Exploring and Promoting the Peaceful Use of Nuclear Technology

The 11th ASEAN Regional Forum (ARF) Inter-Sessional Meeting on Non-Proliferation and Disarmament (ISM on NPD)

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Outline

- Nuclear Organizations in Thailand Overview
- Nuclear and radiation utilization in Thailand
  - Facilities
  - Research fields
  - Services provided to public
- ASEAN networks
  - **ASEAN Large Nuclear and Synchrotron Facility Network (LNSN)**
  - Nuclear Power Safety Research (NPSR)

Nuclear Organizations in Thailand

Ministry of Science and Technology (MoST)

Office of Atoms for Peace (OAP)

Regulatory body

- Established in 1961
- Law and regulations
- Issuance of permits
- Non-power policy

Thailand Institute of Nuclear Technology (TINT)

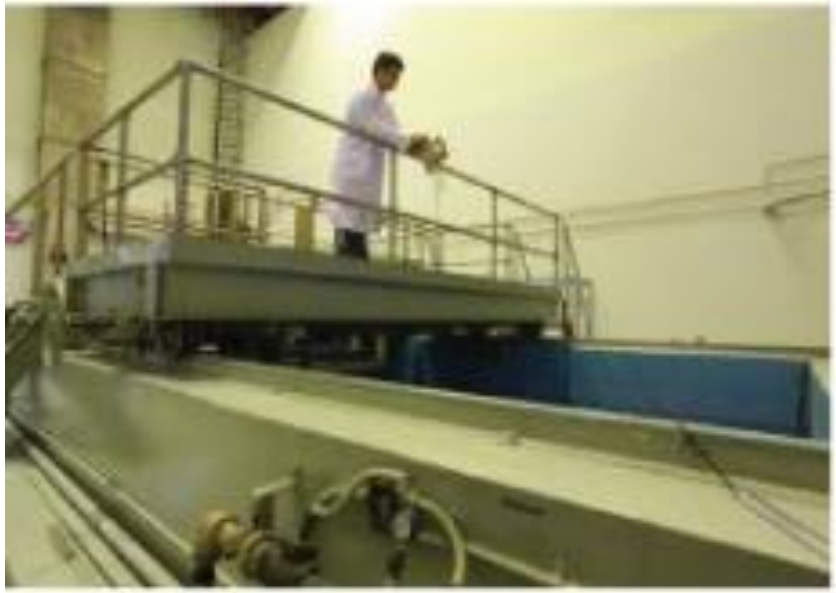
Research and services

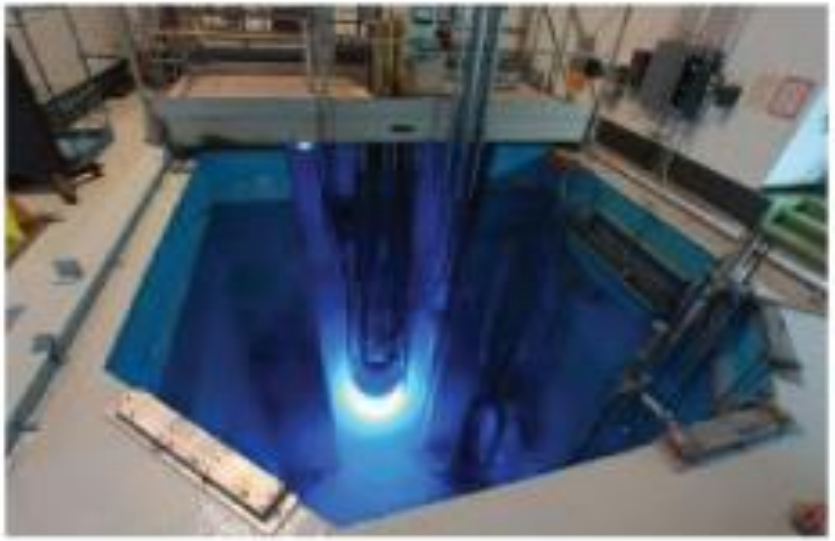
- Established in 2006
- Research and development
- Technological services
- Technology transfer

