9. Recent Status on Decommissioning/Clearance in Thailand

9.1 Concept and Strategy of RWM

RWM Policy

In 1961, the first Thai legal instrument concerning nuclear energy, the Atomic Energy for Peace Act, B.E. 2504, was enacted and became effective on April 26, 1961. Both the Atomic Energy Commission (AEC) as a policy making organ, and the Office of Atomic Energy for Peace (OAEP) as its executive organ, have been established by virtue of this Act.

The fundamental principle RWM policy [1] is as follows:

- Radioactive Waste needs to be safely managed in accordance with internationally agreed principles;
- Reuse/recycle and minimization of radioactive waste should be taken to reduce the amount of waste generated;
- Radioactive Waste needs to be classified by method of treatment, conditioning and disposal;
- Appropriate Research and Development to support the operational and regulatory is needed.
- Spent Sealed Radiation Source should be returned to the supplier/ manufacture.
- Safety and Security of spent radiation source need the responsibilities of all parties, e.g. owner/licensee, regulatory body and the National Centralized Radioactive Waste Management Operating Organization.

Recently, in Thailand the nuclear institution has split into two organizations; the Office of Atoms for Peace (OAP), plays as the regulatory body and the Thailand Institute of Nuclear Technology (Public Organization) or “TINT”, where is a center of nuclear technology, research & development and service. The mission of radioactive waste management in Thailand has been assigned to the Radioactive Waste Management Center (RWMC), where is the only one centralized radioactive waste management facility in the country.

Most of radioactive wastes in Thailand are low level wastes (LLW) arising from the application of radioisotopes in medicine, industry, agriculture, universities, research institutes and other uses. The main wastes from the TINT itself come from the operation of the 2 MW research reactor, hot laboratories, and the production of radioisotopes, such as I-131, Tc-99m, and P-32.

At present, the radioactive waste management facilities are comprised of radioactive waste processing facilities and storage facilities. Low level solid wastes are treated by incineration and compaction. Low level aqueous wastes are treated by flocculation-precipitation. 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. Most waste forms and waste

packages are stored in the temporary storage facilities in the RWMC, TINT, in Bangkok.

RWM Concept

The concept of radioactive waste management in Thailand is the protection of human health and the environment. Radioactive waste is required to be managed in a manner that protects human health and the environment, now and in the future, without imposing undue burdens on future generations. The radiation expose of workers involved in the management of radioactive waste is required to conform for normal operation to the system of dose limitation laid down in the Basic Safety Standard. One aim of radioactive waste management is to minimize waste generation and to produce waste in a form that conforms to the requirements for subsequent handling, processing, transport and storage, and to meet the acceptance requirements for disposal. And the other aim is that the option selected may also result in waste or material that is suitable for return to a manufacture or supplier of radioactive material, to be recycled or discharged as liquids or gases to the environment under regulatory authorization, or for regulatory control to be removed from them as discrete entities.

RWM Strategy

1)The strategy for radioactive waste management in Thailand is as following:
2)Radioactive waste management should be carried out at a national waste management facility
3)Control of waste generation, such as minimization, reuse/ recycling of sealed radiation sources should be applied by users and waste operators.
4)The appropriated characterization and classification of waste should be established and applied according to the waste processing methods and the final disposal.
5)Management system should be established and applied by the user, waste operatorand the regulatory body.
6)Safety assessment and environmental impact assessment should be established and applied by the waste operators and the regulatory body.

Clearance practice

In 2003, the RWM regulation and guidance was first implemented under the Atomic Energy for Peace Act, B.E. 2504 (1961), so called “Ministry Regulation on Rules and Procedures of Radioactive Waste Management, B.E.2546 (2003). In this Ministry Regulation, the Clearance was written the definition in the article 1, as

“Clearance level” means a set of values, established by the Commission and published in the Government Gazette expressed in terms of activity concentration or total activity which can be released to environment. The clearance level was adopted from the IAEA-Tecdoc-1000, “Clearance of Materials Resulting from the Use of Radionuclide in Medicine, Industry and Research”.

The waste arising from regulated activities can be cleared from the regulatory control if the radionuclide content is below national established clearance level, so that, such waste represents negligible radiological hazards.

The users or operators will have a formal mechanism in place to demonstrate compliance with regulatory requirements in respect of clearance (removing material from regulated areas). There should be compliance with other requirements in respect of release from regulatory control regarding any other hazardous aspects of the waste (e.g. infectious or toxic properties).

