Vol. 17 No.1
January-March 2004

AERB Newsletter

ATOMIC ENERGY REGULATORY BOARD

CONTENTS

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Prof. S.P. Sukhatme, Chairman, AERB (left) and Mr. Ashok Thadani, Director, Office of Nuclear Regulatory Research, USNRC & Leader of the Delegation, during AERB-USNRC discussion meeting February 26, 2004.

From the Chairman's Desk

Apart from the regular work of AERB, a number of important activities took place during the quarter covered by this issue of our Newsletter. A delegation from the United States Nuclear Regulatory Commission visited India, the annual Industrial Safety Awards function was held and there was a Special Meet for Users of Gamma Radiation Processing Facilities.

A four-day meeting was held with the US Nuclear Regulatory Commission delegation, which was led, by Dr. Ashok Thadani, Director, Office of Nuclear Regulatory Research. Shri S.K. Sharma, Vice-Chairman, AERB led the Indian Delegation. The topics discussed during the meet were Fire Safety, Ageing Management and License Renewal of Nuclear Power Plants. There was a useful exchange of ideas and in-depth lively discussions. The US delegation also visited MAPS, Kalpakkam.

The Annual Industrial Safety Awards function was held on March 16, 2004. For 2003, the Safety Award was given to the Tarapur Atomic Power Station, the Heavy Water Plant at Tuticorin and the Indian Rare Earths Plant at Chavara. These plants attained high levels of industrial safety during the year. The accident statistics at DAE Units for 2003 show that the number of accidents have reduced compared to 2002 and that the industrial safety standards in operating plants of DAE Units are on par with those existing in other countries. However, AERB is concerned that a comparable level of safety is yet to be attained at construction sites.

An interesting event held within AERB was a Discussion Session on the yearlong training programme, which had been conducted for the staff of AERB. Prior to the Discussion Session, written feed-back had been obtained from the staff. The general feeling was that the training programme had been useful and that in future, training on specific topics should be arranged.

The Special Meet organised for Users of Gamma Radiation Processing Facilities was particularly successful. The use of this application has spread significantly in the last few years and a meeting which brings together users and the regulatory body was useful. The users came to know about the rules and regulations being applied and also appreciated the need for strict compliance. Most of the users who attended were very happy with the information received during the meet and felt that such meets should be conducted at least once every two years.

Following the practice of the previous issues, in this issue also, an article written by a Head of a DAE Unit is presented. This time the article is by Shri R. Gupta, Chairman & Managing Director, UCIL regarding the role of AERB, the expansion plans of UCIL and the challenges posed in opening new mines.

Subas P. Sukhatme.

Industrial Safety Award

The annual Industrial Safety Awards function was held at the Atomic Energy Regulatory Board (AERB) on March 16, 2004. Shri S.D.Soman, former Chairman, (AERB) presented the Safety Awards for 2003 to Tarapur Atomic Power Station, Heavy Water Plant Tuticorin and Indian Rare Earths Ltd., Chavara for attaining high levels of industrial safety.

On this occasion, Prof. S.P. Sukhatme, Chairman, AERB released a compilation entitled "Industrial Safety Statistics of the Department of Atomic Energy (DAE) Units for the Year 2003". The compilation contains data on the injury statistics of different units of DAE. This data was analysed and compared with data from units outside DAE and with international data. The comparison of safety statistics of DAE units with non-DAE industries in India shows that the safety levels of DAE units are higher than the non-DAE industries. Comparison with the frequency rate of injuries for operating nuclear power plants worldwide shows that the values for Indian units are lower.

Safety Award Function

(From left) Shri T.K. Halder, Director (E), HWB, Shri M.P. Mahajan, Executive Director (O), HWB, Shri S.D. Soman, Former Chairman, (AERB), Shri M.S.N. Shastry, Chief General Manager, HWP, Tuticorin and Shri W. Kanthiya, Associate Director, HWB at Safety Award Function

(From left) Shri R.Bhattacharya, SO/G, AERB, Prof. S.P. Sukhatme, Chairman, AERB, Shri S.D. Soman, Former Chairman, (AERB) and Shri V.V. Pande, SO/G, AERB at Safety Award Function, while releasing booklet on "Industrial Safety Statistics of DAE Units for the Year- 2003"

Special Meet for Users of Gamma Radiation Processing facilities

Gamma radiation processing facilities play a vital role in harnessing the beneficial applications of ionizing radiation. The most widespread use of these facilities is for the sterilization of medical or healthcare products, preservation of foodstuff by disinfestations and so on.

