NEWSLETTER

RADIOACTIVE WASTE MANAGEMENT

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The FNCA 2003 Workshop on Radioactive Waste Management

December 15-19, 2003, Jakarta, Indonesia

The National Nuclear Energy Agency of Indonesia (BATAN) and the Ministry of Education, Culture, Sports, Science and Technology (MEXT), and in cooperation with the Japan Atomic Industrial Forum, Inc. (JAIF) hosted the FNCA 2003 Workshop on Radioactive Waste Management from December 15 to 19, 2003, in Jakarta, Indonesia. Participants from the nine countries under the FNCA framework, i.e. Australia, China, Indonesia, Japan, Korea, Malaysia, the Philippines, Thailand, and Vietnam got together for five days to exchange opinions through presentations and discussion. The backgrounds of those representatives are policy making, regulation, and R&D on radioactive waste management. Total 40 persons (foreign and local) attended the Workshop.

On the First Session of the first day, each country presented their current status and progress of radioactive waste management activities. On the first and second day, posters on management of radioactive waste from hospitals were presented by Indonesia and Japan delegations. Other poster presentations were also made from Australia and Japan to introduce industrial level technologies in relation to radioactive waste management.

At the Second Session on the second day, a round table discussion was made on the "Joint Convention on Safety of Spent Fuel and Safety of Radioactive Waste Management" under the discussion topic "Correspondence to International Trend".

At the Third and Fourth Sessions on the second day, sub-meetings were held on "Disposal of LILW including waste acceptance criteria" and "Management of waste arising from decommissioning of small to medium scale nuclear facilities" respectively.

On the third day, technical visit to Serpong Site of BATAN was made, where the participants visited the research reactor and the radioactive waste management facilities on the site.

On the fourth day, a sub-meeting on the Interim Report of the Task Group on TENORM (Technologically Enhanced Naturally Occurring Radioactive Materials) was held to exchange technical information and experiences.

Relevant issues on the practical application of the concept of exclusion, exemption, and clearance on NORM/TENORM management were discussed. The following points were agreed upon:

- NORM/TENORM management is a common concern among FNCA countries
- Dose criteria or concentration levels are needed to manage NORM/TENORM safely based on the concepts by ICRP and IAEA
- Further discussion on the safe management of NORM/TENORM is needed.

Finally at Session 6 "Three Year Work Plan on Radioactive Waste Management" under FNCA framework, the discussion issues were as follows:

- Schedule and venue of the next workshop
- Items to be discussed in the next and future years
- Report issues and brochure
- Statement for the promotion of the Joint Convention
- Poster/Mini Exhibition
- Updated web site and the consolidated report

Views expressed by the Workshop participants on future topical issues and activities in fiscal year 2004 and after are as follows:

- Regulatory aspects including clearance, exemption and NORM/TENORM
- Waste treatment and characterization
- Siting procedure, investigation and safety assessment
- Security issues
- Participants of this Workshop proposed Malaysia as the candidate venue for holding the FNCA 2004 Workshop on Radioactive Waste Management.

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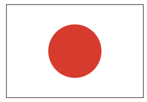
Radioactive Wastes from Medical Facilities and Research Laboratories in Japan



Prof. Toshiso Kosako
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Collection, Treatment and Storage

JRIA (Japan Radioisotope Association) was established in 1951 with the aims of import and distribution of radioisotope as well as the promotion of safe handling of radioisotope. JRIA take over the responsibility for collection, treatment and storage of Radioactive Waste (RW) generated from the hospital and research laboratory in Japan. Number of RW generator/Users is about 1,000 in industry and research fields, and about 1,200 in a medical field.

RW from facilities using radioisotopes, research reactors and from other facilities using nuclear source / fuel materials for research or industrial use, etc. (hereinafter referred to as "RW from Radioisotope and Research institutes, etc."), is currently treated for storage and kept at the facility, but is not finally disposed. At the end of FY2002, the total volume was 235,000 equivalent to 200-liter drums.

Efforts toward a Disposal of "RW from Radioisotope and Research Institutes, etc."