Main facilities

TINT Office at Bangkok

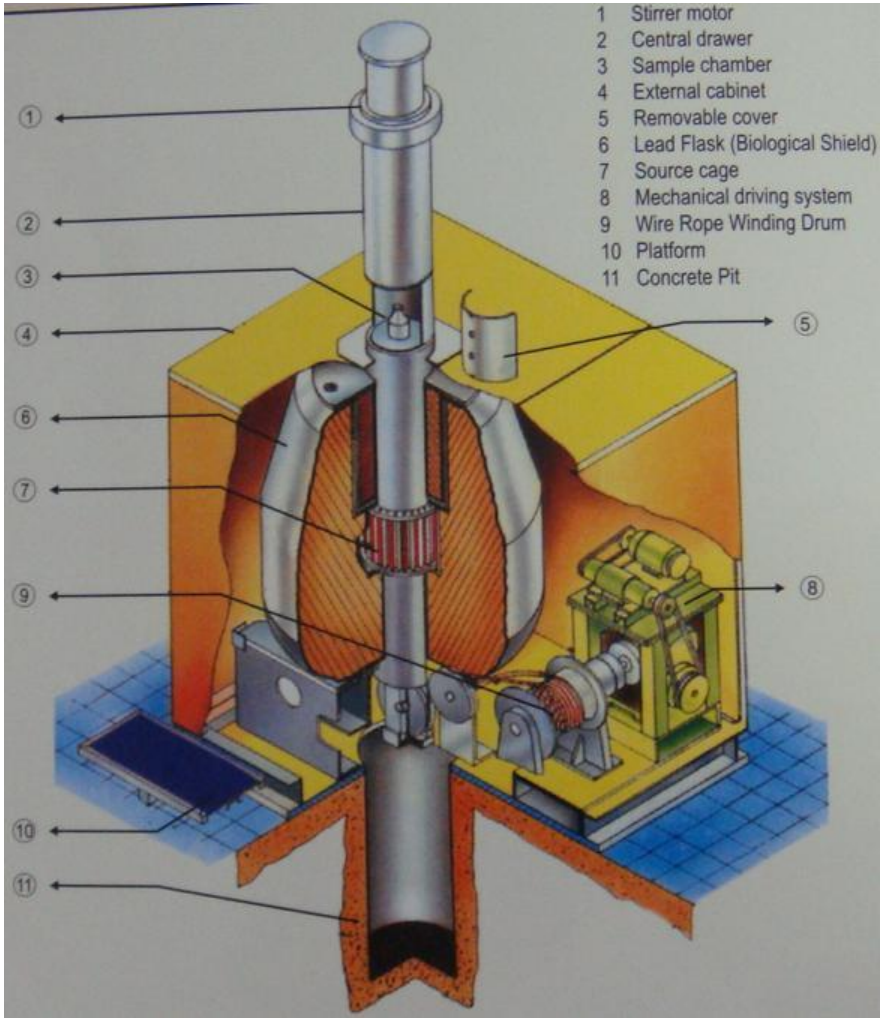
- 2 MW Research Reactor (TRR-1/M1)





Main facilities (Nakhon Nayok Province)

Gamma Chamber 5000 (Co-60, India, 10,000 Ci. , Research Scale)

