should be considered and initiated correctly. To assure to the public on the safety aspects of radwaste disposal, BATAN initiates to prepare The Siting Program of Radwaste Disposal in Jawa Island to supports the introduction of NPP program in Indonesia.

Jawa Island was chosen due to the dominantly of radwaste volume exist in Indonesia (from industrial, medical and research activities) and the first NPP is planned in Jawa Island. The disposal site is better placed in Jawa Island to closeness to the source of waste generators or treatment facility and it's could minimize the radwaste transportation system risk. Also to anticipate the land acquisition problem that becomes more expensive and complicated in future due to high population density problem. Through the program we also could confirm whether any appropriate and safe site(s) occurs (or not) in Jawa Island, and becomes important input for long-term of national radwaste policy in Indonesia.

OBJECTIVE

Objective of the program is to investigate some interested areas and find out the potential (suitable) areas and safe site(s) for dispose radwaste in Jawa Island.

METHODOLOGY

Siting steps from IAEA guidance and experiences from other countries which have siting programs were reviewed, modified and adopted. To obtain the potential areas, some standards and criteria has been arranged and established for excluding and comparative evaluation of interesting areas to find out the potential area/site(s). Arrangement of standards and criteria refer to the important parameters or aspects which were issued by IAEA safety guides and mixed with some National Regulations (Chairman of BAPETEN Regulation, and Ministry of Environment) to meet the local conditions. Both criteria and standards as exclusion and comparative factors will consist of geologically and non-geologically considerations from safety point of view. Up to now we have exclusion and comparative criteria for find out the potential areas.

RESULTS AND DISCUSSIONS

Since Jawa Island has high rainfall rates (see Fig. 1) and cracky character for its soil-rock, a host rock with low hydraulic conductivity (10^{-7} cm/s) type such as clay was proposed for host of Radwaste Disposal facility. Clay rock/soil with impermeable characteristic hopely can control groundwater flow, and then with its good ability to absorp radionuclides will give an advantage as host rock of Radwaste Disposal facility. From desk-top study (cabinet works) to region of interest in Jawa Island, we found some potential areas with clay type based such as in West Jawa region: Karawang, Subang, Sumedang, Majalengka, Central Jawa region: Rembang, Muria Peninsula and in East Jawa region: Tambakrogo, Tuban, Madura, and Serpong Nuclear Research Center (vulcanic rock), totally we have 10 potential areas to be recognized and then evaluated.

