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Implementation of Nuclear Materials Regulation in Thailand

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Abstract

Thailand is a member of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) from December 7, 1972. Thailand, as a non-nuclear weapon state (NNWS), signed and ratified the Safeguards Agreement (SG) with the International Atomic Energy Agency (IAEA) on May 16, 1974. Under the SG, Thailand is required to establish and maintain a state system of accounting for and control of nuclear materials. The Office of Atoms for Peace (OAP), as the nuclear materials regulator, was assigned to be the responsible group to co-operate with IAEA nuclear safeguards inspectors for annual nuclear materials inspection under SG. The main nuclear material is the spent fuel of the 2 MW TINT nuclear research reactor and the others are some nuclear materials in a small amount of some locations outside of facility (LOF). Thailand also signed the Additional Protocol (AP) relating to the SG on September 22, 2005. At present, the legislation processes are continued to approve the improved Atomic Energy for Peace Act draft to support the AP. Various activities of nuclear materials regulations are presented, as well as the concerning international conventions and treaties.

Keywords

nuclear materials, regulation, legislation, NPT, SG, AP

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1. Introduction

1.1 Importance of nuclear materials regulation

The overall objective of a State's nuclear security regime is to protect persons, property, society, and the environment from malicious acts involving nuclear material and other radioactive material [1, 2]. The regulatory authority needs to set up the measures following physical protection regime, i.e.

1) To protect against unauthorized removal
2) To locate and recover missing nuclear material
3) To protect against sabotage
4) To mitigate or minimize effects of sabotage

The primary factor in determining the physical protection measures against unauthorized removal is the nuclear material itself. Table 1 categorized the different types of nuclear material in terms of element, isotope, quantity and irradiation.

1.2 Overview of Thai nuclear materials regulation

On October 15, 1957, Thailand became the 58th member state of IAEA. After that, The Atomic Energy Act B.E. 2504 (1961), was promulgated and the Board of Atomic Energy for Peace was assigned to take responsibility with this Act. The Office of Atomic Energy for Peace (OAEP or OAP at present) was established to perform the regulations and the utilizations of nuclear and radiation facilities. On October 27, 2505, the nuclear fuel was installed in the cores of Thai Research Reactor-1 (TRR-1) and this research reactor was operated to first critical step. OAEP, at that time, had to take responsibilities both of the regulatory body and of the nuclear and radiation utilization and research and development. [3]

On April 20, 2006, the Thailand Institute of Nuclear Technology (Public Organization) referred to as TINT, was separated from OAP to work with TRR-1, research and development and other utilization activities. OAP takes a role as the regulatory body for nuclear and radiation facilities. [4]

For the regulation of nuclear materials, OAP has to co-operate with TINT for TRR-1 spent fuel and take responsibility with another LOF. It is the duty of OAP to report the Material Balance Report, Physical Inventory Listing, and Inventory Change Report to the IAEA according to the Nuclear Non-Proliferation Treaty and Safeguard Agreements ratified with IAEA. [5]

1.3 Nuclear facilities in Thailand

Nuclear facility is a facility (including associated buildings and equipment) in which nuclear material is produced, processed, used, handled, stored or disposed of and for which license is required [6]. In Thailand, there is only a 2 MW research reactor (Fig. 1) under the operation of Thailand Institute of Nuclear Technology (Public Organization), referred to as TINT. They keep some spent fuel (irradiated fuel, Category II) in the pond inside reactor building. Their nuclear security follows the "Atomic Energy Commission for Peace Proclamation on Regulation of nuclear security procedures for nuclear materials in storage facilities during operation, transport, or processing: B.E.2554".

However, at present, there is also a small project of a research reactor (less than 1 MW) installation in one of the universities. The nuclear power plant (NPP) installation project for electricity generation is still in reconsideration after it was abandoned for a while because of the Fukushima Daiichi NPP accident in Japan on March 2011.