1) The Atomic Energy Commission, through its Special Committee on Nuclear Back-End Policy, issued "Basic Policy on Treatment and Disposal of RW from Radioisotope and Research Institutes, etc" (May 1998).
   - It identifies the necessity of establishing laws and regulations on disposal, the waste-procedure's responsibilities and roles in treatment and disposal, nature of an implementing body and a schedule for implementation.
2) The nuclear safety commission, through its special committee on comprehensive nuclear safety, issued "Basic Policy on Safety Regulation of Shallow Land Disposal of Radioactive Solid Waste from Facilities using Radioisotopes, etc." (October 2003).
   - It says that, in principle, similar safety-regulation concepts as for the shallow land disposal of low-level RW from nuclear power plants can be applied. And most waste can be disposed of in trenches since the level of radioactivity is low. But spent sealed sources were excluded in this procedure.
3) MEXT (The Ministry of Education, Culture, Sports, Science and Technology), through its Subcommittee on Safety Regulation for Radiation, issued "Basic Policy on Adopting International Exemption Levels in Laws and Regulations" (August 2003).
   - It presents basic policy on adopting the international concept of an exemption level in domestic laws and regulations, and suggests the promotion of consideration of a domestic law on burial disposal.
4) MEXT established a "Special Committee on the Business of Disposing of RW from Radioisotopes and Research Institutes, etc." (February 2002), and through the special committee has been discussing promotion of the shallow land disposal business.
   - It is currently considering the nature of an implementing body to carry out the business.
5) Together with JAERI (Japan Atomic Energy Research Institute), JNC (Japan Nuclear Cycle Development Institute) and JRIA (Japan Radioisotope Association), which are major producers of RW from Radioisotopes and Research institutes, etc., established RANDEC (Radioactive Waste Management and Nuclear Facility Decommissioning Technology Center) in December 2000, to promote activity toward realization of an actual disposal business.
   - Cooperation agreements have been concluded between RANDEC and the three named organizations, and, with their full support and cooperation, RANDEC is working toward realization of disposal business, including investigations of site planning and public relations.

Storage of treated wastes

Bird's-eye view of disposal facility (planning)

Siting Activity in Thailand

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In the past, Office of Atomic Energy For Peace by Radioactive Waste Management Division in cooperation with the geology department of Chulalongkorn University and the Department of Mineral Resources jointed the feasibility study on the underground disposal site for low level waste repository in Thailand. The 50 areas of interest in the central part and the Korat Plateau were then picked up for consideration. Later on, 5 areas were selected as the candidate sites for further investigation. Those were 2 areas in west central plain, Ratchburi Province at about 180 kms far from Bangkok and 3 areas in the Korat Plateau.

The result of the study revealed that all areas possess promising geology and hydrogeology. After thoroughly investigation regarding the technical performance and economic criteria, the areas in Ratchburi Province were selected as the most suitable candidate sites for near surface disposal in Thailand. The selected areas are now occupied by local people.

Currently, Radioactive Waste Management Program is now considering to set up a corporation with other related departments for investigating the new potential areas for radioactive waste disposal. The new proposal will be submitted to the office for financial support and the project is expected to start in year 2005.

Site Investigation

2003 International Symposium on Radiation Safety Management held in Korea

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The biennial International Symposium on Radiation Safety Management (ISRSM) has been operated since 1997, and the 4th ISRSM was held on November 5 - 7, 2003 in Daejeon, Republic of Korea. The symposium was jointly organized by the Nuclear Environment Technology Institute (NETEC) which is a special division of Korea Hydro & Nuclear Power Co., Ltd. (KHNP) and Korean Association for Radiation Protection (KARP). And it was also jointly sponsored by the OECD Nuclear Energy Agency and Korean Radiation Waste Society in co-operation with the International Atomic Energy Agency(IAEA).

The objective of the ISRSM is to promote the exchange of information on the newly implemented, developed sciences and technologies for low- and intermediate-level radioactive waste (LILW) management and radiation protection and spent fuel management.

After drifting for more than 15 years, arguments pros and cons on the construction of radioactive waste repository has been actively progressed during 2003 and public perception on the necessity of the repository has been gradually improved. For NETEC as the main organization responsible for the selection of repository site and as the organizer of 2003 ISRSM, this symposium was very significant in that respect.

The Symposium consisted of seven sessions, such as Radiation Protection Technology, Radioactive Waste Treatment with High Temperature Melting Technology, Low-and Intermediate-Level Radioactive Waste Treatment Technology, Decontamination and Decommissioning Technology, Radioactive Waste Disposal, Spent Fuel Management, and Radiation Management Experiences at Nuclear Plants.

Also, exhibition session was included and totally five companies participated in this session.

More than 60 papers have been presented from many countries including IAEA, Australia, England, France, Germany, Japan, Korea, Russia, and the USA. Every author addressed his expertise and precious experiences and had a chance to exchange the information of various fields in radiation safety management.