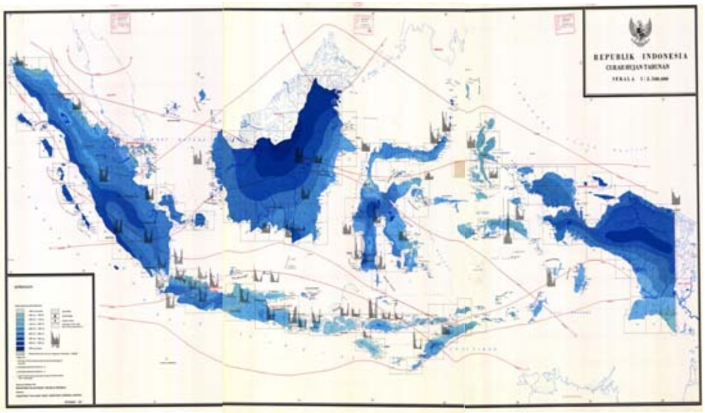

Fig1: Map of annually rainfall rates in Indonesia

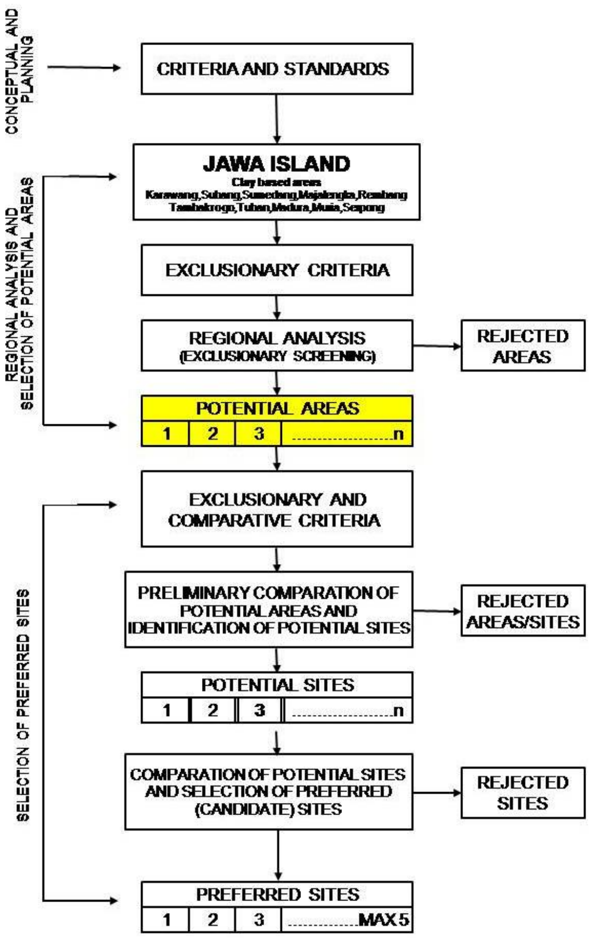

Fig2: Flow chart of the siting program

Since FY 2009 investigation of potential areas through field survey has been performing to recognize the interest areas in Jawa Island (see Fig.2). Some informations of interest areas related to the standars and criteria had been collected and then the data were classified and evaluated carefully to find out potential areas. Screening process is doing to potential areas by using exclusion and comparative factors to find out the potential sites. The results showed that from 10 interesting areas were selected become 5 potential (suitable) areas: Karawang, Sumedang, Rembang, Tuban and Serpong areas. However Serpong area was chosen as a designated site for the demonstration disposal facility.

CONCLUSION

Introduction of first NPP will increase public awareness to environment safety problem, i.e. disposal program. By reviewed, modified and adopted procedures from IAEA guidance, some countries siting report and National Regulation, the preparation of siting program for radwaste disposal in Jawa Island has been discussing intensively. Due to local condition in Jawa Island, clay rock was considered as host rock for radwaste disposal. Since 2009 FY some information of interest areas has been collected and evaluated to find out the potential areas. From 10 interesting areas were selected become 5 potential (suitable) areas: Karawang, Sumedang, Rembang, Tuban and Serpong areas. However Serpong area was chosen as a designated site for the demonstration disposal facility.

Fig3: Situation at the field

Fig4: One of natural clay rock in Subang area

Indonesia-②

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National Nuclear Energy Agency
(BATAN)

Nuclear Emergency Preparedness and Response Exercise on Transfer Channel- Interim Storage for Spent Fuel (TC-ISFSF)– National Nuclear Energy Agency of Indonesia (BATAN)

Spent fuel and radioactive waste management is conducted by National Nuclear Energy Agency (BATAN) as operator, it is contained in The Act number 10 year 1997 on The nuclear Energy, whereas one of center in BATAN that has task to manage spent fuel and radioactive waste is Center for Radioactive Waste Technology (CRWT) in accordance with The Regulation of BATAN Chairman number 14 year 2013 on The Organization and Working Procedure of BATAN. Center for Radioactive Waste Technology has 2 (two) installations those are radioactive waste treatment installation for processing low and intermediate level radioactive waste, and the transfer channel installation storage for spent fuel from research reactor.

According to The regulation of BAPETEN Chairman Number 1 year 2010 on The Nuclear Emergency Preparedness and Response, that each installation uses radioactive substance must make nuclear emergency preparedness and response programme. The programme determined is base on the assessment of radiological potential hazard appropriate with radiological hazard category.

Fig1: Sliding Bridge of TC-ISSF

According to The Regulation of BAPETEN Chairman mentioned above, CRWT installations is included into category II that is the installation or facility has danger potential to generate radioactive release having dose exceeds the limit dose but the dose does not give deterministic effect seriously out of site.

Government Regulation number 54 year 2012 on The Nuclear Installation Safety and Security mentioned that every licencee must hold nuclear emergency exercise on facility level, and ensure that nuclear emergency preparedness programme can be done, licensee must hold nuclear emergency exercise on facility level at least once in a year.

Base on the regulation above, then CRWT held nuclear emergency preparedness and response on TC-ISFSF. Hopefully this exercise can increase the capability of personnels on nuclear emergency preparedness and response, and it can also be known existing infrastructure condition and something else must be present on emergency condition.

Fig1: Evacuation of victim

The scenario of this exercise was accident at pool of TC-ISFSF during transferring spent fuel from rack on the pool to intermediate stage before inserted to transfer hood. There were 4 (four) operators that transfered a spent fuel, 2 operators operated handling tool, one operator operated balancer and the last one was radiation protection officer. The position of 3 operators were on sliding bridge and radiation protection officer conducted monitoring from side of the pool. During processing of transferring of spent fuel, suddenly sling balancer was broken so that handling tool fell down to break spent fuel which was being carried and spent fuel on the rack. Handling tool operator reflexed to hold it but failed and the operator instead fell into the pool.