On account of the versatile applications of gamma radiation processing facilities, their number is constantly increasing not only in the developed countries but also in the other countries. The recent months have witnessed an impressive growth in the number of gamma radiation processing facilities in India. There are 12 gamma radiation facilities operating satisfactorily in the country and one new facility is going to commence operation within a few weeks. The first food irradiation facility for research purposes, FIPLY (Food Irradiation and Processing Laboratory) located in BARC, commenced its routine operation in 1966 and the first commercial irradiation facility for medical product sterilization, i.e. ISOMED (Isotopes in Medicine) started operating in 1974. AERB has issued clearance for the site of installation for five new irradiation facilities. It is felt that there exists a need for the management of Gamma Radiation Processing Facilities in the country to interact among the members and with the regulatory authorities on matters relating to radiological safety. For this purpose, AERB organised a special meeting on Friday, February 27, 2004. Prof. S.P. Sukhatme, Chairman, AERB; Shri S.D. Soman, Formerly, Chairman, AERB; Shri S.K. Sharma, Vice- Chairman, AERB and Shri J.K. Ghosh, Chief Executive, BRIT graced the meeting by their presence and active participation. About twenty-five participants attended the special meet consisting of senior representatives of the management, facility-in-charges, radiological safety officers, operators from various operating and new gamma radiation processing facilities.

The deliberations during special meet brought out various safety issues such as conducting of exclusive training course for RSOs for gamma radiation processing facilities; arranging more number of training courses for operators; necessity for the amendment of G.S.R. no. 254 entitled, "Atomic Energy (Control of Irradiation of Food) Rules, 1996 in respect of technological conditions & qualifications of personnel; standardization of the deigns of radiation processing facilities by Board of Radiation and Isotope Technology (BRIT) and existence of effective safety culture among personnel of such facilities etc. Participants stated that such special meets shall be conducted at least once in two years as it provided close interaction among users and the regulatory body.

AERB-USNRC Discussion Meeting on Nuclear Safety

A six-member USNRC delegation led by Shri Ashok Thadani, Director, Office of Nuclear Regulatory Research, USNRC visited India for the third AERB-USNRC Nuclear Safety Discussion Meeting that was held during February 23-25, 2004 at the World Trade Centre in Mumbai. The Indian team for the meet was led by AERB Vice Chairman, S.K. Sharma. The topics of focus during the discussions were Fire Safety,

(From left) Shri S.D. Soman, Former Chairman, (AERB), Prof. S.P. Sukhatme, Chairman, AERB and Shri A.U. Sonawane, SO/F, AERB in the Special meet for users of Gamma Radiation Processing Facilities.

Ageing Management and License Renewal of Nuclear Power Plants. Presentations made by experts from both the sides were followed by extensive discussions. Many specialists from AERB, NPC, IGCAR and BARC took part in the discussions.

On 26th February 2004, the US-NRC delegation called upon Chairman, AERB at Niyamak Bhavan. This was followed by an enlightened talk by Ashok Thadani on "Perspectives on Reactor Safety" at the Nabhikiya Urja Bhavan Auditorium, which was attended by a large gathering.

The USNRC delegation visited the Madras Atomic Power Station at Kalpakkam on 27th February 2004. Here, the US team was briefed by the station personnel on the En-masse Coolant Channel replacement and various safety upgradations carried out earlier in MAPS Unit-1 and similar works being undertaken presently in Unit-2. Demonstration of coolant channel replacement at the mock-up facility and the on-power refueling operation at the fuelling machine rehearsal facility were presented. The delegation also had a field visit of MAPS the Turbine Building, Control Room and switchgear areas.

The inter-regulatory co-operation between AERB and USNRC resumed in February 2003 when a USNRC team led by their Chairman, Dr. R.A. Meserve visited India. The five safety related topics pertaining to NPPs identified for this co-operation were Fire Safety, Aging Management and License Renewal, Emergency Operating Procedures, Risk Informed Regulation and Design modifications. Brief discussions on these topics were initiated in the first meeting and these were expanded during the second meeting that was held in Washington D.C. in September 2003 when a six member Indian delegation led by AERB Vice Chairman, S.K. Sharma visited USNRC. The fourth meeting of the two-year programme for 2003/2004 is proposed to be held in USA during August/September 2004.