There are also IAEA assistance activities related to the International Physical Protection Advisory Service (IPPAS Mission), to give advice about physical protection of the nuclear material in Thailand and to support the nuclear security in the building of the 2 MW Thai research reactor by surveillance camera installation. [7]

Table 1 - Categorization of Nuclear Materials

Material	Form	Category I	Category II	Category III[c]
1. Plutonium[a]	Unirradiated[b]	2 kg or more	Less than 2 kg But more than 500 g	500 g or less but more than 15 g
2. Uranium-235 (^{235}U)	Unirradiated[b] - Uranium enriched to 20% ^{235}U or more - Uranium enriched to 10 % ^{235}U or less than 20% ^{235}U - Uranium enriched above natural, but less than 10 % ^{235}U	5 kg or more	Less than 5 kg But more than 1 kg 10 kg or more	1 kg or less but more than 15 g Less than 10 kg but more than 1 kg 10 kg or more
3. Uranium-233 (^{233}U)	Unirradiated[b]	2 kg or more	Less than 2 kg but more than 500 g	500 g or less but more than 15 g
4. Irradiated fuel *(The categorization of irradiated fuel in the table is based on international transport considerations. The State may assign a different category for domestic use, storage and transport taking all relevant factors into account.)*			Depleted or natural uranium, thorium or low enriched fuel (less than 10% fissile content)[d,e]	

Note: This table is not to be used or interpreted independently of the text of the entire publication INFCIRC/225/Revision5 (IAEA Nuclear Security Series No. 13 – Recommendations).

[a] All plutonium except that with isotopic concentration exceeding 80% in plutonium-238.

[b] Material not irradiated in a reactor or material irradiated in a reactor but with a radiation lvel equal to or less than 1 Gy/h. (100 rad/h) at 1 m unshielded.

[c] Quantities not falling in Category III and natural uranium, depleted uranium and thorium should be protected at least in accordance with prudent management practice.

[d] Although this level of protection is recommended, it would be open to States, upon evaluation of the specific circumstances, to assign a different category of physical protections.

[e] Other fuel which by virtue of its original fissile material content is classified as Category I or II before irradiation may be reduced one category level while the radiation level from the fuel exceeds 1 Gy/h (100 rad/h) at one metre unshielded.

Fig. 1 TINT 2 MW Research Reactor

2. Safeguards Implementation

Thailand is a member of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) from December 7, 1972. Since then, the Bureau of Technical Support for Safety Regulation (BTSR), OAP, is the main organization to regulate nuclear materials in Thailand. Thailand, as a non-nuclear weapon state (NNWS), signed and ratified the Safeguards Agreement with International Atomic Energy Agency (IAEA) on May 16, 1974.

Safeguards are activities by which the IAEA can verify that a State follows its international commitments not to use nuclear programmes for nuclear-weapons purposes. The Nuclear Non-Proliferation Treaty (NPT) and other treaties against the spread of nuclear weapons entrust the IAEA as the nuclear inspectorate. Today, the IAEA safeguards nuclear material and activities under agreements with more than 140 States.

The activities that the IAEA inspectors perform during and in connection with on-site inspections or visits at facilities may include auditing the facility´s accounting and operating records and comparing these records with the State´s accounting reports to the agency; verifying the nuclear material inventory and inventory changes; taking environmental samples; and applying containment and surveillance measures (e.g., seal application, installation of surveillance equipment). [8]

Under the Safeguards Agreement, Thailand is required to establish and maintain a state system of accounting for and control of nuclear materials. [9] The main task focuses on the spent fuel of the 2 MW TINT nuclear research reactor. Besides that, there are some nuclear materials in a small amount in some locations outside of facility (LOF). Most of them are used for some research and development projects.

2.1 The co-operation between OAP and TINT during IAEA inspection

OAP (Thai regulatory body) has the authority to inspect nuclear materials under the safeguards agreement in connection with NPT. OAP, as the nuclear materials regulator, was assigned as the responsible group to co-operate with the IAEA nuclear safeguards inspectors for routine nuclear materials inspection in Thailand once a year under the Safeguards Agreement. [7, 10]

Since TINT is the operator of Thai facility (2 MW research reactor), for which the irradiated fuel (Fig. 2) is the special nuclear material, it is the responsible institute to report accounting records of all inventory changes, all concerning measurements, and all adjustments and corrections. TINT's reports, Physical Inventory Listing: PIL, and Material Balance Report: MBR, are delivered to OAP. If there is import and export of these special nuclear materials, the Inventory Change Report or ICR will be created and reported to OAP too.

OAP will inspect this facility first from TINT's accounting records and check nuclear material quantities together with all the detector devices by visual observation. They also inspect nuclear material storage and the measures of safety and security of this facility. Their inspection reports together with TINT's reports will be submitted to IAEA.

IAEA Nuclear Safeguards Inspector will inspect the facility (Fig. 3), TINT's research reactor, from the report obtained. They will investigate the irradiated fuel according to TINT's reports and perform the verification by other physical examinations on some important checkpoints that are declared in Subsidiary Arrangement. The counting of nuclear fuel rods and other items, which have nuclear materials in their composition, is also implemented.