Any radiation markings will be removed from any material to which regulatory control no longer apply, and markings will be removed from or covered on containers from which material subjects to regulatory control has been removed, or empty, clean containers normally use for carrying or storing radioactive material. Information on material from which regulatory control has been removed will be recorded and retained for examination by the regulatory body as required.

When building and sites will be decommissioned and before the removal of regulatory control, any residual radioactive waste will be properly managed, removed and transferred to an authorized storage facility. The facilities and sites will be decontaminated to the levels required by the regulatory body.

9.2 Planning for Decommissioning of Waste Treatment of Waste Treatment and Storage Facilities

Generally, the initial planning decommissioning plan should be prepared and submitted by the operator in support of the license application for the construction of the facilities. Due to our nuclear legislation has not been updated; the initial decommissioning plan has not been prepared. However, we try the best to prepare the decommissioning plan for our existing treatment and storage facilities in the Bangkok site. The plan will be included information on background radiological data for the existing facilities, the operating history of the facilities, as well as the significant abnormal events. The decommissioning plan should be submitted for the regulatory approval before final shutdown of the waste management facilities. For such small facilities as waste treatment and, storage facilities, a relatively simple decommissioning plan with a logical and adequate justification will be sufficient. Such a plan would include either immediate decommissioning after shutdown of the facilities or decommissioning after an appropriate period to allow for decay of short lived radionuclide. The schedule is drafted as shown in Table 1.

Main Tasks of Decommissioning Activity [(2)]

- Characterization of the facility

A survey of radiological and non- radiological hazards is an important input for safety assessment and for implementing a safe approach during the decommissioning activities. The characterization survey should depend on the type of facility being decommissioned. For example, the facility contains sealed radiation sources, the sources should be determined whether or not any sources have leaked. For facilities which use unsealed sources, a more comprehensive survey may be required to identify and locate any contaminated areas.

- Source Removal

The removal of sources will result in a reduction of radiation hazards. In the case of disused source storage facilities, this is easy to accomplish. But in case of sources are present in the form of liquid or contaminated surfaces, the method of removal may require more comprehensive planning.

- Decontamination

Decontamination is the removal or reduction of radioactive contamination in or on materials, items, buildings and area of facilities. Decontamination can lead to a minimization of the volume of the categories of material that will be classified or disposed of as radioactive waste. The overall decontamination strategy should be optimized, taking into account the benefits which result from reduced public exposure, reduced the additional exposures to the workers engaged in decontamination operations, the costs of operation, including treatment cost of generated wastes.

- Dismantling

Dismantling is one of the processes use during decommissioning, in order to reduce in size of the objects/components to facilitate their management, i.e. decontamination, handling, etc. In selecting the dismantling techniques, the consideration should be given to simplicity and reliability of the techniques and equipment, minimizing the generation of radioactive liquid and solid waste.

- Waste Management

A waste management plan, which is part of the decommissioning plan, should be developed giving consideration to the different categories of waste generated during decommissioning and to their safe management. Significant reductions in radioactive waste volumes can be achieved through decontamination, dismantling techniques, contamination control, sorting of waste materials, effective processing and, in some cases, administrative controls. Reused and recycle have the potential of reducing the amounts of waste to be managed. Similarly, the release of low activity materials from regulatory control (clearance) as ordinary waste or for reuse and recycling can also substantially reduce the amount of material which has to be considered waste.

- Final Radiation Survey

The decommissioning plan should include provisions for a final radiation survey, which is to ensure that the radiation protection objectives have been fulfilled. The survey data should be documented in a final survey report. This report should form part of the basis for the application for release of the facility/site from regulatory control. The results of the survey should be included the final decommissioning report.

- Staffing and Training

In some cases, contractors may be used to carry out all or some aspects of the decommissioning activities. This is likely to occur when decommissioning is deferred or when plant personnel may not have the required expertise. Financial considerations may also necessitate a greater use of

contractors. Examples of such activities include the use of specific decontamination processes and dismantling activities. Appropriate levels of control, supervision and training should be provided to ensure safely. The training of staff should be commensurate with the size, complexity and nature of the decommissioning activities to be performed. Personnel should be competent to perform their assigned work safely.