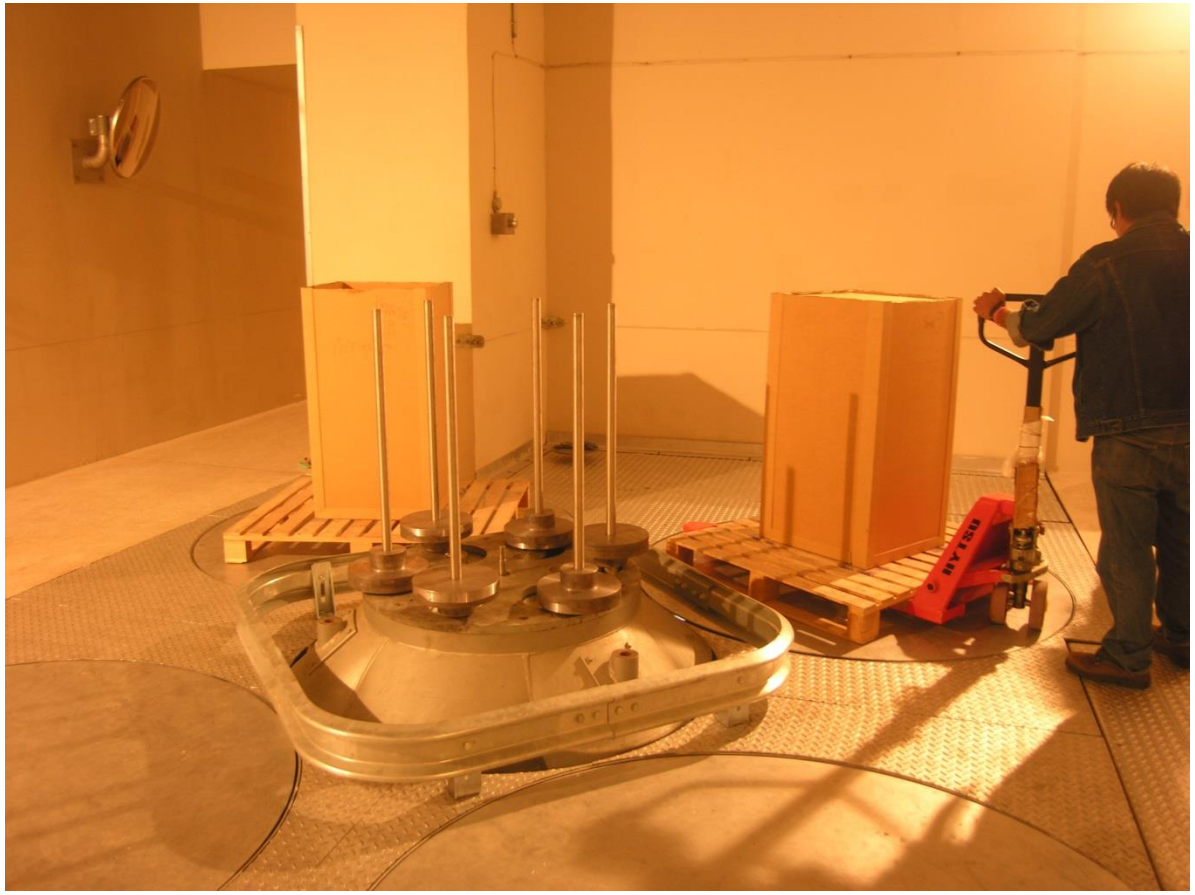


TINT: Gamma Chamber 5000 (India)

Gems Irradiation Center (GIC)

Thailand Institute of Nuclear Technology (Public Organization)

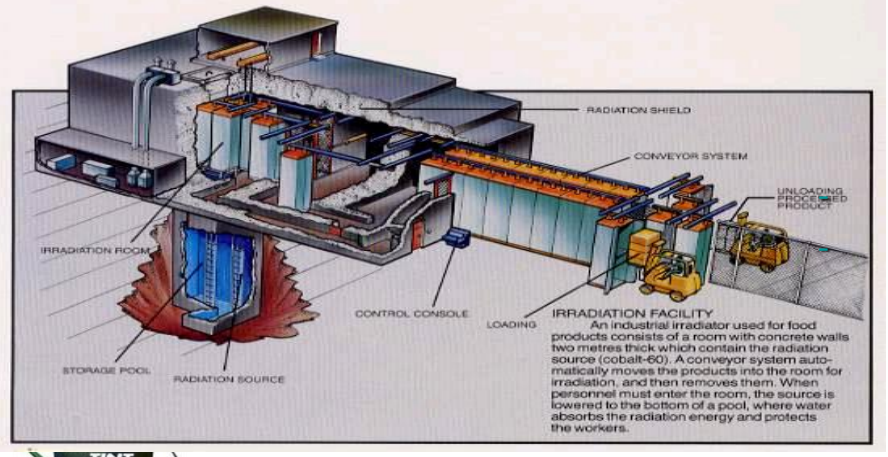
Gems Irradiation Center (GIC)