Radiation Protection Officer (RPO) saw that accident then threw the ring buoy to the victim , RPO helped the victim to reach intermediate stage. A few moments later gamma area monitor alarm was ringing to indicate that the radiation on pool area increased.

RPO immediately reported to Security Officer about that accident, then Head of Security reported immediately to Head of CRWT, and activated emergency team, then gave instruction to rescue and security team to go to location then followed by the other teams.

Head of Security as Operation Control (OC) contacted immediately all head division to assembly at crisis center room. Head of CRWT determined emergency scale and announced to all CRWT workers about emergency, after that reported immediately this accident to Head of Center for nuclear strategic Area and Informatic utilization as a manager of nuclear Serpong area, BATAN chairman, and BAPETEN Chairman.

All emergency teams reported to Operation Manager (OM) appointed by Operation Control (OC) and then discussed how to handle this emergency. After the discussion and got advice from OM and Radiological Assessor (RA) emergency teams work according to their task and function.

After victim was handled and the condition returned safely, then head of CRWT declare that emergency was over. This nuclear emergency preparedness and response exercise were attended by representatives of BAPETEN (regulator), Center for Quality and Nuclear Standardization, Center for Nuclear Fuel Material Technology, Center for Science and Technology of Advanced Materials as observer, and representatives of Center for Multipurpose Reactor and Center for Nuclear Strategic Area and Informatic Utilization as evaluator. This exercise was held in 2 days, first day for preparation and coordination and the second day was the real exercise. The activity of exercise was ended with evaluation session from evaluator, observer and all participants. The goal of evaluation is to know shortage of our facility and to improve our poorness forward, so if there is a real emergency condition we will have been ready. The evaluation covers implementation of SOP, existing of SOP, availability of material and instrument and method of communication.

Japan

Prof Toshiso Kosako
University of Tokyo

Dr Takatoshi Hattori
Central Research Institute of Electric Power Industry

On the Establishment of the Nuclear Risk Research Center

In the interest of creating a center for research and development necessary for utilities to improve safety of nuclear power on their own initiative, the Central Research Institute of Electric Power Industry (CRIEPI) established the Nuclear Risk Research Center (NRRC) on October 1, 2014.

In light of the Fukushima Daiichi Nuclear Power Station accident, it is vital to continually strive for even higher levels of safety in the use of nuclear power generation. To that end, it will be necessary for nuclear utilities themselves to go further than simply meeting the regulatory requirements and to pursue sustained commitment to reduce nuclear risk.

To reduce risk, it will be imperative to implement appropriate measures to counter natural disasters involving large earthquakes, massive tsunamis, and tornados, as well as other events that are of low frequency, yet have the potential to cause significant damage. Similarly important are measures to mitigate any damage if an accident does occur. For that purpose, it will be necessary to predict the progression and behavior of accidents at power stations that have been caused by such events, and formulate countermeasures. Moreover, because the focus is on events that are of low frequency and involve substantial uncertainty, it is necessary to verify the effectiveness of measures based on comprehensive risk assessments utilizing PRA and other probabilistic methods.

In the interest of providing a nucleus for research and development aimed at acquiring technologies and expertise for the activities outlined above, CRIEPI has established the NRRC to more effectively harness the human resources and research infrastructure in related fields it has collected to date.

Further, in the interest of fostering a cycle that combines research and development with utilization of results together with the electric power industry and the broader industrial sector, CRIEPI has created a framework for joint studies by various levels of the management hierarchy, including the Chief Nuclear Officers Conference.

Additionally, in view of the importance of strengthened international cooperation within the NRRC's activities, CRIEPI has invited world-class authorities of nuclear safety with strong leadership experience to serve as the NRRC's executives.