Table 1. The Planning of Decommissioning Schedule

Plan	2008	2009	2010	2011	2012	2013	2014	2015	2016
Personnel Training	→								
Decommissioning Preparation		→	→	→	→				
Decommissioning Activity					→	→	→	→	

9.3 Case Study on Decommissioning Plan of Incineration System

According to the TINT board's policy, the TINT is now planning to relocate at the new site; Ongkharak district, Nakhon Nayok province, where is about 60 km. north-east of Bangkok. Within the next 5 years, the radioactive waste management facilities will be re-located at the new site. So that the decommissioning plans of the existing radioactive waste processing facilities should be prepared. .

Due to the old age (20 years) of the incinerator (Fig 1) located at Chatuchak district, Bangkok; the decommissioning plan is under consideration. The main problems of the incineration system are corrosion, and some broken parts. The filter bag system has to be changed. So that, the proper maintenances are often performed, and the cost is related high. The corrective operation is advised to the incinerator operations, to ensure the low fuel consumption rate and extend the life span of the incinerator. However, we plan to have a new incineration system at the new site, Ongkhrak within 2-3 years, so that the decommissioning plan of the old incinerator is indeed to prepare.

The consideration of the different categories of waste produced during the

decommissioning activity should be taken by operator as well as the estimation of amount of waste generated by decommissioning of the existing incineration system at RWMC in Bangkok (Fig.2) is assumed as shown in Table 2.

Table 2 Estimation of Amount of Waste Generated by Decommissioning of the Incineration System at RWMC, TINT, Bangkok.

Type of Waste	Amount (Ton)
Concrete	110
Metal (stainless steel and steel piping)	3.5
Brick	10
Ceramic tile	0.32
Teflon Bag Filter	0.2
Miscellaneous	0.1
Total	124.35

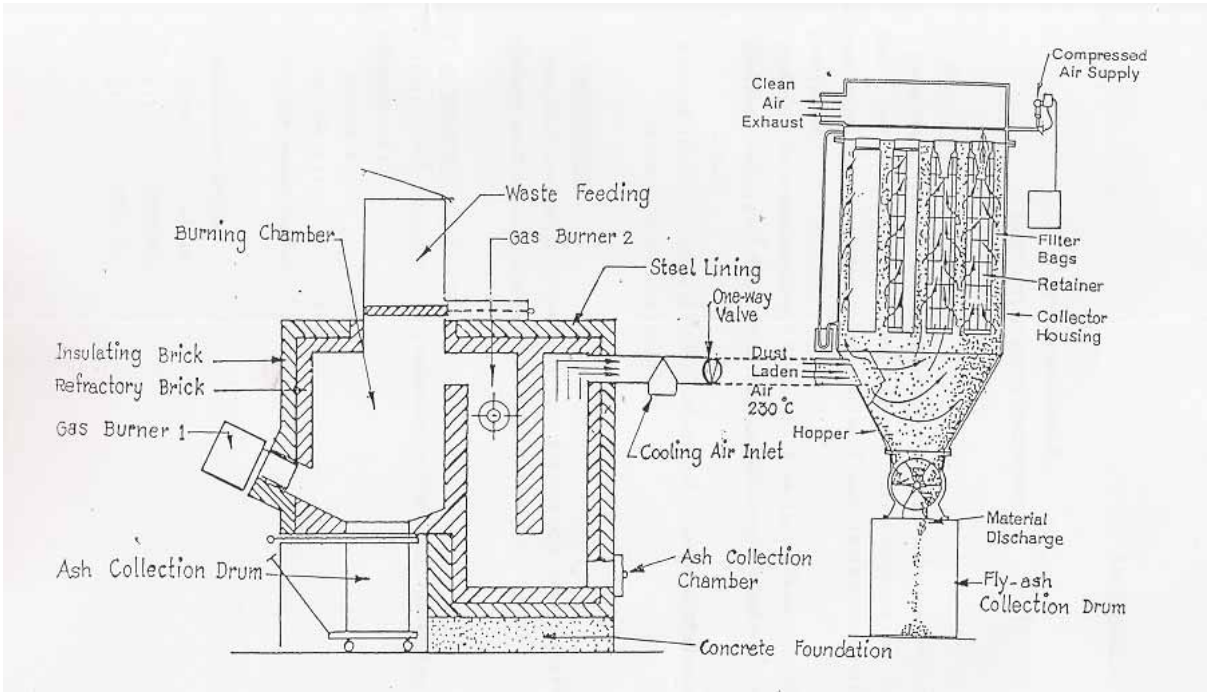

Fig. 1 Drawing of Incinerator with Off-gas System [(3)]