Fig.2 Irradiated fuel rods kept in the pond of TINT 2 MW Research Reactor

Fig.3 IAEA Safeguards Inspection at TINT 2 MW research reactor

2.2 Additional Protocol Implementation

Under the Safeguards Agreement, Thailand signed the Additional Protocol (AP) on September 22, 2005. AP is a legal document granting the IAEA complementary inspection authority as provided in SG. A principal aim is to enable the IAEA inspectorate to provide assurance about both declared and possible undeclared activities. Under the Protocol, the IAEA is granted expanded rights of access to information and sites. [8]

The improved Atomic Energy for Peace Act draft to support the AP is still under the consideration of the Thai Council of State. There is also some preparation work ongoing for the Initial Declaration of the AP in advance, according to the article 3a of AP that requires a state to provide it within 180 days of the entry into force of the AP.

IAEA updated status on SG and AP of Asian countries is shown in Table 2. [11, 12]

Table 2 - SG and AP Status of Asian Countries (31 December 2014)

State	SQP	Safeguard agreements	Additional protocols		
			BOG Approval	Signed	In Force
Brunei Darussalam	x	In force: 4 Nov. 1987			
Cambodia	Amended : 16 July 2014	In force: 17 Dec. 1999	3-Jun-14		
Indonesia		In force: 14 July 1980	20-Sep-99	29-Sep-99	29-Sep-99
Lao P.D.R.	x	In force: 5 April 2001	4-Mar-14	5-Nov-14	
Malaysia		In force: 29 Feb. 1972	22-Sep-05	22-Nov-05	
Myanmar	x	In force: 20 April 1995	10-Sep-13	17-Sep-13	
Philippines		In force: 16 Oct. 1974	23-Sep-97	30-Sep-97	26-Feb-10
Singapore	Amended: 31 March 2008	In force: 18 Oct. 1977	20-Sep-05	22-Sep-05	31-Mar-08
Thailand		In force: 16 May 1974	20-Sep-05	22-Sep-05	
Viet Nam		In force: 23 Feb. 1990	6-Mar-07	10-Aug-07	17-Sep-12

3. Other related nuclear materials regulatory activities

3.1 National legislation work

The Atomic Energy Commission Proclamation, "Thai Atomic Energy Commission for Peace Regulation of nuclear security procedures for nuclear materials in storage facilities during operation, transport, or processing; B.E.2554 (2011)" [13] is applied for nuclear materials regulation. This proclamation is in connection with the IAEA publication "Nuclear security recommendations on physical protection of nuclear material and nuclear facilities (INFCIRC 225 Rev.5). [6]

There are also other concerning nuclear materials regulations and laws, as the following:

1) Ministerial Regulations for specifying the conditions of license request procedure and the management of special nuclear materials, source materials, by-product materials or atomic energy; B.E. 2550 (2007)

2) Atomic Energy Commission for Peace Proclamation on safeguards of nuclear materials non-proliferation; B.E. 2554 (2011)

3) Atomic Energy Commission for Peace Proclamations B.E. 2554 (2011) on:

a. License forms of nuclear materials and source materials
b. Permission period of nuclear materials and source materials license
c. Report forms of nuclear materials quantities in possession and in the case of being lost or damaged or being threatened to perform anything else to these nuclear materials
d. Transfer of permitted nuclear materials to store at another place, which is not identified in their licenses
e. Procedures of radioactive wastes treatment and return

4) Atomic Energy Commission for Peace Proclamations on the consideration criterions to issue the licenses of production, possession, or utilization and the licenses of importation and exportation of special nuclear materials, source materials, and by-product materials in urgent and necessary cases; B.E. 2556 (2013).

The improved Atomic Energy Act Draft to support 3S (safety, security, and safeguards) of nuclear and radiological facilities, especially for the regulation of the future NPP installation, has already been compiled and prepared by OAP and it is still under consideration by the Thai Council of State. After that, it takes time for the enactment and coming into force of the law.

3.2 International Conventions and treaties

Thailand has already signed the "International Convention for the Suppression of Acts of Nuclear Terrorism". At present, Ministry of Foreign Affairs and the other state agencies are performing all the concerning work to ratify this convention.