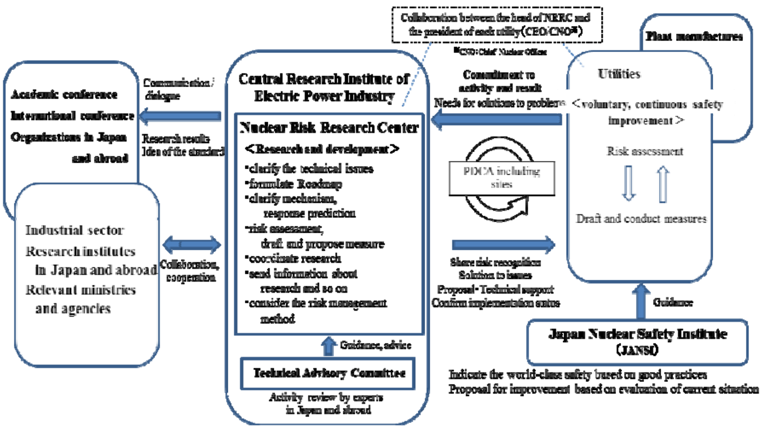

Fig1: The Activities of Nuclear Risk Research Center

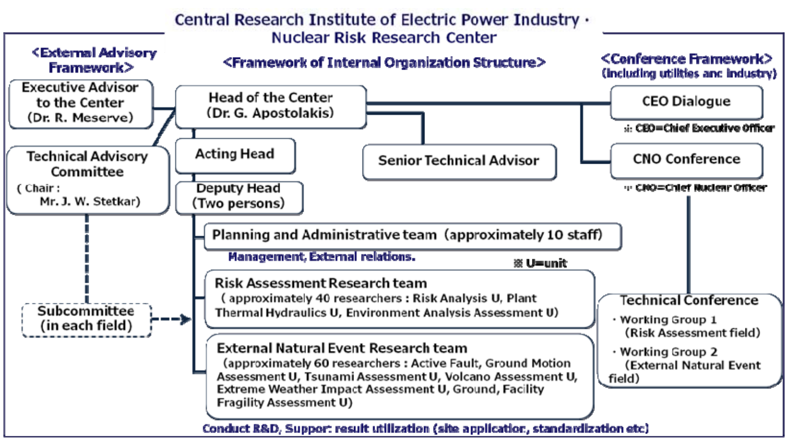

Fig2: Outline of the Organization

CRIEPI Press Release "On the Establishment of the Nuclear Risk Research Center" Oct.1, 2014 http://criepi.denken.or.jp/en/publications/pressrelease/20141001.pdf

Kazakhstan

Dr Erlan Batyrbekov

National Nuclear Center of RK

Operation conduction on radiation hazardous situation liquidation at the territory of the former Irtysh Chemical and Metallurgical Plant, radioactive waste disposal area as well as territories adjacent to them

Background

The Irtysh Chemical and Metallurgical Plant (ICMP) was constructed and put into operation in the period from 1958 to 1961.

Raw material, reprocessed Loparite mineral contained rare earth element (hereinafter - REE): Cerium, Neodymium, Praseodymium, Samarium, Gadolinium, Europium and others. Raw material upon high temperature and interaction with gaseous chlorine pass into soluble concentrate: REE chloride melt, natural thorium content in which composed 0.3-0.9%. 10 tons of raw materials were reprocessed per a day.

During REE removal in condition of closed technological cycle in 22 and 22a operating workshops, accumulated radioactive wastes (RW) led to their accumulation in solutions. Insoluble residue remained in volume of about 320 ton/year, of specific activity – $(4\text{-}20)\times10^{7}$ Bq/kg. Residue was then mixed in special engineering structures at radioactive waste disposal site (RWDS), located at the territory adjacent to ICMP.

Another residue (cake) was obtained after solution reprocessing with specific activity of 1.5×10^{8} Bq/kg in quantity of 20 ton/year since RW was disposed at RWDS.

After work stoppage as well as technological process shutdown radioactive wastes were remained in 22 and 22a operating workshops: in tanks and pipelines in form of technological solutions, punching machines and collecting tanks in form of solid wastes.

Completed Operations

Within the period from 2004 to 2014 the National Nuclear Center of RK performed substantial volume of operations on: search, removal and disposal of ionizing radiation sources (IRS), solid and liquid radioactive wastes, detecting of contaminated sites boundaries and elimination of radiation hazardous situation at the territory of ICMP, radioactive waste disposal sites and adjacent territories.

In 2004

- Radiation survey of 90000 m^2 was realized at RWDS territory and RW storage sites located there. Areas contaminated by radioactive substances of total area of ~200 m^2 were detected, (contaminated soil thickness composed 0.1-0.5 m). Three containers with encapsulated ionizing radiation sources (EIRS) and 19 EIRS without containers were also found at the territory surveyed.
- Detailed survey, RW and IRS removal from storage tank were realized. During work performance 69 m^3 of RW (total weight of about 120 tons) were studied. 86 packages with EIRS and RW were removed from the tank.
- 306 EIRS (including: 1 neutron source, 12 beta-sources and 293 gamma-sources) and 35 containers with EIRS were detected. All radioactive materials (RM) delivered to “Baikal-1” Research Reactor Complex (RRC) were packed

into special containers and disposed.