Fig. 2 the Existing Incineration System (Case Study of Decommissioning)

Management of Decommissioning Waste

The optimization of waste management technology and minimization of cross -contamination and secondary waste generation are considered for the next step. Thus, radioactive waste processing and storage facilities at the new site will be prepared in advance by considering the production amount and production rate of decommissioned wastes. For waste handling, the waste processing and storage facilities at the new site will provide to the decommissioning waste management. The volume of waste can be reduced by mechanical, thermal and chemical methods. Decommissioning waste will be fixed into cement or appropriated containers before shipment to the disposal site or the temporary storage. Estimation the volume of the treated waste would be less than 100 cubic meters, or less than 500 drums (200 liter drum). Radioactive wastes generated from decommissioning shall be stored safely at the new waste storage facility at the new site; the capacity of the new storage facility is about for 2500 drums (200 liter) storage.

However, the decommissioned waste management should be required by the related-regulation and the criteria of industrial safety. Decommissioned waste should be disposed or reused by classifying as radioactive waste and general waste by Clearance Level of Decommissioning Waste (which is not yet established).

9.3 Problem to be solved

The decommissioning plan shall be reviewed and updated with the regulatory requirements. The national regulatory authority should provide guidance on radiological criteria for the removal of materials, facilities and sites from regulatory control. The necessary waste management systems, including storage and/or disposal facilities, should be established to cope with the decommissioning waste before starting decommissioning activities

A waste management plan, which is part of the decommissioning plan, should be developed giving consideration to the different categories of waste generated during decommissioning and to their safe management. Significant reductions in radioactive waste volumes can be achieved through decontamination, dismantling techniques, contamination control, sorting of waste materials, effective processing and, in some cases, administrative controls. Reused and recycle have the potential of reducing the amounts of waste to be managed. Similarly, the release of low activity materials from regulatory control (clearance level) as ordinary waste or for reuse and recycling can also substantially reduce the amount of material which has to be considered waste.

The insufficient appropriated regulations in relation to the safety of radioactive waste management should be solved. The requirements for the regulatory body are to develop and update waste management regulations, to provide advice on development, interpretation and application of legislation, to ensure that standards and criteria relating to the safety of facilities, processes, and operations for radioactive waste management are established, including handling, processing, storage and disposal; these should address acceptance of waste packages for disposal in existing and planned facilities.

9.4 Conclusion

The Ministerial Regulation on Rules and Procedures of Radioactive Waste Management, B.E.2546 was established and implemented; the main content is the guideline for waste generators to follow the rules and procedures. Since Thailand does not have any specific regulation on disposal and radioactive waste management operations. All users of radioactive materials are required to be responsible for the wastes they produced. The Radioactive Waste Management Center, TINT has the responsibility to provide services in the radioactive waste management.

In the near future, the working place and personnel of TINT will be relocated at Ongkharak site within 5 years due to the board's policy. The development of radioactive waste management facilities is therefore projected and focused on the new waste processing and storage facilities at the new site. For the existing facilities, which are needed to consider for decommissioning. The case study of decommissioning of incineration system at RWMC in Bangkok has been set up for the first decommissioning activity of nuclear facilities at the OAP area, Bangkok. The arising of waste from decommissioning activity is estimated by operator as well as the preparation of decommissioning technology. The cost estimation is also very importance. Furthermore it is necessary to examine in detail verification methods when establishing a regulatory system including clearance levels. The decommissioning plan shall be reviewed and updated with the regulatory requirements. Therefore, it would be appropriate to discuss the establishing of effective guideline or practical manual, prior to the actual implementation and application of the clearance. Finally, international cooperation and information exchange shall become important to establish clearance levels and regulation system acceptable.

9.5. References

(1) IAEA, *Predisposal Management of Radioactive Waste Including Decommissioning Safety Standard Series No.WS-R-2,* IAEA, Vienna (1999)

(2) IAEA, *Decommissioning of Medical, Industrial and Research Facilities Safety Standard Series No.WS-G-2.2,* IAEA, Vienna (1999)

(3) S. Thiangtrongjit, K.Visavakorananta, and P. Yamkate, *Upgrading of Radioactive Waste Incinerator,* OAEP, Bangkok (1993)