Hitachi Ltd. and RWMC (Radioactive Waste Management Funding and Reserach Center) of Japan presented advanced radioactive waste treatment system and basic strategies for radioactive waste disposal in Japan, respectively. It was regarded as a good example of close cooperation between neighboring countries in the field of radiation safety management.

In addition, many papers addressed the topics related to the radioactive waste treatment with high temperature melting technology reflecting the international interests in the vitrification technology for LILW. Recently, the KHNP/NETEC started design phase of a prototype vitrification plant for LILW and it is planned to be commercially operated at Ulchin nuclear power plant in Korea from 2007.

Consequently, the 2003 ISRSM was recognized to be very successful and all participants have contributed to the harmonization of various fields of radiation safety management and enjoyed the warm atmosphere of the symposium.

Establishment of the Korean Radioactive Waste Society(KRS) in Korea

The Korean Radioactive Waste Society(KRS) was established on June 20, 2003 with over 300 members representing wide spectrum of radioactive waste management specialists in this country. In its 1st meeting held at Nuclear Environment Technology Institute of Korea Hydro & Nuclear Power Co. Ltd.(KHNP-NETEC) located in Daejeon, Professor Kun-Jae Lee at Korea Advanced Institute of Science and Technology(KAISTS) was elected as president of the society. Dr. Myung-Jae Song (President of KHNP-NETEC) and Dr. Hyun-Soo Park (Senior Vice-President of Korea Atomic Energy Research Institute) were unanimously nominated as Vice-Presidents.

In recent years, radioactive waste management in Korea has been received national attention, and the siting for final disposal of low-and intermediate-level radioactive waste has become one of the most difficult national projects. Under these circumstances, the establishment of KRS was welcomed not only by the Korean nuclear industry but also by the government. The role of KRS is expected to be an unique group of radioactive waste management specialists in Korea who could provide balanced view and expertise on the safety and technology issues related to the radioactive waste management, as well as promoting an academic development and public understanding in this field. KRS has already organized or sponsored successfully several international symposiums and seminars on radioactive waste management including the ISRWM(International Symposium on Radioactive Waste Management) 2003 held at Grand Intercontinental Hotel Seoul on November 2-3, 2003.

Dr. Myung-Jae Song was promoted to be President of NETEC/KHNP

Last December, Dr. Myung-Jae Song who is currently the Korean Project Leader of FNCA-RWM was promoted to be "President" of Nuclear Environment Technology Institute (NETEC) of Korea Hydro & Nuclear Power Co., Ltd (KHNP). Before his promotion, he dedicated as Director of R&D Office of NETEC/KHNP for the past few years. He earned a doctorate in public health from University of Michigan and is well-known for a worldwide expert in the field of radiation protection.

Site Selection for a Near Surface Radioactive Waste Disposal in the Philippines Phase II

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The development of a repository in the Philippines is characterized by several stages. During the first stage, a number of potential sites were identified throughout the country using a set of pre-determined criteria. This was done largely by desk studies and supported and evaluated by a small number of reconnaissance field visits. The identified sites were then ranked according to their geological, hydrological, hydrogeological and terrain access suitability.

Based on these information, the Phase II of the siting project was initiated. About 10 sites were identified for further field investigations to confirm and validate the results of previous studies. Due to the large sizes of the previously identified sites, it was noted that several sites may contain a number of areas that may warrant further investigation. At this point, a set of more stringent criteria based on geology, hydrology and accessibility was defined to select a more specific potential site with a workable area reduced to 100 hectares. Surface investigation will be conducted detailing the geographic distribution of each site including their aerial extent, information on their homogeneity, depth, thickness, tectonic and hydrogeological settings. These information will be compiled and analyzed to determine preferred areas for further study. A ranking scheme will be established to rate the suitability of each site for detailed subsurface investigation. The aim of this exercise is to determine the 3 most suitable sites that will be subjected for subsurface investigation and analysis.

The last step of phase II is to conduct further field investigations involving deep auger exploration, soil sampling and in-site permeability testing on the 3 sites. The techniques for investigation will be expanded for more detailed studies. Soil samples will be collected and analyzed for index soil properties.

The data and information that will be generated from this phase will be assessed according to a site selection criteria and other relevant factors that will permit the selection of the most preferred site for the location of the proposed repository.