On March 20, 1997, Thailand signed the Bangkok Treaty to support South East Asia Nuclear Weapons-Free zone (SEANMFZ). Since that time, BTSR has conducted some domestic and international training courses and workshops on SG, nuclear forensics and nuclear security, every year, for the front line officers, i.e. soldiers, border patrol polices, forensic science polices, explosive ordnance disposal officers, customs officials, airport officers, and forensic science officers. [14]

In 2006, the Thai Subcommittee for setting up measures to control the proliferation of nuclear and radiation weapons of mass destruction appointed the working group on the Design Basis Threat (DBT) for nuclear and radiological facilities. This group has reviewed the DBT in 2014.

3.2.1 Protection of Nuclear Material under the Convention of the Physical Protection of Nuclear Material

States are obliged to protect nuclear material (NM) on their territories and during international transport, at levels specified in the Convention of the Physical Protection of Nuclear Material **(**CPPNM), i.e.:

- Annex I : Levels of protection by category of NM.
- Annex II: Definition of three categories of NM

Moreover, States are not to undertake transport/transits unless NM is protected at appropriate levels. Penalties are required under national law. [1]

A physical protection (PP) system is designed primarily to prevent access to a nuclear facility and its nuclear material by unauthorized persons (outsiders). Nuclear material accounting and control (NMAC) helps to deter and detect possible removal or misuse of nuclear material by authorized persons (insiders). Both systems, NMAC and PP, should be implemented, work effectively, and work together as in diagram of Fig. 4. [15]

IAEA also plays a role in co-operation with the Member States in combating illicit trafficking of nuclear materials and other radioactive sources. The four categories of their support are the following:[16]

a. Prevention, in the areas of legislation, physical protection, accounting for and control of nuclear material, control and security of radioactive sources, and export/import control;

b. Response, for assisting States to detect and respond to cross-border movements and to analyze confiscated materials and utilizing the Agency's data base on illicit trafficking;

c. Training, both prevention and response; and

d. Exchange of information, which is accomplished through international and interagency meetings and conferences.

Thailand is in the stage of performing to apply to be a member of CPPNM. At present, the draft regulation of the Thai Atomic Energy Commission on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC 225 Rev. 5 Implementation) has been already prepared and is under consideration by the Thai Council of State for approval.

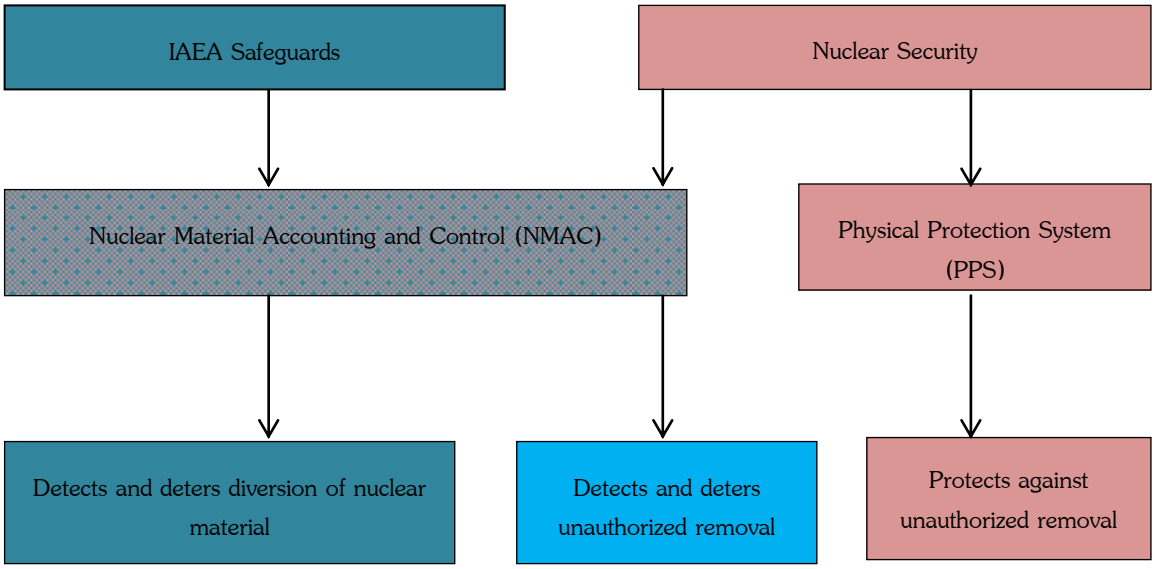

Fig. 4 The relation diagram between NMAC and PPS

3.2.2 Protection of Nuclear Material under the resolution of United Nations Security Council 1540

UN Security Council Resolution 1540 requires protection against the proliferation of weapons of mass destruction, i.e.:

