

# Joint ICTP-IAEA workshop on Radioactive Waste Management-solutions for Countries without Nuclear Power Programme 6 November 2015

THIPSUKON KHUMSAENG, Ph.D  
Chiang Mai University  
Thailand



# Ministry of Science and Technology

Since 2006

## Thailand Institute of Nuclear Technology (TINT)

Performing R&D, utilization of nuclear technology

## Office of Atoms for Peace (OAP)

Making Regulations, inspection, licensing

**Radioactive Waste Management Center (RWMC)**  
RW Processing and Storage Facilities


**Bureau of Radiation Safety Regulation**

**Thai AEC**  
17 sub-committee

**Research Reactor Center - Spent Fuel Management**

**Bureau of Nuclear Safety Regulation**

## 17 SUB COMMITTEES

- EMERGENCY PREPAREDNESS
  - DATABASE ON MEDICAL APPLICATION
  - ATOMIC FOR PEACE ACT REVISION
  - LICENSING PROCESS REVISION
  - NATIONAL POLICY AND STRATEGIC PLAN
  - INDUSTRIAL APPLICATION
  - MEDICAL APPLICATION
  - AGRICULTURAL APPLICATION
  - FOOD TECHNOLOGY
  - RADIATION SAFETY OFFICER ACCREDIT
  - WEAPON OF MASS DESTRUCTION
  - CTBTO
  - NUCLEAR FUEL SAFEGUARD
  - RADIOTHERAPY
  - LICENSING OF RADIOISOTOPES AND NUCLEAR MATERIALS
  - LICENSING OF RADIATION GENERATING MACHINE
  - NUCLEAR SAFETY
- 

# THE UTILIZATION OF NUCLEAR TECHNOLOGY IN THAILAND

1.



Medicine (15%) : *Clinical Therapy,  
Radiotherapy  
(Radiation sources)*

2.



Industries (40%) : *Process and Plant Control, Quality Control  
Non-Destructive Testing*

*(Radiation sources)*

*X-ray devices*

*Accelerators*

3.



Research and Education(30%): ***Universities***

***Research centers***

**Research reactor**

***(Radioisotopes, stereotactic radiosurgery: SRS)***

4. Others consumer products (15%): **smoke detectors,**

**Lightening,**

**preventers**

***(Radioactive materials)***

Sources: Ya-anant & Suntarapai, 2013.

**Radioactive materials:**  $^{60}\text{Co}$ ,  $^{99}\text{Mo}$ ,  $^{99\text{m}}\text{Tc}$ ,  $^{137}\text{Cs}$ ,  $^{226}\text{Ra}$ ,  $^{241}\text{Am}$ , Am/Be,  
 $^{131}\text{I}$ ,  $^{90}\text{Sr}$ ,  $^{85}\text{Kr}$ ,  $^{55}\text{Fe}$ ,  $^{109}\text{Cd}$ ,  $^{63}\text{Ni}$ ,  $^{225}\text{Cf}$  etc.,

Sources: Ya-anant & Suntarapai, 2013.

# MAIN SOURCES OF RADIOACTIVE WASTE (DSRS, NORM, RR, SF)

Note : RW and DSRS will be transferred to and Managed by Radioactive Waste Management Center(RWMC), TINT

# Disused Radioactive sealed Source (DSRS) in Thailand

## Safety and security management of disused sealed radioactive sources in Thailand

The Radioactive Waste Management Center, Thailand Institute of Nuclear Technology, is authorized to operate the treatment, conditioning and storage of DSRS in Thailand. The successful results included that the record keeping of DSRS has been developed, and the national inventory of stored DSRS has been made up to date. The results confirmed that the quality control at the DSRS storage facility at Thailand Institute of Nuclear Technology was established and well implemented to ensure safe and secure management.

Source: Ya-anant et al., 2015

Journal of Physics: Conference Series 611 (2015) 012014

[HTTP://IOPSCIENCE.IOP.ORG/ARTICLE/10.1088/1742-6596/611/1/012014/PDF;JSESSIONID=D3BF7CA233BA84FD4899CDDD54027D1F.C1](http://iopscience.iop.org/article/10.1088/1742-6596/611/1/012014/pdf;jsessionid=D3BF7CA233BA84FD4899CDDD54027D1F.C1)





THE SERIOUS RADIOLOGICAL ACCIDENT IN THAILAND OCCURRED IN SAMUT PRAKAN PROVINCE IN 2000, WHEN COBALT-60 HEAD OF A DISUSED TELETHERAPY UNIT WAS PARTIALLY DISMANTLED, AND TAKEN FROM THAT STORAGE TO BE SOLD AS SCRAP METALS. THREE VICTIMS DIED AND 10 PEOPLE RECEIVED HIGH DOSES FROM THE RADIOACTIVE SOURCE

Source: Ya-anant et al., 2015



# CHECKING FOR CONTAMINATION AND DOSE-RATE OF DSRS.

Source: Ya-anant et al., 2015



# IDENTIFICATION OF DSRS.

Source: Ya-anant et al., 2015





Before



After

Before and after the reorganization of DSRS at TINT storage facility no.1.

# NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM)

## SYSTEMATIC APPROACH TO CHARACTERIZATION OF NORM IN THAILAND

### NORM activities

- from mining, milling, dressing and smelting (uranium, thorium and potassium have high concentration along the west side of the country from the north down to the south of Thailand)
  - in Sediments (*Comparative Study on U, Th and K Concentrations in Sediments at the Mae Moh Mine and Lam Phra Phloeng Dam*; Vichaidid et al., 2009)
  - in lignite ash (*Quantitative analysis of uranium, thorium, and potassium from lignite ash by neutron activation method*; Ratanakorn & Prongpanyasakul, 1984)
  - at one meter above the surface of local soil along roads in the surroundings of Phuket Island (the richest tin province in Thailand) (*Terrestrial gamma radiation in Phuket Island, Thailand*; Chanyotha et al., 2011)
- petroleum, oil and gas, exploration and production activities arisen in Thailand.

source., Assoc. Prof. Supitcha Chanyotha, 2014.

<http://www.nre9.com/presentations/chanyotha-key.pdf>



Chiang Mai

Lam pang

Nakon Ratchasima

Bangkok

Phuket



# NATIONAL WASTE INVENTORY

## 1 List of Spent Fuel Management Facilities

- Thailand has only one interim storage facility for spent fuel at Bangkok to serve the Thai Research Reactor (TRR1/M1)
- Wet-interim storage was applied in the research reactor's pool.

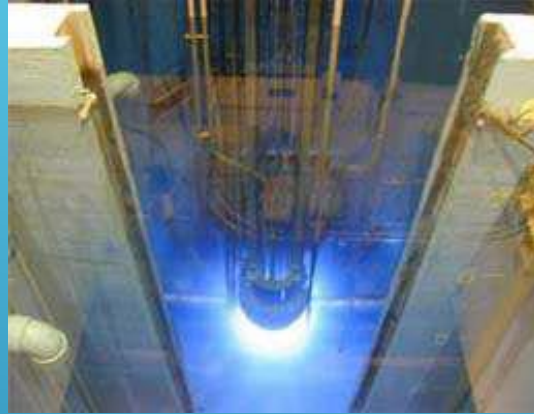
## 2 Inventory of Spent Fuel

- 4 items of Spent Fuels which are stored at a storage pool of TRR1/M1 awaiting for re-export to USA.
- 49 irradiated fuels are stored in the storage pool of TRR1/M1

Sources: Ya-anant & Suntarapai, 2013.

# TRR: THAI RESEARCH REACTOR

HRD



Neutron  
Activation  
Analysis

Gems  
Coloratio  
n



Public Relations



Research &  
Development

Isotope  
production



Neutron  
radiography



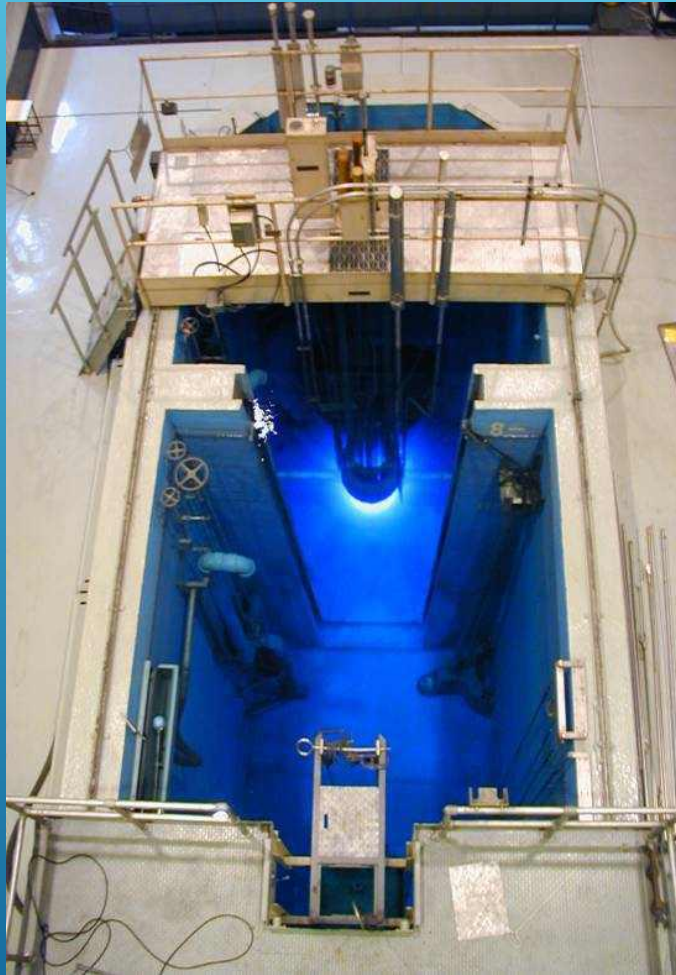
# TINT has been managing a research reactor facility