In 2005

- Radiation survey of territory adjacent to RWDS at a distance up to 500 m (total area of 144 ha) from RWDS fencing was carried out. During the survey, 1440000 measurements of equivalent gamma-ray dose rate and 3600 measurements of alpha, beta-particles flux density and neutron equivalent dose rate were made. In this regard, 50 contamination spots with radioactive substances at territory were detected. Total contamination area after removal of small spots comprised 17400 м^2, total volume – 8700 м^3 (gamma-rays were ranged from 0.7 to 130 μSv/h, alpha-particles flux density was from 1 to 160 part/(min×cm^2), beta-particles flux density was from 10 to 900000 part/(min×cm^2).
- Radiation survey of ICMP operating shops 22, 22A and adjacent territory was carried out, about 4400 m^2 of total area of premises (~7200 m^2) had radioactive contamination higher allowable limits.
- Based on data received in 2004-2005, technical proposals and long-term work program on liquidation of radiation hazardous objects located in controlled territory of ICMP as well as at the territory of RWDS were developed.

In 2006

- Radiation survey of 78 ha of territory adjacent to ICMP from west and north at a distance up 100 m from fencing and territory within ICMP fencing was carried out. During the survey, 85 contamination spots with radionuclides were detected.
- Collection, transportation of EIRS and RW detected at the surface and their long-term storage to “Baikal-1” RRC were carried out. Contaminated soil from 36 spots (7.8 m^3) was removed.
- Based on data of radiation surveys of operating workshops 22 and 22 A, technological process was developed.
- Remediation activities at contaminated territories adjacent to RWDS and ICMP detected in 2005 were conducted.

In 2007

- Radiation survey of territory around Pervomayskiy settlement was carried out, 9 contaminated regions with total area of 238 m^2 were detected.

In 2008

- Operations on establishing system for underground and discharged water radiation monitoring at territory of ICMP and Pervomaiskiy settlement were completed, monitoring operations were conducted.
- Environmental and remediation activities at trench disposal areas detected in 2005 were completed. Six regions at the territory adjacent to ICMP and having radioactive contamination with total area of 13360 m^2 were cleaned up. Removed radioactive soil in the amount of 2590 m^3 (low active radioactive waste) was placed in special prepared earth trenches. The integration of operations on radiation hazard elimination had begun.
- The operations on dismantling of contaminated equipment in operating workshop 22A and its transportation to “Baikal-1”

RRC were commenced. 30 m^3 of solid radioactive wastes were dismantled, packaged and transported to "Baikal-1" RRC.

In 2009

- Irrigation system of radioactive wastes storage site was created.

In 2010

- The operations on monitoring of ground and discharge waters at the territory of ICMP and Pervomayskiy settlement were carried out.
- Liquid RW in amount of 90 m^3 were reprocessed.
- Solid RW in amount of 342.54 tons (construction materials, details of technological equipment, metal structures, etc.) and 325.01 tons of reprocessed liquid RW were dismantled, packaged into PU-1 type containers, transported and placed for the storage at "Baikal-1" RRC.

In 2011

- Solid RW in amount of 288.86 tons were packaged into PU-1 type containers, transported and placed for the storage at "Baikal-1" RRC.
- Liquid RW in amount of 60 m^3 were reprocessed. Reprocessed (cemented) liquid RW in amount of 241.34 tons were packaged in casks, transported and placed for the storage at "Baikal-1" RRC.

In 2013

- Additional radiation survey was carried out that showed locations contaminated with RM in amount of ~578 m^2.
- Approximate volume of contaminated soil is ~133.4 m^3.
- The areas for containers containing RW were arranged.

In 2014

- Solid radioactive wastes in amount of 210 tons were accepted for long-term storage at "Baikal-1" RRC. Totally 1500 containers for solid RW were produced.

Totally in 2004-2014 more 1400 tons of RW and more 300 EIRS were transported and placed for the storage at "Baikal-1" RRC.

Fig1: The loading of casks with cemented RW into cargo truck

Fig2: Radiation survey in operating workshop

Fig3: Loading of containers with solid radioactive wastes into cargo truck

Fig4: Radiation survey of adjacent territories near radioactive wastes disposal site (RWDS)

Malaysia

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Preparation for Conditioning of Disused Sealed Radioactive Sources (DSRS) for Final Disposal in Malaysia

Malaysia has been actively involved in projects for ensuring safety and security in management of radioactive waste, including disused sealed radioactive sources (DSRS). A national activity was implemented for the on-the-job training of personnel tasked with the conditioning of DSRS, from 13th to 17th October 2014 at the Waste Technology Development Centre (WasTeC) facilities. This is part of "cradle-to-grave" control of radioactive sources to protect the workers and public from the hazards of ionizing radiation.