Radioactive Wastes from Hospitals in Australia

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Australia's population of 20 million people is well served in the area of diagnostic and therapeutic nuclear medicine. There are approximately 180 nuclear medicine centres (government plus private clinics) in the country, which conduct approximately 450,000 patient studies per year. To meet the demands for medical radioisotopes in nuclear medicine, Australia is serviced by one nuclear research reactor and seven compact cyclotrons, four of which are located at Government Hospitals.

Approximately 85% of all diagnostic imaging in Australia is conducted using ^{99m}Tc-based compounds. ^{99m}Tc is supplied in the form of ^{99}Mo / ^{99m}Tc generators. Using fission-produced ^{99}Mo, ANSTO manufactures approximately 130 generators per week to meet the diagnostic needs in Australia, South East Asia and New Zealand. Isotopes produced for radiotherapy include ^{131}I capsules and ^{90}Y-microspheres.

Neutron-deficient radioisotopes, produced in Australian Hospitals for PET-imaging include ^{18}F, ^{13}N, ^{11}C and ^{15}O. The ANSTO 30 MeV cyclotron produces ^{201}Tl, ^{67}Ga and ^{123}I for diagnostic SPECT imaging.

To understand the legislative requirements for the control of radioactive materials, including wastes, in Australian hospitals it must be considered that Australia is a constitutional monarchy with six independent States. Each of the State Governments has constitutional responsibility for the operation and control of public hospitals within that State. For instance, in the State of New South Wales (NSW) the control of radioactive substances within this State's Hospital system is covered by the following acts:

- Radiation Control Act 1990
- "Protection of the Environment Operations Act" - 1997.

The NSW EPA is the appropriate regulatory authority for the purposes of this Act.

The control of radioactive materials in other Australian States is legislatively covered under their respective Departments of Health (under State Radiation Control Acts).

From the perspective of national management of radioactive wastes there are comparatively small volumes ~160 m^3 of combined solid wastes from sources such as universities and laboratory waste from hospitals in Australia. The main mechanism of waste management in Australian Hospitals is:

- sewerage systems for liquids through approved trade waste permits,
- incineration and storage of solids on-site, in a shielded and restricted area, pending the operation of a National Waste Repository,
- discharge to atmosphere for gases or aerosols.

The Radiation Protection and Control legislation applies only to radioactive substances that are radioactive ores, radioactive substances with specific activity of more than 35kBq/kg and that contain one or more prescribed radionuclides. For the transport of radioactive hospital wastes the activity in each package must be less than the transport limit and the maximum exposure rate at any point on the surface of each package must be less than 5 μSv/h.

Most of the radionuclides used in diagnostic imaging and therapy in Australian Hospitals involve short half-lives (<20 days) and do not constitute a long term waste storage problem eg ^{99}Mo / ^{99m}Tc, ^{131}I, ^{51}Cr, ^{90}Y, ^{64}Cu, ^{201}Tl, ^{67}Ga, ^{111}In, ^{103}Pd, ^{32}P, ^{153}Sm.

Hospital wastes containing the above isotopes maybe treated as non-active waste-forms after a suitable decay period.

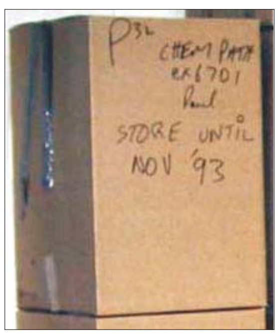
Longer lived radioisotopes such as ^{60}Co from old teletherapy sources ^{137}Cs, ^{57}Co, ^{226}Ra sources and ^{153}Gd transmission sources, used for calibrating SPECT cameras, have to be stored on-site for the long-term, pending the operation of a National Radioactive Waste Repository.

Cardboard box with red bag as the inner liner in a Perspex shield box. Suitable for storage Phosphorus-32 waste (strong beta emitter) in the laboratory

A B C

Different types of packages suitable for transporting radioactive waste as "excepted" packages. A: Metal drum (not suitable for incineration), B: red plastic bag, C: cardboard boxes with red bags as the inner liner

Labelling details of the radioactive waste package (note that the labelling is hand -written only)



Hospitals with on-site cyclotrons generate small volumes of solid waste from radio-activation of metal foils, target seals and metal target-cell assemblies. Typical isotopes arising from cyclotron component activation include ^{56}Co, ^{57}Co, ^{58}Co, ^{55}Fe, ^{53}Mn, ^{54}Mn etc.