Mr. Dinesh Bhatia, Dy. Secretary, ER, DAE, Mr. S.K. Sharma, Vice-Chairman, AERB, Prof. S.P. Sukhatme, Chairman, AERB, Mr. Ashok Thadani, Director, Office of Nuclear Regulatory Research, USNRC & Leader of the Delegation, Mr. Augus Simmons, Consul General, US Consulate, Mumbai during AERB-USNRC meeting Feb. 2004.

Constitution of Committees from January to March 2004:

No.	Name of the Committee	Constituted on
1.	Safety Committee on Gamma Radiation Processing Plants (SCOGRAPP)	February 5, 2004

Reconstitution of Committees from January to March 2004:

No.	Name of the Committee	Reconstituted on
1.	Advisory Committee for Project Safety Review of PHWR based NPPs and PFBR (ACPSR-PHWR-PFBR)	January 23, 2004
2.	Safety Review Committee for Operating Plants (SARCOP)	March 12, 2004

Press Release:

January 29, 2004: AERB Permits Restart of RAPS Unit- 1:

The Atomic Energy Regulatory Board (AERB) issued clearance to Nuclear Power Corporation of India Limited (NPCIL) to restart Unit-1 of Rajasthan Atomic Power Station (RAPS) on January 29, 2004 after an extensive safety review. Earlier AERB had asked NPCIL to close down the unit from April 30, 2002. The reactor remained shut down since then.

During the 21 month shut down of RAPS Unit-1, NPCIL inspected various systems, structures and components of the unit to assess their fitness for further service. The required actions were then taken by way of replacement of certain major equipment like some of the heavy water heat exchangers. Other safety related up-gradations included incorporation of high pressure emergency core cooling system, provision of supplementary control room and addition of a third emergency diesel generator. The fire and smoke detection system in the plant was also upgraded. These up-gradations were similar to those carried out earlier on Unit-2, which has been operating satisfactorily since then. The upgraded plant now meets the current safety requirements. AERB will again review the safety status of reactor after six months of operation for issuing further operating authorisation.

Authorisation issued by AERB

1. Clearance for Erection of Major Equipment for RAPP-5 issued on March 15, 2004.
2. Authorisation for Commissioning and Operation Retrieval, Uranium Recovery and Storage (THRUST) Project of IREL, Udyogamandal was issued on March 24, 2004. ●

Safety Review of Projects of Front End Nuclear Fuel Cycle Facili-

P. K. Ghosh,
Atomic Energy Regulatory Board, Mumbai - 400 094, pkg@aerb.gov.in

1. Introduction

One of the responsibilities of the Atomic Energy Regulatory Board (AERB) is to ensure that the front-end nuclear fuel cycle facilities viz. Uranium/Thorium mining & processing, Heavy mineral mining & processing, Fuel fabrication and Heavy water production units to be sited, constructed and operated does not result in undue radiological, chemical and industrial risk to the workers, the public and the environment.

2. Review Methodology for Projects

The first level of review is by Project Safety Review Committee (PSRC) constituted by AERB for a specific project or the Unit Safety Committee. The second level of review is normally conducted by Advisory Committee for Project Safety Review (ACPSR) constituted by AERB, which consists of experts from other technical organizations of the government, academic and research institutions and the regulatory body itself. Review of the project at this stage takes into consideration, the safety review and assessment of the previous stage. The third and final review is by the Board of AERB, which is the consenting authority for all front-end nuclear fuel cycle facilities.

The nuclear fuel cycle facilities are widely varying in the nature of the process flow sheets, quantities of radioactive or toxic or flammable chemicals handled. The three-tier review process is carried out for facilities where an accident can have impact beyond the plant premises. For other facilities, which are not so complex in nature, the regulatory process may involve only two steps. The documents viz. Design Basis Report, Safety Analysis Report and Quantitative Risk Analysis Report (Part of safety analysis report) and approach to inherently safe plants are discussed in this paper.

2.1 Design Basis Report

The Design Basis Report is a document submitted by an applicant to AERB after a site is selected for these site-specific facilities. This enables the regulatory body to review the safety aspects before a construction clearance is given to a particular facility.
The DBR is to be structured considering the following aspects:

- salient features of the site along with the Environmental Impact Assessment Report
- system description –choice of process, flow sheets, lay out diagrams
- operations/containment for normal/mal operating conditions
- design basis for process, mechanical, electrical and civil structure
- applicable standards, codes and guides for design
- safety features and safety margins in design
- postulated failures against which system is designed
- radiological safety aspects
- fire safety aspects
- waste management
- quality assurance program

2.2 Safety Analysis Report

The Safety Analysis Report is the principal document to determine whether the operation of the front-end fuel cycle facility under review will result in unacceptable risk to the workers, the public and the environment and whether control measures are in place to mitigate the consequences of major accidents. The report should identify the type, the relative likelihood and the consequences of major accidents.