This was implemented under the RAS9071 "Establishing a Radioactive Waste Management Infrastructure". The training workshop was organized in collaboration with the IAEA. It was attended by (managers, operators and technicians) from several groups in Nuclear Malaysia and the Atomic Energy Licensing Board (AELB).

Fig1: Discussion with the IAEA experts (Conditioning Area)

Prior discussion was made with the experts on the conditioning area and the equipment in place. Minor adjustments were made on shielding and placement of equipment.

Fig2: Selection of DSRS for conditioning (Storage Area)

Prior segregation and characterization of DSRS were done in the storage facility – based on radionuclide, type of devices, common features, etc.

Fig3: Discussion with the IAEA experts (Conditioning Area)

Ascertained type of DSRS, location in device and suitable tools or equipment needed for dismantling DSRS from device. Specific tools may be needed for different type of devices.

Fig4: Separating, cutting, transferring to shielded capsule

DSRS were separated from holders (by cutting, when needed). The serial number of each DSRS confirmed as in inventory. DSRS were transferred into a stainless steel capsule, which is placed inside a lead container shielding.

Fig5: Welding of capsule and leak testing of welded capsule

Welding of the capsule was done remotely to minimize dose to the operators. The welded capsule was allowed to cool before undergoing leak-testing under 0.25 atm in ethylene-glycol.

No leakage was recorded.

Fig6: Placement of capsule into temporary storage drum

The capsules were then transferred into cement-lined 200-L drums, complemented by layers of lead sheet. Dose rates were recorded and the drum were transferred to temporary storage area prior to placement within the main storage facility

The first day of the training was focused on discussion with the experts on DSRS conditioning aspects. This includes the working area layout, operational procedures, radiation protection aspects and capsule welding techniques. The next 4 days were dedicated to training for the local team, covering preparations before conditioning and operational aspects during and after conditioning activities.

Shielding was erected on the working areas for each operation (DSRS receiving area, encapsulation, welding, leak-testing). The welding machine tested and operated by qualified welders trained in tungsten inert gas (TIG) welding techniques for stainless steel capsules. The radiation doses expected during the DSRS conditioning operations were estimated and all safety aspects were discussed. The IAEA experts verified that the working conditions fully met the requirements for the conditioning exercise. Work was done on rotational basis among the staff to reduce the dose received.

Two encapsulated capsules were generated after the training workshop. The main DSRS encapsulated during this exercise were mainly Cs-137, Co-60 and Sr-90. The main significant activity is from Capsule 1 which contains Cs-137 (55 units, 92.5GBq) while activity in Capsule 2 is lower. Overall, this exercise managed to improve our understanding on the technical aspects, preparation, unexpected possibilities and also improvement needed for future conditioning activity of DSRS.

The Philippines

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The Joint Workshop of the Philippine Nuclear Research Institute (PNRI) and the Japan Atomic Energy Agency (AEA) on Radiological Emergency Preparedness and Response

The joint National Workshop on Nuclear and Radiological Emergency Preparedness and Response and the Follow-Up Training Course on Nuclear and Radiological Emergency Preparedness was conducted at the Philippine Nuclear Research Institute on February 9 – 13, 2015. This activity was undertaken in cooperation with the Nuclear Human Resource Development Center (NuHRDeC) of the Japan Atomic Energy Agency (JAEA). It aimed to further strengthen the radiological emergency preparedness and response capabilities of the PNRI and its participating organizations in dealing with accidents or incidents involving nuclear or radiological materials such as dirty bomb used for sabotage.

The key learning areas of the workshop were to clearly establish the goals of the emergency preparedness and response, to impart the roles and responsibilities of the different participating agencies and the scope of the response structure, to learn the effective use of radiation detection equipment, and other related tools, to share relevant international and national guidance, decision-making criteria, and procedures, and to understand the correct and efficient emergency response techniques.

Fig1: Mr. Teofilo V. Leonin, Chief of the Nuclear Regulatory Division, gave an overview of the National Radiological Emergency and Response Plan as part of topic given in the course.

Five (5) participants from the Philippine Nuclear Research Institute (PNRI) and twenty (20) from the different cooperating government agencies, namely: Office of Civil Defense of the National Disaster Risk Reduction Management Council, Bureau of Fire Protection (Quezon City), Philippine National Police (Quezon City), Explosive Ordnance Disposal Battalion of the Philippine Army, Health Emergency Management Bureau of the Department of Health, Metropolitan Manila Development Authority, and Quezon City Disaster Risk Reduction Office, took part in this five-day preparedness and response workshop, which included a field exercise..