Liquid effluent waste, arising from clinical and laboratory practice within a hospital should be delayed prior to release to the metropolitan sewage. For instance, a number of public hospitals utilise ^{131}I in thyroid ablation therapy in which a patient is prescribed 6GBq of ^{131}I. Patient liquid metabolites, plus washing's associated with showers and laundering of bed linen, maybe contaminated with ^{131}I (8.02d T1/2). This effluent should be delayed prior to release to the metropolitan receiving system. Generally hospitals discharge liquid wastes into the sewer systems as industrial trade waste. Hospitals discharging to sewer are required to apply for and obtain approval to discharge in the form an industrial waste permit, which contains radioactive discharge limits. The maximum activity, which may be disposed of via sinks or toilets into the sewers in any week, is 20 x the Annual Limit on Intake by ingestion for prescribed radionuclides.

With the construction and operation of a National Waste Repository within Australia, radioactive wastes accumulated since the 1940's in public hospitals shall be considered for processing and safely managed in the national interest. Prior to this eventuality it is considered that appropriate legislation at both the Federal and State levels of government would have to be enacted.

Option for Treatment of Contaminated DEHPA Waste

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Diethylhexyl phosphoric acid (DEHPA) in kerosene has been used as a solvent to extract rare earth elements in the monazite cracking process. Since monazite contains naturally occurring radioactive materials, the process results in the transfer of these materials into the solvent phase. Obviously, the NORM contaminated DEHPA apart from its nature being chemically corrosive, needs to be addressed properly as it poses a disposal problem. It is estimated that the amount of U and Th contained in the solvent to be approximately 1,400 ppm and 100 ppm respectively. The solvent generated is presently stored at MINT and its volume is approximately 30 cubic meters. Four options for converting this contaminated DEHPA waste into a more stable form as been suggested as follows;

i. extraction of U & Th into aqueous phase, followed by precipitation,
ii. converting the waste into a ceramic material,
iii. incinerate the waste, and
iv. immobilize the waste into cement.

A study to extract U & Th into the aqueous phase is an attempt to recover and hence re-use DEHPA. At the same time it also enables one to precipitate U & Th and subsequently immobilize the precipitate into cement. The process involves mixing DEHPA with sodium carbonate solution and heating at an elevated temperature (~50 C). The mixture forms three layers (see Picture 1.) where kerosene with the least dense material, appears at the top layer, while the sodium-DEHPA and the aqueous layers located at the middle and bottom layers respectively. Most of the radioactivity is found to be in the bottom layer. To remove further U & Th from the solvent, the upper two layers are repeatedly extracted with similar sodium carbonate solution till the level of U left in those layers of about 1-2 ppm.

Finally, U & Th in the aqueous phase is precipitated to form hydroxides at pH 10-12.

The second option involves converting DEHPA into ceramic. A process to do this has been established and a patent is pending. The advantage of this process is that it does not generate any secondary waste. There is also a need to look at the possibility of using the ceramic for certain applications, otherwise the material can be transformed into a more stable ceramic waste form.

The third option to treat DEHPA waste is through incineration. Although the option is simple and produces a favorable glassy solid at high temperature ~1000 C, but the corrosive nature of the process may cause difficulty to carry out such work. Further study on scrubbing system is required to overcome attack on the incineration components.

The last and also a viable option for DEHPA waste is to immobilize them into an ordinary Portland cement. The study is being carried out by groups of researcher at ANSTO and MINT.

Initial results indicate the process is feasible and economic. In this process (see Picture 2 and 3) DEHPA is mixed with an additive prior to adding cement at a suitable proportion. Although the process is simple, nevertheless the drawback is that it generates larger volume of waste in the end.

MINT is currently evaluating all of the above options from the various considerations such as in terms of cost, feasibility, secondary waste generation, re-usability, practicability, volume of secondary waste generated etc.

Picture 1. The three layers formed in extraction using sodium carbonate solution

Picture 2. Original DEHPA waste prior to immobilization

Picture 3. DEHPA waste after immobilisation

Management of Spent Radiation Sources from Hospital in Indonesia

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This paper describes the effort of Center for Development of Radioactive Waste Management (CDRWM)-BATAN to develop and implement activities in the management of radioactive waste especially radiation sources from hospitals. The new policy of government of Indonesia for spent radiation sources is whenever possible spent sealed sources should be returned to the supplier, and this policy gives positive effect to the recent radiation sources coming to Indonesia from the supplier but not for the old sources in the hospitals.

