10. Recent Status on Decommissioning/Clearance in Vietnam

10.1 Policy and Practice of RWM

1) RWM Policy

In the past ten years, the radiation and radioisotopes were intensively and broadly applied in the different sections of the national economics such as health care, industry, agriculture, research and education. Together with the development of nuclear techniques in our country, the radioactive waste is increased.

The majority of radioactive waste arisen from:

- The activity of nuclear research reactor
- Uranium waste created in the uranium processing
- Radioactive waste contained radioactive elements after monazite treatment

The remaining of radioactive waste comes from radioactive sources used and disused in research, industry and medical profession.

According to Ordinance on Radiation Control and Safety, the government of the Socialist Republic of Vietnam set the policy about the peaceful use of atomic energy and radioactive waste management as follows:

- Radioactive waste must be controlled and safety managed in accordance with internationally agreed principles
- Radioactive waste need to be classified and then treated by suitable methods before conditioning and disposal
- Minimization of radioactive waste generation

2) RWM Practice

a) Legislative Framework

Generally, Vietnam legislative framework on radiation protection & control as shown in Fig.1. The main legal documents concerning the safe use of ionizing radiation as follows:

- Ordinance on Radiation Safety and Control (ORSC) was passed on June 25, 1996 by the Standing Committee of the National Assembly of the Socialist Republic of Vietnam and went into effect on January 1, 1997. There are eight chapters with 38 articles in this ORSC.
  - Decree 50/CP/1998 on the detailed direction for implementation of ORSC. This Decree was enacted on July 16, 1998 by Prime Minister and went into Effect on August 1, 1998. There are seven chapters with 49 articles in this Decree.

Fig.1 Vietnam Legislative framework concerning radiation protection and control

- Decree51/CP/2006 on the Punishment on violation of the ORSC and Decree 50/CP/1998. This Decree supersedes Decree 19/CP/2001, the former Decree on the Punishment on violation of the ORSC and Decree 50/CP/1998. This Decree was enacted on May 11, 2006 by Prime Minister. There are five chapters with 38 articles in this Decree.

- Circular/Regulation on radiation protection:
  - On December 28, 1999, two Ministers of the MOSTE (Ministry of Science, Technology and Environment) and MOH (Ministry of Health) enacted the Ministerial on Guidelines for implementing Radiation Safety in Medical Practices
  - Safety Regulation for ionizing radiation TCVN 4397-87: Before enacting of ORSC, in 1987 Safety Regulation for ionizing radiation TCVN 4397-87 was issued by the Minister of MOSTE in series of Vietnam standard TCVN. It went into effect on January 1, 1988.
  - Regulation for Safe Transport of Radioactive Materials-TCVN 4955-89 was enacted by MOSTE on December 25, 1989, and went into effect on July 1, 1990.
- Safety Standard, Safety Requirements, Code of Practice and Guidelines
  - Radiation dose limits for radiation worker and public TCVN 6866:2001
  - Safe Management and Treatment of Radioactive Waste – Classification of Radioactive Wastes TCVN 6868: 2001
  - Radiation Protection – Medical exposure, general provisions TCVN 6869:2001

- Exemption of Radiation Sources and Practices from Regulatory Control TCVN 6870:2001

b) Organization and Responsibilities for the Radiation Protection Management

The Ministry of Science Technology and Environment (now it is renamed Ministry of Science and Technology (MOST)) has been assigned as the regulatory body under the Article 29 of ORSC and the Article 34 of Decree 50/1998/ND-CP. To assist minister of MOST in State management of Radiation Protection and Nuclear Safety, Vietnam Radiation Protection and Nuclear Safety Authority (VRPA) was established by the Decision No. 389/TTg of the Prime Minister of July 30, 1994 and Decision No 159/QD-TCCB of Minister of MOST of March 4, 1995.