Committee	Constitution	Assignment
Project Safety Review Committee (PSRC)/ Unit Safety Committee	• Constituted by AERB for a specific project or the Unit Safety Committee • Committee of experienced Scientist/ Engineers experts in the field	Review the documents from siting upto operating stage
⇩	⇩	⇩
Advisory Committee for Project Safety Review ACPSR)/ SARCOP	Experts from other technical organizations of the government, academic and research institutions and the regulatory body itself	• safety review, assessment of the previous stage. • review of unresolved safety issues if any, put forth by the previous committee. • recommendations submitted to AERB.
⇩		⇩
Atomic Energy Regulatory Board	• considers the recommendations of ACPSR or SARCOP and decides on the consent for the appropriate activity/stage of fuel cycle facility. • may prescribe requirements and conditions governing the performance of the activity and • may also specify a time limit on its validity	

In a nutshell the requirements of a Safety Analysis Report is given below:

The important aspects Safety Analysis Report

1. Criticality safety
2. Radiation safety and monitoring
3. Chemical safety
4. Fire safety
5. Management of waste

Content of Safety Analysis Report

- topographical and geological aspects
- description of the process and critical parameters
- safety systems to ensure safe operation of the facility within the design parameters to prevent fire, explosion or release of radioactive/ toxic material.
- safety organization to ensure health and safety in the plant
- quality assurance program

2.3 Quantitative Risk Analysis Report

The Risk analysis consists of hazard identification, consequence analysis and probability calculation.

2.3.1 Hazard Identification

The first and most essential step in any risk assessment is the identification of all relevant hazards and initiating events applicable to a particular plant or operation. The basic approach to hazard evaluation is predictive hazard evaluation and this in all cases necessarily leads to establishing: what dangerous situation exists within a plant or a process operation and how these situations may arise.

Techniques of hazard identification fall into two categories:

Category-I: Comparative Methods: Some of the comparative methods are Checklist, Safety Audit, Indices - Dow, Mond Indices & Dow Chemical Exposure Index, Preliminary Hazard Analysis

Category-II: Fundamental Methods: Some of the fundamental methods are Hazard and Operability Study (HAZOP), Failure Modes & Effects Analysis (FMEA), "What If " Analysis.

2.3.2 Consequence Analysis

Consequence analysis is to be carried out for a loss of containment scenario involving a hazardous material, which has an impact in terms of death, injury or health hazard. Meteorological and topographical characteristics that affect the consequences of accident must be established before applying appropriate physical models and

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AERB's SAFETY REVIEW OF PLANTS/ PROJECTS

Unit-1 of Kakrapar Atomic Power Station shut down as per directive of AERB

The Kakrapar Atomic Power Station (KAPS) situated near Surat in Gujarat has two units of 220 Mega Watt each. On 10 March 2004, when Unit-1 was in operation generating 170 Mega Watt of electricity, an event involving rise of reactor power occurred.

For controlling reactor power, adjuster rods are provided which move in or out of the reactor core as per the command from the Automatic Reactor Power Control System. While carrying out some maintenance work, power supply to these rods failed rendering them inoperable. At the same time, another design feature of the reactor power control system, called Automatic Liquid Poison Addition System got inhibited due to erroneous operator action. Also, the reactor overpower trip was not appropriate to the operating power level at that time. Reactor power increased slowly and the reactor tripped automatically on sensing of higher than permissible power by the reactor safety system as per design intent. The incident did not result in any damage to the plant or the reactor fuel and there was no radiological consequence. However, the event reflected certain weaknesses in safety culture at the plant and need for improving safety practices. Taking all these factors into account AERB provisionally rated the incident at level-2 of the International Nuclear Event Scale (INES). Levels 1 to 3 of INES relate to safety significant nuclear events and levels 4 to 7 are assigned to accidents. India is a participant in the INES reporting system.