Gamma multipurpose irradiator, **Co-60, 70,000 Ci, England**

Nakhon Nayok Province

Thai Irradiation Center, Prathumthanee Province



Co-60, Canada, 400,000 Ci

E-Beam, Canada, 10 Mev, X-ray (5 Mev)
2019

TRR-1/M1 Reactor

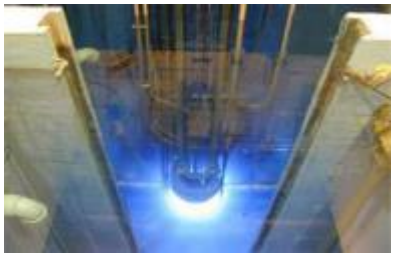
- Safely in operation since October 1962
- Main utilization :
  - Radioisotope production (mainly Sm-153)
  - Gems Irradiation (In-core irradiation)
  - Neutron Activation Analysis (commercial service)
  - Research (NAA/ Neutron radiography / Material irradiation, etc.)
  - Training and public education

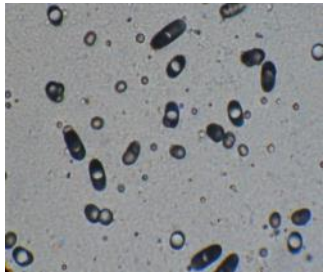
Utilization of TRR-1/1

Student training
(2 – 3 students/y)

Neutron activation analysis (100+ samples/y)

Gems coloration (~30 kg/y)





Research (2 – 3 projects/y)

Isotope production (Sm-152, P-32)

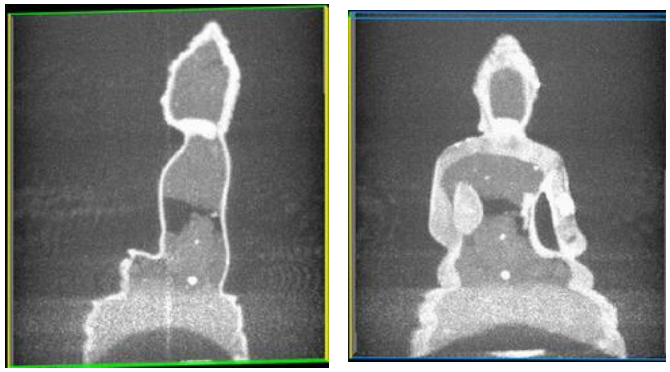
Technical tours
(1000+ persons/y)

Neutron Radiography (10 samples/y)

Training and public education

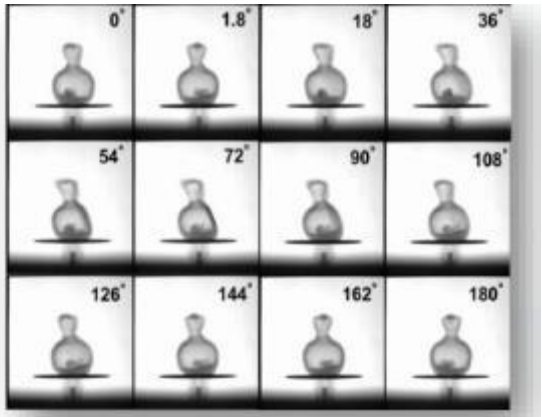
Neutron/X-ray for Cultural Heritage

Buddha statue



3D reconstruction of continuous 2D images at TINT reactor

Sample



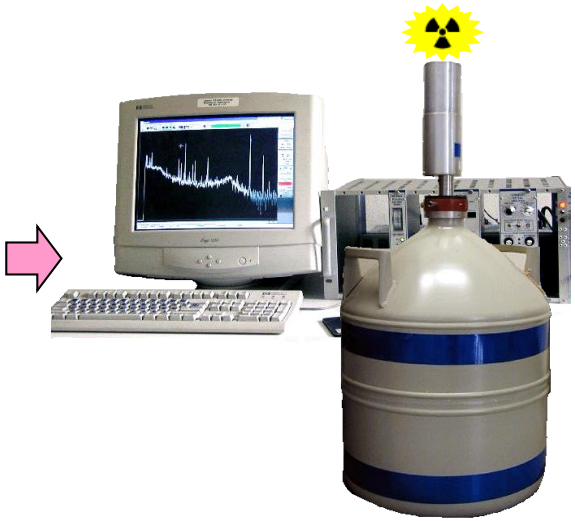
2D projections (101 images)