To ensure that the state management on atomic energy promotion is more independent from the state management of radiation protection and nuclear safety, VRPA was upgraded into Vietnam Agency for Radiation and Nuclear Safety & Control (VARANSAC) by the Governmental Decree 54/2003/ND-CP and Decision 1073/QD- BKHCN dated June 20, 2003 of MOST. At present time, diagram of State Management in Radiation and Nuclear Safety & Control (new version) was demonstrated as Fig.2. Where MOST is a regulatory body responsible to government for the execution of unified state management on radiation safety and control throughout the country, responsible for organizing and directing all radiation safety and control activities within the scope its function and duties. VARANSAC assists MOST in performing the function of state management of radiation protection and nuclear safety according to the function, and responsibilities of the new agency were defined in the Articles 34 of the Decree 50/1998/ND-CP and Decree 54/2003/ND-CP. According to the article 42 of the Decree 50/CP the Departments of Science and Technology (DOST) of 64 provinces /cities under direction of MOST are also involved in the provincial management of radiation protection in its province such as issuing a license for diagnostic radiology departments and reporting regularly to MOST via VARANSAC. Under direction of the MOST, besides the state function of atomic energy promotion, VEAC is mobilized to assist the VARANSAC on the following aspects:

- Performing the technical radiation protection services such as calibration, personal dose monitoring...
- Reviewing SAR
- Doing safety assessments, analysis;

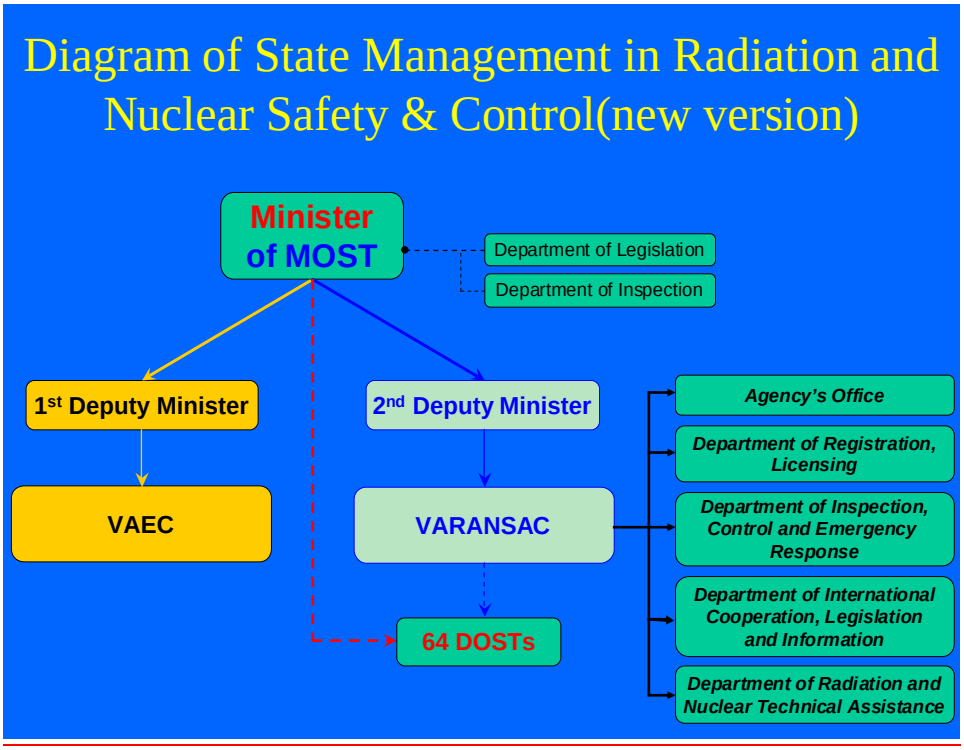

Fig.2 Diagram of State Management in Radiation and Nuclear Safety & Control

3) Decommissioning and Clearance strategy

Previously, following the old soviet union standards, the old clearance level of the radionuclides were regulated in the Safety Regulation for ionizing radiation TCVN 4397-87. At present, the final version of draft of an Atomic Energy Law is being reviewed and expected to be submitted to the National Assembly in the end of 2007. In this law, the clearance system and decommissioning of the nuclear facility are introduced. The ordinance under this law will adopt the values provided by IAEA safety guides. Up to now Vietnam standard TCVN 6870:2001 on Exemption of Radiation Sources and Practices defines exemption values for the radionuclides which are based on the IAEA Basic Safety Standards 115. Introduction of clearance for the waste from NORM, research and medical facilities is now under discussion.