KAPS and Nuclear Power Corporation (NPCIL) were asked to carry out investigations to identify causes of the incident. Results of investigations and analyses by Expert Groups were discussed at length by the Safety Review Committee for Operating Plants of AERB on 31 March and again on 21 April 2004. Since the exact reasons for reactor power rise have not yet been clearly established, AERB directed the unit to be shut down as a measure of abundant caution. The station and NPCIL have been asked to carry out further detailed investigations. Accordingly, KAPS Unit-1 was shutdown in the early hours of 22 April 2004

Safety Enforcement at PFBR, BHAVINI, Kalpakkam

Chairman, AERB ordered for suspension of construction work of site assembly building at Prototype Fast Breeder Reactor, Kalpakkam on Dec 8, 2003 following a fatal accident that has taken place on Dec 2,2003 at the construction area of Site Assembly Shop of PFBR, Kalpakkam. A sub-committee of Fatal Accident Assessment Committee of AERB visited the site for an assessment of the facts causing the accident. The committee investigated the accident and reviewed the safety status prevailing at the construction site and recommended improvements in the Safety Management System for safe execution of construction works.

The stipulations of the committee were complied with by PFBR. An AERB team conducted an inspection to check the compliance. Based, on appropriate compliance of stipulations, permission for re-starting of construction activities of Site Assembly Shop was accorded by. Chairman, AERB on March 1, 2004

Opening of Open Cast Uranium Mine at Banduhurung in Jharkhand by Uranium Corporation of India Limited:

UCIL has proposed for opening one Opencast mine of Uranium ore at Banduhurang, East Singbhum district of Jharkhand, which is in proximity to the existing Uranium mines. This is the fifth mine in the series in the same thrust belt of Singbhum but is the first opencast mine of uranium in India. Unlike underground mining the activities and the hazards remain almost same throughout the life of the mine and hence AERB has decided to authorise the operation of the project in single stage. AERB is in the process of review of the proposal and has visited the site, discussed in the UCIL -Safety Committee of AERB. After clearance from safety committee, the proposal would be reviewed by Advisory Committee on Projects Safety Review and then by AERB Board.

Site of proposed Banduhurang open cast uranium mine-hill behind the UCIL Safety Committee Members.

Visit to Indian Rare Earths Limited Udyogmandal by Chairman AERB

Chairman AERB visited the IRE Udyogmandal Plant on February 10, 2004 in connection with the issues viz. decontamination of Silo's for waste disposal, retrieval of Thorium from Silo's(THRUST Project), and review of ventilation system to reduce the dose rates for plant personnel. The matter was discussed in SARCOP as well as in AERB Board and permission for the starting the THRUST has been granted.

Chairman AERB & Director IPSD, AERB with officials from IRE Udyogmandal visiting SILO's site

VIEWS

Environment Friendly Mining and Processing of Uranium Ore in India – Role of AERB

Ramendra Gupta,
Chairman & Managing Director, Uranium Corporation of India Limited, Jaduguda

Uranium Corporation of India Limited (UCIL) is a Public Sector Undertaking of the Department of Atomic Energy, Government of India. It was constituted in 1967 after the successful indigenous efforts in locating uranium resources by the Atomic Minerals Directorate during the early 1950s and the pioneering the efforts in exploratory and development mining under the Jaduguda Mining Project during the 1960s which led to the establishment of India's first uranium mine and mill at Jaduguda in the East Singhbhum district of erstwhile state of Bihar and presently Jharkhand. As a sequel to increased fuel demands two new mines namely Bhatin and Narwapahar were opened during the 1980s and early 1990s in the Singhbhum belt and the capacity of the mill was also increased. The new thrust for realizing 10000 MWe by nuclear sources by 2010 A.D. necessitated prompt action for the opening of additional mines in India. Thus since 2000 A.D. UCIL has embarked on a rapid expansion with programme of opening six additional mines – four in Singhbhum namely Turamdih, Banduhurang, Bagjata and Mohuldih besides one each at Domiasiat in Meghalaya and at Lambapur in Andhra Pradesh.

In all such endeavors UCIL faces the twin challenge of complying with statutory metal mine regulations under the Directorate General of Mines Safety (DGMS) for opening and operating in the first instance besides others that are imposed by other regulatory agencies such as the State Pollution Control Board and the AERB. Since 1965 the radiological safety of mine workers and personnel associated with the uranium mine and processing plant at Jaduguda is being closely monitored by the Health Physics Unit (HPU) of BARC. The HPU also keeps a close vigil on environmental issues that have a direct bearing over the processing of the uranium ore and its tailings disposal. There is a close liaison between UCIL, HPU and AERB in these matters. The AERB constituted in 1983 under the Atomic Energy Commission (AEC) is entrusted with the responsibility of regulatory and safety functions envisaged under the Atomic Energy Act, 1962 and other related Acts subsequently. It provides various codes, guides and enforces rules and regulations for ensuring the safety of unit personnel, the public at large and the protection of the environment. At present the AERB carries out monitoring and inspection of the mines, plants and new projects in three modes, namely:

1. Regulatory inspection, once a year.
2. Unit safety committee meeting in each quarter.
3. Safety Review Committee for Operating Plants (SARCOP) as and when required.