During the exercise, participants conducted radiation monitoring and environmental sampling and analysis. They measured the contamination level of the ground surface and conducted gamma spectrum analysis and vehicle-based monitoring – activities that are conducted following any nuclear or radiological incident or emergency. Results were then compared amongst participants.

Fig2: Mr. Seiichi Kanaizuka of JAEA, gives advice in the proper wearing and taking off of the personal protective suit.

The workshop also provided an opportunity to practice coordination between and among the various radiological and nuclear response teams and helped learn how the different teams can work together and learn from each other in order to provide immediate assistance under the National Radiological Emergency Preparedness and Response Plan (RADPLAN).

Fig3: The participants actively play part of the surface contamination monitoring and decontamination at the former PNRI Gamma Garden.

The 5th day of the workshop served as the highlight of the workshop where the participants had to undergo the integrated radiological emergency field exercise to test their knowledge and skills on their ability to demonstrate their responsibilities and procedures including implementation of appropriate decision-making criteria.

Fig4: Dramatization of a radiological emergency response from a terrorist attack using a radiological dispersal device. The first response team carefully placed down and monitored one of the casualties.

medical care, determination of the extent of contamination, controllingthe crowd, and planning for recovery and clean-up operations. The scenario exercise was about act of terrorism whereby unknown terrorist group used a radioactive dispersive device.

Fig5: Part of the field exercise is to demonstrate how each participating response and action team will respond properly to an emergency.

Thailand

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Thailand Institute of Nuclear Technology (TINT)

Radiological Emergency Exercise: Megaports Initiative Project at Laem Chabang Port Laem Chabang Port, Chonburi, Thailand

Exercise objectives

The aims and objectives of the Exercise of the Magaports initiative project at Laem Chabang Port (LCP), are as follows:

1) To implement the workflow in the developed Standard Operating Procedure (SOP) of Magaports system at LCP which are related to the various agencies, develop information sharing mechanisms, and plan the deployment of respond action during a radiological materials found at LCP.

2) To conducted as a facilitated discussion or analysis of the detection and response to alarms events in a stress-free environment that promotes discussion on how to resolve problems

or issues with existing operational plans or procedures.

3) Validate plans and procedures by utilizing a hypothetical scenario to drive participant discussions.

Fig1: Picture of Leam Chabang Port

Scenarios

Two scenarios are designed for detection and response. These scenarios consisted of two different themes of the exercise.

1. The alarm event from high radiation level orphan radioactive source in scrap metal is imported to LCP or is exporting from LCP.
2. The alarm event from stolen nuclear materials masked with Cerium ore is exporting from LCP.

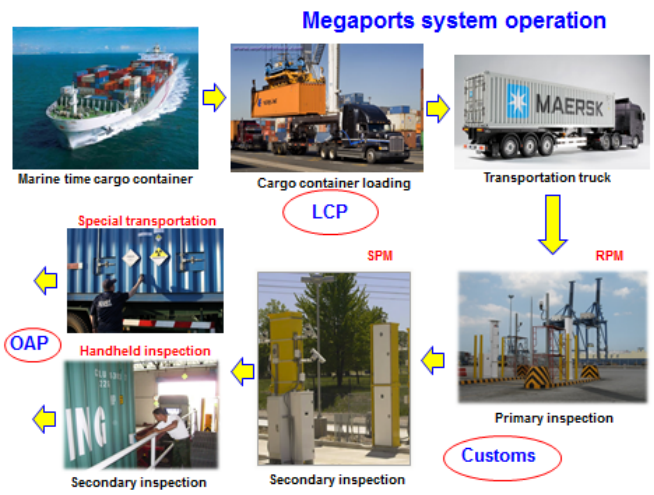

Fig2: Magaports System Operation

Participated Agencies

Agency-level response depends on the Nuclear/Radiological threat analyzed of the alarm events. The scenarios need the player and evaluator only 4 agencies as follows:

1. Laem Chabang port Customs Bureau
2. Office of Atoms for Peace (OAP)
3. Thailand Institute of Nuclear Technology (TINT)
4. Laem Chabang Port

Remarks: National Nuclear Security Administration (NNSA), USDOE and Chulalongkorn University are worked as technical supports.

Participants will have 2 kinds of exercises as follows;

Tabletop Exercise (TTX) – designed to bring one or more agency together to evaluate and improve existing plans, policies, and procedures by testing those products in response to reality-based exercise scenarios. These discussions are informal and not time constrained.

Full-Scale Exercise (FSE, also known as FTX) – the most complex event, is designed to evaluate and validate plans, policies, and procedures across all levels of engagement using reality-based exercise scenarios. The exercise is conducted in real time using field personnel and may also include functional play from participants at other sites such as operations command center, and other agency coordination centers.