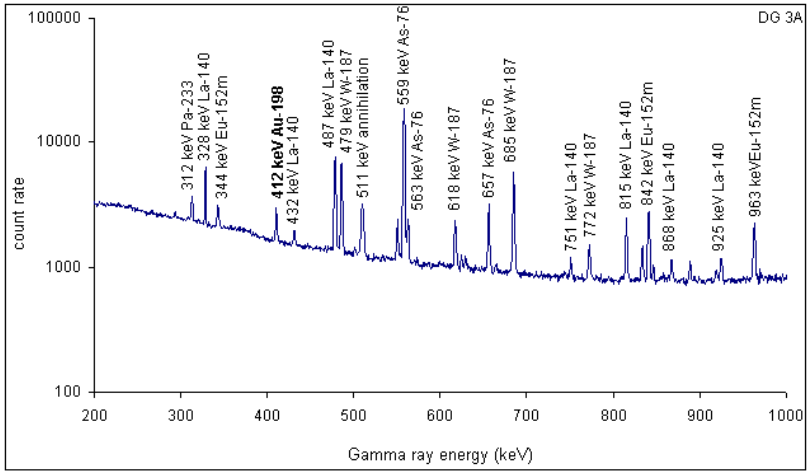
Internal structure revealed by digital section of the 3D image

Ancient decorative beads elemental composition by XRF

Neutron Activation Analysis (NAA)

- Minerals and Geological Samples
- Foods and Biological Samples
- Air Particulates





Nuclear and radiation research

Radiation Technology

Materials & Environment

- Isotope hydrology for natural resource management
- Development of rare-earth materials as biodiesel catalysts

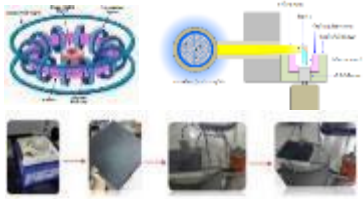
- Environment-friendly biodegradable polymers

- Chitosan development for plant growth enhancement and disease resistance

Biology & Health

- Crop and plant improvement (rice, chilis, mushrooms) to suit Thailand conditions.
- Sterile insect technique
- Medical radioisotopes.
- Fruit irradiation techniques for increased export.
- Medical products such as wound-dressing hydrogel.

Physics & Engineering



- Radon measurement in construction materials (safety) and in water (earthquake prediction).
- Plasma physics and magnetic fusion study.
- Neutron shielding material
- Neutron analytical techniques (Activation analysis, Radiography)
- Material corrosion inside nuclear reactors

Nuclear Technology

- Neutron activation analysis (NAA)
- Prompt Gamma Neutron activation analysis (PGNAA)
- Neutron Radiography (NR)
- Gems Irradiation
- Radioisotope Production
- Neutron Scattering (NS)
- Neutron field for detector calibration
- Corrosion of the material in the reactor
- Nuclear fusion study in magnetic field
- Predicting the impact of the nuclear power plant accident

Food irradiation

Irradiation of Herbs

Gamma and e-beam irradiation of herbs for cosmetic development

- Decontamination of microorganisms
- Maintain antioxidant properties

Plant Mutation Breeding

Rice breeding

- Fast neutron was used to produce a fragrant rice mutant that can flower in dry season.

Parent **Mutant**

Light sensitive **Light insensitive**

- Irradiation of seeds by gamma source (Co-60)

Production of Plant Growth Promoter from Chitosan by Radiation Processing

- **Higher yield**
- **Shorter harvest time**
- **Increase sweetness**

Production of Superwater absorbent (SWA) from Cassava Starch by Radiation Processing

- Increase survival rate of rubber trees
- Reduce watering
- Increase productivity

Radiation-induced Sterile Insect

Area-wide control of oriental fruit fly using SIT

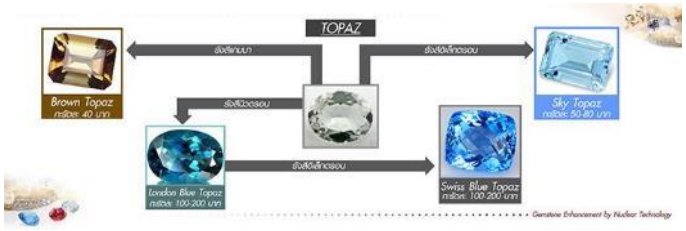
Field operations with >80% oriental fruit-fly population reduction