Furthermore it is necessary to evaluate the calculation methods carefully when establishing a regulatory system including clearance levels. 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 play the important role in establishing of clearance levels and regulation system acceptable to public. In Vietnam there are two national centers, one belongs to Institute for Technology of Radioactive and Rare Elements (ITREE) responsible for management of radioactive waste in the northern region, the another belongs to Dalat Nuclear Research Institute and responsible for management of radioactive waste in the southern region. To strengthen the technical infrastructure of radioactive waste management

in Vietnam, these centers have been upgrading recently.

In Institute for Technology of Radioactive and Rare Elements (ITREE):

+ The new equipment for treatments of radioactive waste such as: compact compressor, evaporator, ion exchange column have been provided.

+ The treatments of some kinds of radioactive contaminated materials have been conducting in new facility of radwaste treatment.

+ Our proposal for Technical Co-operation Project on upgrading laboratory of RWM in ITREE was approved in 2007. The staffs of ITREE are ready to perform this project.

In Nuclear Research Institute (located in Dalat province):

+ Replacing the fuels of high enriched uranium (HEU) by fuels of low enriched uranium (LEU) have been done successfully thank to the close cooperation with US and Russian scientists

+ Although we can prolong the activities of Research Reactor until 2020, now we start to study on decommissioning of this Research Reactor in the future.

In addition to that, due to understanding the risks of storage of the disused radiation sources in many different facilities, VARANSAC submitted the plan to build the national facility for storage of the disused radioactive sources. When the construction of this national facility have finished, all the disused radiation sources including the orphan sources will be stored in this location to ensure the radiation safety and security absolutely for public.

10.2 Case Studies on Decommissioning/Clearance_

1) Pilot Plant and Temporary Storage Facility at Phung

Institute for Technology of Radioactive and Rare Elements (ITREE) is responsible for treatment and management of all kinds of radioactive waste in the Northern region of Vietnam. The Phung Interim Storage Facility is operated by ITREE, and is located about 25 km west of Hanoi. In this site there is a monazite pilot plant that was constructed in cooperation between Vietnam and India. This plant put in operation in 1992 and shutdown in 2001 due to low demand of rare earth elements in Vietnam. The Phung Interim Storage Facility now belongs to Center of RWM, which was established 3 years ago and has 15 staffs. Previously this center had only two concrete tanks to store the untreated wastes, but the ground level of the tanks was about 2 meters below from the surrounding ground level. This may cause the danger for surrounding public and environment due to the potential flooding of this area during the rainy season. Following the technical advices from former FNCA Task Group on TENORM, ITRRE already filled up with soil the area under the tanks and now the ground level is higher than 2 meters. The temporary vault for untreated radwaste, the plant for treatment of radwaste and the new radwaste storehouse were built. The plant for treatment of radwaste has been provided with the new equipment as compact compressor,

evaporator, ion exchange column.... The main radioactive waste has been stored since 1981 brought back from mines including uranium ores, uranium tailing, and wastes from monazite processing. A part from that, radwaste from research activities was also treated here. Radwaste was treated and conditioned in drums and then stored in the new radwaste storehouse, up to now there are 645 drums of radwaste stored in this house. FNCA Task Group on Decommissioning/Clearance has measured the radiation dose rate in this facility. The typical radiation dose rates measured in different locations inside the Center are as follows:

+ Inside the clothes exchange room: 0.12 µSv/h

+ RW Treatment Plant building: 0.16 µSv/h inside the building and outside 100 meters from the door it is 0.14 µSv/h. At surface of the 1st Drum: 0.34 µSv/h; at surface of the 2nd Drum: 0.50 µSv/h (near the Ion exchanger); at surface of 3rd Drum (40 ton-packing compressor): 2.3 µSv/h; at surface of liquid evaporate equipment: 4.4 µSv/h.