## Current status of Thai Research Reactor(TRR-1/M1)

<b>Place/Site</b>	<b>Maker Type</b>	<b>Recent Power</b>	<b>First Criticality</b>	<b>Status</b>
Bangkok	GA	1.2 MW	1964	in operation

Sources: Ya-anant & Suntarapai, 2013.

# CURRENT STATUS OF TRR-1/M1 FUEL

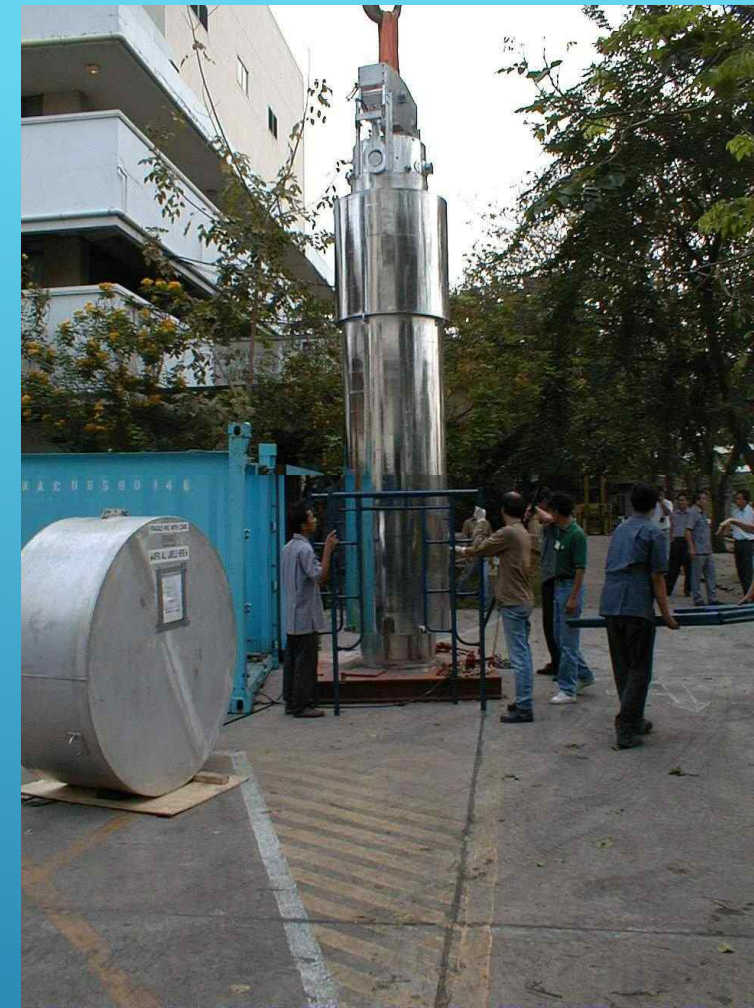


Approximately 160+ fuel elements in total

- 107 fuel elements used in the current core with 4 control rods
- All fuel elements are kept in underwater fuel racks in reactor pool (large section pool)
- Each rack can store up to 20 fuel elements
- Transfer of fuel element in pool by fuel handling tool
- Transfer of fuel element out of pool by transfer cask



# SF: SPENT NUCLEAR FUEL



SPENT FUEL FROM THAI RESEARCH REACTOR HAS BEEN RETURN BACK TO ORIGIN (USA) IN 1999

Sources: Ya-anant & Suntarapai, 2013.

# RADIOACTIVE WASTE MANAGEMENT FACILITIES

Facilities	Items	Capacity	Type of Waste	Operational year
1 Solid Waste treatment	1.1 incinerator equipped with off gas cleaning system	15 kg/h	Burnable waste	1987
	1.2 compactor	40 ton	Compactable waste	1993
2 liquid waste treatment	2.1 Accelerator for chemical precipitation plant	5 m <sup>3</sup>	Aqueous waste low salt content	1965
	2.2 Incineration for organic liquid waste	20 kg/h	Organic liquid waste Ash, sludge	1995
3 conditioning	In Drum Cement Mixer	200 liter	Treated Waste; ashes and sludge	1993
4 Interim Storage	4.1 Storage facility no.1	65 m <sup>2</sup> x 4.5 m	Disused SRS	1994
	4.2 Storage facility no.2	80 m <sup>2</sup> x 4.5 m	Waste form in drums	1997
	4.3 Storage facility no.3	300 m <sup>2</sup> x 5 m	Waste form/ SRS packages	2005
	4.4 Storage facility no.4 (New)	1050 m <sup>2</sup> x 7 m	Waste form/ SRS packages	2014
5 Transporters	5.1 Truck no.1	3.5 ton	All kinds of waste	1997
	5.2 Truck no.2	5.5 ton	All kinds of waste	2006
6 Laundry	6.1 Washing machine	20 kg	Contaminated clothes	2006
	6.2 dryer	20 kg	activity < 0.4 Bq/cm <sup>2</sup>	1997