- **2008 – 2011: Khlung district, Chanthaburi**
  - Major produce: longkong
  - Operation successfully transferred to Department of Agricultural Extension
- **2011 – 2014: Long and Mueang districts, Phrae**
  - Major produce: milk jujube
- **2017: Wang Thong and Noen Maprang districts, Phitsanulok**
  - Major produce: mango, longan, plumage
- **Current: Nong Suea district, Pathum Thani**
  - Area: 1,600 hectares
  - Major produce: mango, tangerine, guava, banana
  - Funded by Integrative Provincial Budget

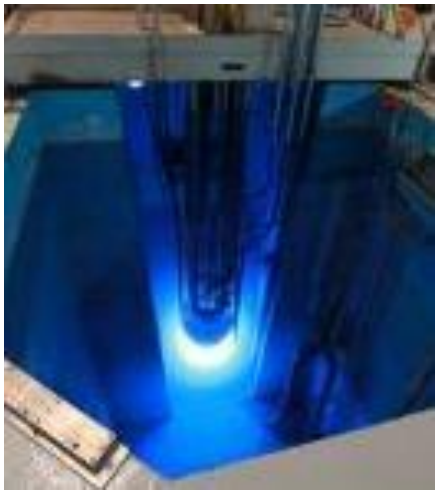
Exported Fruits to USA

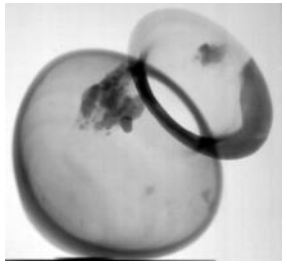




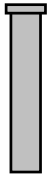




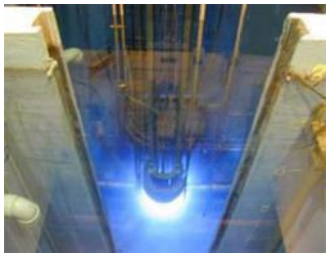




Nuclear and radiation technology services

Isotope Production



Target
Aluminium
container



Irradiated
by Reactor

Processed
in a hot cell

Radioisotope

- Radiopharmaceuticals
- Medical imaging and treatments
- Sm-153, I-131 etc.
- > 25 nuclear medical and cancer centers across Thailand

Thai Irradiation Center

- USA/ Australia/ New Zealand accredited for gamma irradiation treatment of fresh fruits for quarantine purpose
- EU accredited for treatments for spices
- ISO 17025 certified for
  - microorganism analysis
  - dosimetry

Irradiation and microorganism analysis

Co-60 Irradiator 400,000 Ci

Nuclear Technology Service Center

ISO 17025 TLD & OSL Laboratories

Gamma radiation field for calibration

- Distillation column scanning
- Radiography
- Elemental analysis
- Radioactivity and radionuclide measurements
- Radiation exposure dosimeter service
- Survey meter calibration

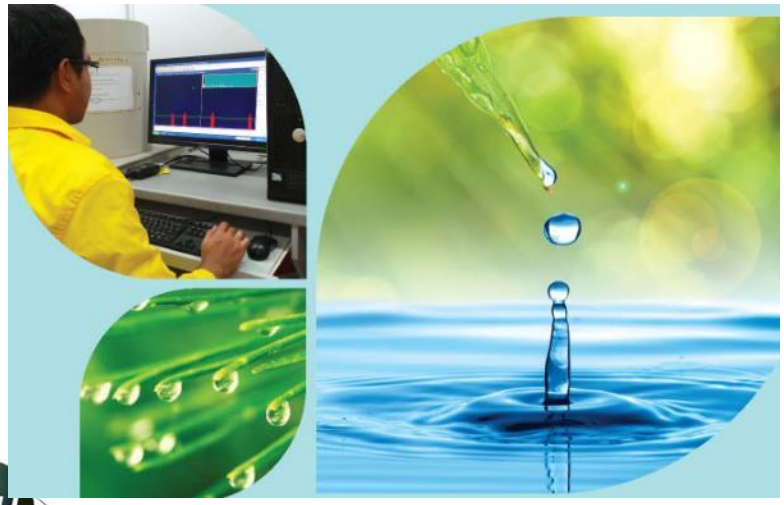





Radioactive Waste Management

ISO 14001 Environmental Management System

Radioactive waste management



- Radioactive waste management and storage
- Decontamination services
- Measurement of radioactivity in water