- Prohibition of unauthorized persons from engaging in activities with nuclear weapons and material
- Criminal laws - punishment for offences.
- Accounting for and securing items and material
- Effective physical protection
- Effective border controls and law enforcement to detect, deter, prevent, and combat illicit trafficking
- Effective import/export regulations

As a member of the United Nations, Thailand has to follow the resolution of the United Nations Security Council 1540 (Non-Proliferation of Weapons of Mass Destruction). It is necessary to set the nuclear material regulatory system to control the manufacturing of nuclear, chemical, and biological weapons of mass destruction, as well as control of international transit and shipment. [1, 17]

In Thailand, there is a Subcommittee on Law and Regulation of Export Control for Dual-Use Items, which has the Deputy Director General of the Department of Foreign Trade as the Chairman and includes 14 members from 10 following agencies, i.e.:

1) Defence Industrial Department,
2) Department of Industrial Works,
3) Department of Agriculture,
4) Department of Medical Sciences,
5) The Customs Department,
6) Department of Treaties and Legal Affairs,
7) Department of Foreign Trade,
8) Law Reform Commission Office of the Council of state,
9) Office of Atoms for Peace and,
10) Office of National Broadcasting and Telecommunications Commission.

The Subcommittee on Law and Regulation of Export Control for Dual-Use Items is responsible for providing advice and guidelines on related export control law and regulation and how to draft or amend the export control law and regulation. [18]

This Subcommittee has already approved for use the list of controlled dual-use items of European Union, commonly known as the "EU List", which is used worlds wide as a guideline or reference for national control list. The latest version is the EU List 2012, which is included in the Regulation (EU) No 388/2012 of the European Parliament and of the council of 19 April 2012 amending Council Regulation (EU) No 428/2009 setting up a Community regime for the control of exports, transfer, brokering and transit of dual-use items.

These Dual-use Goods which are export controlled under the regulation of OAP (Ministry of Science and Technology) are source materials (uranium and thorium), special nuclear materials (plutonium with density of 233 or 235) and other by-product materials (all types of radioactive materials) under the Atomic Energy for Peace Act, B.E. 2504(1961). These are in Category 0 of EU List 2012, i.e. dual-use Goods export control Codes 0A001 and 0C001. [19, 20, 21]

3.2.3 Nuclear forensics laboratory set up

Nuclear forensics is the analysis of intercepted illicit nuclear or radioactive material and any associated material, which can assist in law enforcement investigations as well as assessments of the potential vulnerabilities associated with the use, production and storage of these materials as part of a nuclear security infrastructure. It provides information on the origin, history and manufacturer of nuclear and other radioactive material outside of regulatory control. As a result, it becomes an important tool to fight against illicit trafficking in nuclear and radiological material

Therefore, it is a capability for States to assess whether material encountered outside of regulatory control is or is not consistent with nuclear or other radioactive material produced, used or stored within the State.

In 2013, to support the law enforcement and nuclear security investigations in Thailand, BTSR established a nuclear forensics laboratory to investigate, analyze, and recheck the suspected nuclear materials or any suspected components for the arms control of nuclear weapons. Most of the assistance comes from European Union (EU). The responsibilities and job descriptions of this laboratory follow the Safeguards Agreement of NPT for the purposes of nuclear security of nuclear materials. [22]

4. Conclusion

The Thai 2 MW research reactor is in operation for more than 50 years. Thailand became a member of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) from December 7, 1972. Two years later, Thailand signed and ratified the Safeguards Agreement (SG) with the International Atomic Energy Agency (IAEA). Under the SG, OAP needs to perform the accounting for and control of nuclear materials, both for the spent fuel and LOF. The Additional Protocol relating to the SG has already been signed 10 years ago. The legislation work for approving the improved Atomic Energy for Peace Act draft to support AP and other nuclear materials regulation is ongoing. Some more work to protect nuclear materials under international Conventions and Treaties, i.e. CPPNM, are in process of legislative preparation and documentation for ratification. From the annual IAEA safeguards inspections together with OAP reports, based on nuclear materials accounting and control, there are only peaceful uses of nuclear materials and there are no undeclared nuclear materials and activities.

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infrastructure, operations, control systems, safety systems, health physicists monitoring, research reactor utilizations and so on, are also appreciated.

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