+ Untreated Temporary Vault: outside surface of the wall: 0.54 µSv/h

+ Temporary RW Storage: at the door: 2.08 µSv/h; center of the room: 5.7 µSv/h; at surface of the 1st Drum: 16.5 µSv/h; at surface of the 2nd Drum: 30 µSv/h;

+ Monazite Pilot Plant (shut down in 2001): at the entrance gate: 0.16 µSv/h

+ Outside: brick: 0.15 µSv/h; Ash of ZnO: 0.07 µSv/h;

+Background of facility (Entrance gate of facility): 0.05 µSv/h

The Center has a plan to re-build with the layout divided into 3 areas: Uranium Processing Pilot Plant and R.W. storage (radioactive areas) and the ZnO production area (non-radioactive area). *Plans for decommissioning and clearance of Monazite Pilot Plant haven't been set up yet.*

Temporary Radioactive Waste Storage at Phung

The radioactive treatment plant

2) Danang General Hospital

Hospital was established in about 1967. It has currently 860 planned beds and 1500 operating beds with about 2000 patients.

Employees: 1026 people, Medical Doctors: more than 300 in which more than 80% are graduate level (Masters, PhDs).

There are 2 Departments related to utilization of the radioactive materials which are Oncology Department and Nuclear Medicine Department.

At present time the Nuclear Medicine Department is using 2 radioactive sources: Tc-99m and I- 131 and Oncology Department used to use the Co-60 source. Now this source is very old and low activity (0.8kCi). The Co-60 teletherapy machine is PICKER-C9 and it is already too old so now stopped being used. However there is no expert to decommission this equipment. According to MOST policy the disused sources should be returned to the supplier (vendor). However this source although originated from Canada but came to Danang hospital as gift from World Vision Organization of Australia, so hospital could not send back this source to Australia or Canada. Now hospital wants to replace this old machine by new equipment, and they intend to de-assembly this machine and bury this source in concrete tank under soil by themselves. The decommissioning/clearance group advised them that they must submit their official decommissioning plan of this machine to VARANSAC and Danang DOST and have to wait for their plan to be approved by VARANSAC; they can only start decommissioning this machine after they already have the approval for this from VARANSAC.

In 2006, at Nuclear Medicine Department, besides diagnosing task, 107 basedow patients and 4 thyroid cancer patients were treated. There is only a simple regulation for patients coming for treatments in this department.

In future the hospital will build a new Oncology Center and will purchase 2 new linacs of Phillip and 1 Co-60 teletherapy equipment from Canada. This is funded by an American NGO named East meets West Organization.

The cobalt teletherapy room with the very old Co-60 source

Co-60 Source in Danang General Hospital has not been used since 2002

3) Thanh Tam Co. Ltd. in Quang Nam province (Monazite beach sand processing)

THANH TAM Co., Ltd was established in 2003 in Quang Tri province and the Quang Nam Branches were set up last year. In Quang Tri, they have 2 sand exploiting factories and 1 sand refining factory with 200 employees in total.

In Quang Nam, they have 1 sand exploiting factory with 100 employees and 1 sand refining factory with 50 employees. Given the information of that currently there are about 7 factories operating in Quang Nam amongst 13~14 factories registered. They are planning to set up a new branch in Binh Thuan province.

The sand exploiting factory has a capacity of 40 ton/day with 7 segregating machines, is located in an area of 35.000m^2 rented from an Army base. The process of exploiting sand is as follow:

They dig 4~7m underground and pump the natural sand intake into the segregating system to get black sand as their semi finished product. After several times of segregation within segregating system, the remaining sand will be returned to sand beach.