CDRWM-BATAN with the Nuclear Energy Control Board (BAPETEN) and the Ministry of Public Health of Indonesia is continuesly collecting the data of the radiation sources and spent radiation sources in the hospitals arround the country. The data is always updated periodically, so it is expected that most of the sources are under control. This action is also to minimize the lost of the radiation sources.

BAPETEN as the regulatory body is informed by the hospital when a sealed source is taken out of use, and becomes a spent source in storage. By the permission of BAPETEN, the hospitals could store the spent source in their temporary storage before returning to the supplier or transporting to CDRWM-BATAN.

In CDRWM-BATAN, spent sealed sources is segregated and collected separately because of their potentially high radiological hazard. Spent sealed sources generally are not removed from their associated shielding or source holders unless adequate precautions are taken to avoid exposure to radiation and contamination. Peripheral components of large irradiation equipment (i.e. those not directly associated with the source) are removed, monitored and disposed of appropriately. Sealed sources are not subjected to compaction, shredding or incineration.

Figure 1. Boxes of Ra-226 needles in the Ministry of Public Health's storage before transferred to CDRWM-BATAN.

Figure 2. Containers of Co-60 and Cs-137 in the Ministry of Public Health's storage before transferred to CDRWM-BATAN.

Figure 3. Ra-226 needles from the Ministry of Public Health in the BATAN's interim storage.

CDRWM has a strategy to handle the radium by applying simple but effective methods of increasing the security of spent sealed sources. A potentially suitable method of securing spent sources is to contain the spent sources or source holders in a suitable size concrete metal drum (200 L). A convenient way to embed the source in concrete would be to place it in the center of the 200 L drum that filled with concrete. When immobilizing spent sealed sources the need for security and possible long-term retrievability of the drum is always considered. At the end of 2003, all of the Ra-226 needles in the Ministry of Public Health to CDRWM, and the needles will be conditioned on March 2004. However still there about 120 needles of Ra-226 and about 18 other sources (Cs-137 and Co-60) in some hospitals that have to be transferred to CDRWM in the near future.

Recent Activities of CDRWM-BATAN on Radioactive Waste Management

Center for Development of Radioactive Waste Management (CDRWM) -BATAN conducted several activities during 2003. These are including:

a. Conditioning of Spent Radiation Sources.

Every year CDRWM conducted the conditioning of SRS coming from hospitals and industry, and at 2003, the conditioning was done at October with total of 123 SRS (this numbers include the SRS from the previous years).

b. Construction of the new Interim Storage building

It is predicted by the increasing of the coming radioactive waste, the present interim storage building (IS No.1) with the size of 1420m2 (80 m x 18 m) will be full for the next 5 years. At 2001, BATAN decided to build the new interim storage building (IS No. 2) to anticipate that situation. At the end of December 2003, the construction has already completed, and is going to be handed over to CDRWM this year. The capacity of IS No. 2 is the same as IS No.1.

c. Decommissioning program for the yellowcake production installation of a fertilizer company at East Java

A fertilizer company in East Java has the uranium by-product recovery installation. This installation was designed to extract U3O8 from phosphate rock through phosphoric acid purification by producing the yellowcake. By the market problems, the management of the plant finally decided to stop its operation and left the facility inactive for years. At the year of 2001, National Nuclear Control Board (BAPETEN) recommended the plant management to decommission the installation.

d. Treatment of the Bandung Facility waste

As the understanding between the two facilities in BATAN (the Bandung Nuclear Research and Development Center (BNRDC) and the CDRWM), the accumulated, transportable wastes at BNRDC were finally removed and transported to Serpong for processing and ultimate storage. The wastes have been accumulating for quite many years from different activities such as reactor operation, radioisotope production, etc.

The whole wastes have been processed using the following methods:

- Direct immobilization for wet resin
- Compaction for the compactable solid
- Conditioning for non compactable solid wastes
- Precipitation for liquid wastes, followed by immobilization.

However, there is still a lot of radioactive waste still remaining at BNRDC. These wastes are the result of the upgrading of the TRIGA Mark II reactor. These include the graphite reflector and other solid wastes whose volume are so much and their process not yet determined.

e. Transport of Ra-226 SRS

The agreement between BATAN and the Ministry of Public Health has provided basis to the removal and transport of 199 Ra-226 needles from the storage of the Ministry and 56 needles from the Cipto Mangunkusumo Government Hospital in November 2003. However there are still 129 needles left throughout Indonesia which will be planned to be removed by 2004. It is programmed that all the Ra-226 needles already in CDRWM storage will be conditioned in March 2004.

Introduction of New RWM Project Leader

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