Results: The Standard Operating Procedure (SOP) is developed as shown in Figure 3-5.

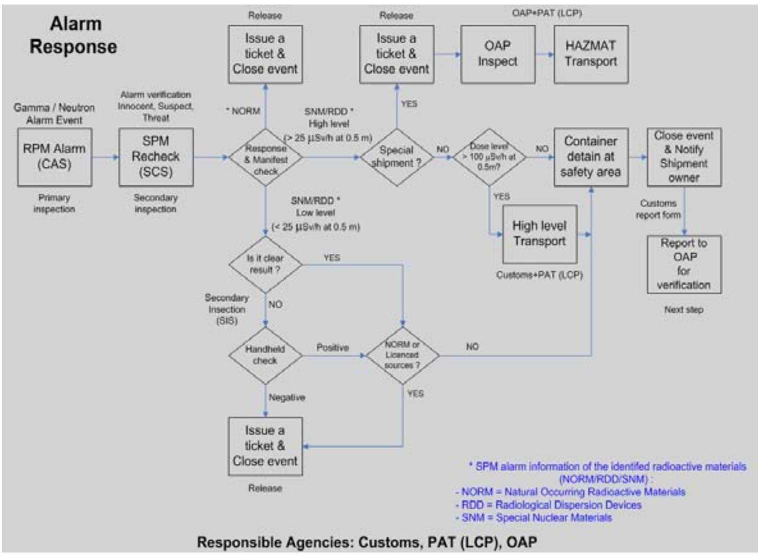

Fig3: SOP of Alarm Response

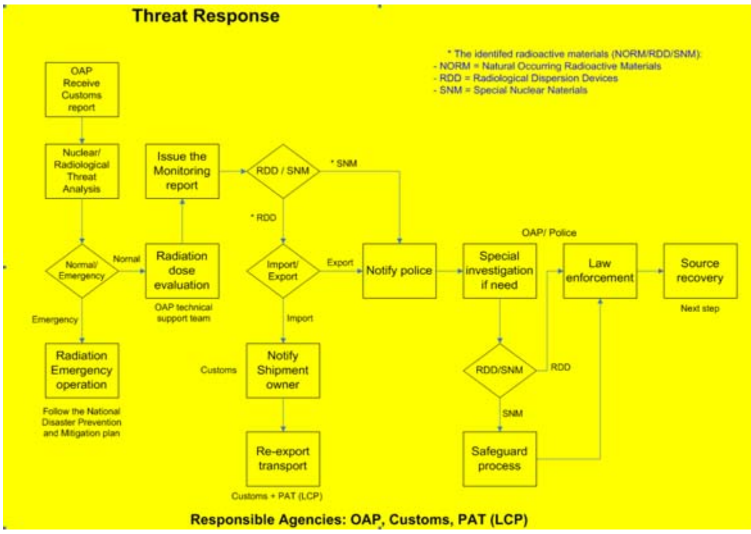

Fig4: SOP of Treat Response

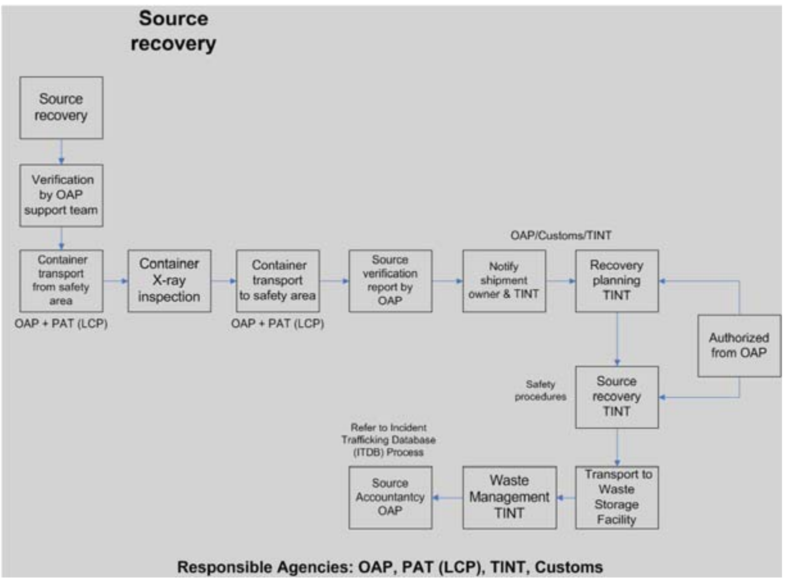

Fig5: SOP of Source Recovery

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The FNCA Framework