The sand refining factory has a capacity of

+ Ilmenite: 10 ton/day
+ Zircon: < 0.5 ton/day
+ Rutile: 0.3 ton/day
+ Monazite: several kg/ day

FNCA Task Group on Decommissioning/Clearance has measured the radiation dose rate in this facility. The typical radiation dose rates measured in different locations inside the Center are as follows:

At the exploiting factory (1st factory):

+ at surface of original natural sand: 0.1 µSv/h
+ at surface of the segregating machines: 0.2 µSv/h
+ at surface of the black sand (the product at this stage, then to be refined): 2 µSv/h
+ at surface of the remaining sand (to be returned to the beach): 0.05 µSv/h
+ at working area of workers: 0. 2 µSv/h

At the refining factory (2nd Factory)

+ Inside the building: at the surface of the semi finished mixed material (Ilmenit+Zircon +Monazite + Rutile): 6.4 µSv /h
+ at the surface of the pack of Ilmenite (53%): 0.68 µSv/h
+ at the surface of 1st step exploited Rutile: 2.0 µSv/h (outside, behind of the building)
+ at the surface of drying Rutile ship: 1.0 µSv/h (outside of the building)
+ at the surface of finished products of Rutile: 0.8 µSv/h

+ at the surface of (Zircon + Monazite + rutile) materials: 4.0 µSv/h

+ at the surface of (Zircon + Monazite) : 6.4 µSv/h

+ at the surface of Finished products in the storage: Zircon: 4.0 µSv/h;
Ilmenite: 0.7 µSv/h; Monazite (Outside): 60-70 µSv/h

+ Background in facility office: 0.15 µSv/h

+ at the surface of Waste Sand (Outside): 0.2 µSv/h

+ at the surface of Sand under a tree: 0.06 µSv/h

Sand was pumped from pond to segregating equipment

Sand segregating system

Black sand after primary segregation

The storage of finished monazite product

The view of site after returning the remaining sand and vegetation

10.3 Problems to be Solved

It is most important that the clearance system and decommissioning of the nuclear facility must be regulated by law and performed according to the specific guidelines of decree under law. This is expected to be solved soon by the Law of Atomic Energy to be approved by Nation Assembly by the end of 2007 and the following decree of Prime Minister.

Due to the lacking experiences of determination the clearance level and decommissioning the nuclear facility so the development of manpower for these issues as well as training people in the related fields are very important for Vietnam. We hope we can overcome these difficulties by the strong support from IAEA and close cooperation with FNCA countries especially with Japan which country has a lot of experiences in these fields.

In near future, in our country there will be new cyclotrons, research reactor and more the big nuclear departments, which are going to generate the many kinds of radioactive waste. So safe management of medical waste including the treatment and clearance of this waste become very important and should be considered carefully.

About 2020, the Dalat nuclear research reactor will be shutdown and then decommissioned later, but at that time almost the senior staffs who commissioned and have been working here for long time will retire. So now we have to strengthen the management of

the historical operating data of research reactor and recording and archiving in logbooks & other documents to serve for decommissioning task in future.

10.4 Conclusion

The infrastructure of radioactive waste management in Vietnam already was upgraded step by step. However according to Strategy for Peaceful Utilization of Atomic Energy up to 2020 by Vietnam Government, January 3, 2006 and performed plan just approved by Prime Minister July 23, 2007 the nuclear power station will be introduced in Vietnam by 2020. In order to get public consent on nuclear power plant the safe management of radioactive waste in Vietnam should be enhanced strongly. So Decommissioning and Clearance strategy should be improved to foresee and meet the requirements of decommissioning the nuclear facilities in the future. Together with the increase of number of the facilities related to nuclear techniques as research laboratories, nuclear medicine departments, industrial enterprises ... the level of radwaste also increases much larger so the practical clearance system for these facilities becomes very important. Strong support form IAEA and the exchange of information and provision of technical assistance from FNCA countries are very necessary and useful for Vietnam to strengthen the Decommissioning and Clearance issues.