# RADIOACTIVE WASTE MANAGEMENT (RWM) STATUS IN THAILAND

Updated as of March 2007 FNCA Consolidated Report on  
RWM (Thailand)

The main waste from the OAP itself comes from the operation of the 2 MW TRIGA Mark III Research Reactor, radiochemistry laboratories, and the production of radioisotopes, such as I-131, Tc-99m, P- 32 etc.

Since, the OAP has been responsible for radioactive waste management in Thailand. This mission was assigned to the Radioactive Waste Management Program (RWMP), where is the centralized radioactive waste management facility in the country.

[http://www.fnca.mext.go.jp/english/rwm/news\\_img/rwm\\_cr03-08\\_r004.pdf](http://www.fnca.mext.go.jp/english/rwm/news_img/rwm_cr03-08_r004.pdf)

# NATIONAL POLICY / NATIONAL PLAN FOR MANAGING RW

## **Radioactive Waste Management and Spent Fuel Management Policies**

*At present Thailand **has no** national policies on RWM and SNF , **No act** on RWM and Spent Fuel Management. However*

**Ministerial Regulation on Rules and Procedures on RWM (2003) is provided,**

**Article 7, “Licensee (User) shall response to their radioactive waste”**

**Article 8, “Licensee (User) shall prepare their radioactive waste and send to Office of Atoms for Peace (OAP) for **further management\***.**

**Article 10, (3) “DSRS shall be return to their origin”.**

**Remarks: \*: RW and DSRS will be transferred to and Managed by Radioactive Waste Management Center(RWMC), TINT**

Sources: Ya-anant & Suntarapai, 2013.

## MANAGEMENT OPTIONS CONSIDERED FOR DSRS, NORM, LLW, RR SF, OTHER

### ▶ **RWMC is an organization responsible to manage Radioactive Waste**

#### **Management in Thailand**

- ▶ • Responsibilities cover on collection, transportation, segregation, treatment, conditioning and storage
- ▶ • Low level solid wastes are treated by incineration and compaction.
- ▶ • Low level aqueous wastes are treated by chemical flocculation-precipitation, and ion-exchange method.
- ▶ • The treated wastes are solidified by cementation in 200 liter-drums.
- ▶ • The disused sealed sources are conditioned by several technologies, such as cementation, encapsulation, and over-packages.
- ▶ • Waste forms and waste packages are stored in the National Storage Facilities at TINT, in Bangkok and Klong 5 District, Pathumthani Province

Sources: Ya-anant & Suntarapai, 2013.

# AVAILABILITY OF RESOURCES (HUMAN AND FINANCIAL)

The current and future financial arrangements for the management of radioactive waste will be borne by the generators and funding set aside for this purpose will be preserved for the time when it is needed. (Polluter Pays Principle)

- The Government of Thailand will take the financial responsibility for the future management of the waste which the generators no longer exists.

Source: Ya-anant & Soontrapa, 2015



# DISPOSAL PLAN

Currently, there is **no disposal facility**/ repository **in Thailand**.

Considerations may make for the future waste management programs.

Thailand is in Concept C. This concept means disposal of LILW in near surface in engineered concrete vault with drainage system and multilayered covers, constructed in saturated/unsaturated zone on a site with changing level of water tables

FNCA Consolidated Report on RWM (Thailand), 2007

# CONCERNS, PROBLEMS, CHALLENGES IN MANAGING RW

- Thailand **requested the expert mission from IAEA** to help us to draft the national policy and strategy.

- In February 2014, the expert mission on “Drafting the national policy and strategy for managing radioactive waste and spent fuel” was held in Bangkok.

- This project is under RAS9069.

- **Public Awareness in radioactive waste**

Source: Ya-anant & Soontrapa, 2015

[https://www.iaea.org/INPRO/10th\\_Dialogue\\_Forum/Day3/Session4/01.Ya-Anant\\_Thailand.pdf](https://www.iaea.org/INPRO/10th_Dialogue_Forum/Day3/Session4/01.Ya-Anant_Thailand.pdf)

**THANK YOU VERY MUCH  
FOR YOUR ATTENTION**