ISO 17025
Water Testing Laboratories

ASEAN cooperation and outreach

Asia-Oceania Neutron Scattering Association (AONSA) Meeting and ASEAN Neutron Symposium
Bangkok, Nov 2017

ASEAN Networks

- ASEAN Large Nuclear and Synchrotron Facility Network (LNSN)
- Objectives:
- 1. To develop an ASEAN network among large nuclear and synchrotron facilities and their users,
- 2. To promote the development and utilization of nuclear and synchrotron technology in ASEAN and
- 3. To promote human resources development in the field of nuclear and synchrotron science and technology as well as facility operation and management.

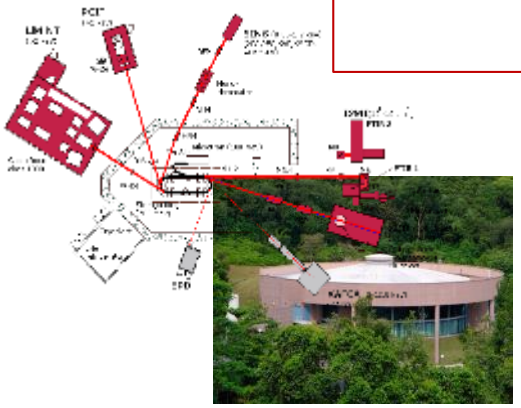
- ASEAN Network on Nuclear Power Safety Research (NPSR)
- Objectives:
- "To establish the research network for researchers in the field of nuclear power safety in order to contribute to regional capacity building, and help gain public trust toward nuclear power safety in all ASEAN countries"

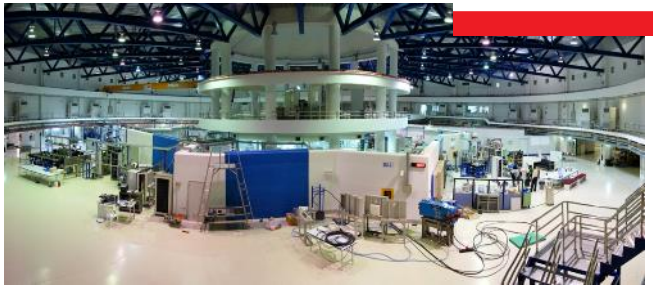
ASEAN Large Nuclear and Synchrotron Facility Network (LNSN)

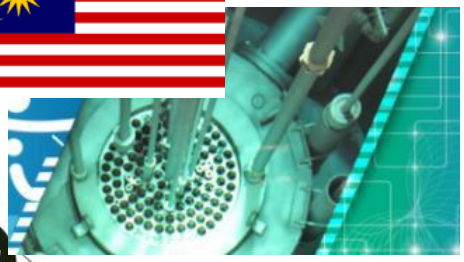
1. Synchrotron and Neutron sources are extremely useful for R&D.
2. In Asian-Oceania, synchrotron and neutron communities (AOFSRR and AONSA) have been established for sharing/helping each others.
3. Today, there are several facilities in SE Asia including synchrotron facilities, nuclear reactors for research and more in near future.

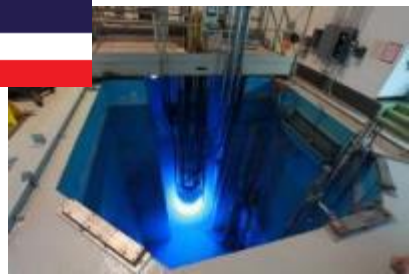
LNSN

ASEAN Platform for
Utilization of nuclear and synchrotron facilities
to enhance the competitiveness
Academics/ Industry/ Economy









ASEAN Network on Nuclear Power Safety Research (NPSR)

ASEAN NPSR shall facilitate:

Assessment of benchmark problems

Annual meeting

Knowledge and information sharing

Research collaboration

for researchers/practitioners.

Conclusions

- Nuclear and radiation research and services have long been used for the benefits of mankind.
- ASEAN Networks provide platforms for facility/knowledge sharing and research cooperation among ASEAN countries.
- The activities are aimed toward building public trust and promoting resource sharing among ASEAN members for regional competency development.


THANK YOU
FOR YOUR ATTENTION