The AERB comprises a team of highly qualified and experienced scientists and engineers and conducts regular inspection of the mine, mill, tailings pond and Effluent Treatment Plant (ETP) and reviews radiological and safety aspects related to process systems, operation and maintenance of mines and plants and the over-all safety performance. It also monitors matters related to the health physics and industrial safety aspects of the mine and the mineworkers in terms of radiological impact, noise and dust levels. Visit to the ore processing plants such as the crushing, grinding and leaching sections by AERB members provide ample opportunities for evaluating the working environment and suggest improvements and modifications that help in providing a more conducive working environment and thus contributes to productivity. UCIL is an ISO-9001; 2000 and ISO-14001 company with a well defined quality policy and has adopted latest state-of-the-art for its mines and process plant.

Keeping in view the urgency to open new mining projects, AERB has also been expediting matters related to clearance of mine projects and also providing additional information that enhances and improves the perception of the regulatory bodies of the concerned States in terms of prescribed or permissible limits of certain elemental abundances such as manganese, uranium, radium and other substances in ground and surface waters, based on National and International agencies such as ICRP, IAEA and their findings and recommendations.

Because of the rapid increase in fuel demands UCIL is poised to take up three new mining projects that are new in terms of mining methods and technology. For the first time in India, open-cast uranium mining will be carried out at Banduhurang in Singhbhum. The Domiasiat and Lambapur deposits will also be exploited in a similar fashion. The exploitation of these deposits poses new challenges of different types such as terrain constraints in Meghalaya and proximity to a large water body in Andhra Pradesh. The challenges posed need to be addressed jointly by mining engineers, uranium mill planners, environmental engineers and the AERB's experts. The prophetic statement of "we do not know what we cannot do" by NASA scientists after the successful landing of the Mars probe, should inspire us to face these challenges collectively. Uranium mining and processing is also over three decades old and new challenges arise. Issues related to mine closure and modernization of existing plants come up. AERB's scope thus gets expanded and individual units and the regulatory body need to charter new areas. We need to take a proactive role in these aspects and liaise closely with other units of DAE. Active research in terms of environmental friendly reclamation of the mined out area and safe reclamation of tailings pond sites need to be encouraged jointly between DAE units and universities. The role of AERB thus become multifaceted and demanding. ●

TRAINING ACTIVITIES

Feed back session of AERB Training Activity

The Training Activity of AERB was completed in the month of November, 2003. A feedback session was held on February 03, 2004 in AERB auditorium, to obtain the suggestions/views/comments from the staff of AERB on this completed training activity. Chairman, Vice-Chairman, Directors/ Heads of divisions, Shri G.R. Srinivasan, Former Vice-Chairman, AERB were present conducting this session. Shri A. Ramakrishna, SADD made a presentation highlighting the aspects of completed Training Activity during this session.

Vice-Chairman, AERB expressed his views on the training requirements, modules covering different type of reactors, new staff joining AERB and on safety documents of AERB and International Atomic Energy Agency (IAEA).

Chairman, AERB appreciated the efforts made by the team for conducting the course in well-planned manner for 26 long months. He mentioned that the future training modules should be planned at advanced level and requested larger participation from divisions. He expressed that AERB Colloquia should be arranged as a regular feature of the training activity.

The views/suggestions from the staff of AERB were collated and a summarized version was projected to facilitate focused discussion in the feedback session.

AERB Colloquia

AERB conducted the following colloquia:

1) Mr. George Philip, Senior Assessment Officer in the Department of Nuclear Safety and Security, IAEA delivered a talk on February 5, 2004 in AERB auditorium on the following topics:
   a) Convention of Nuclear Safety: Issues and Trends
   b) Overview of Safety Services of the Division of Nuclear Installation Safety including International Regulatory Review Missions.
2) Shri H.S. Kushwaha, Dr.A .K. Ghosh and Shri Vivek Bhasin from BARC delivered talks on the following topics on February 16, 2004 in AERB auditorium.
   a) Probabilistic Structural Integrity Assessment
   b) Generation of hazard curves, determinations of fragilities of components and convolutions of failure probabilities with fragilities of components for Seismic PSA.

Safety Research Programme

The 29th meeting of Committee on Safety Research Programme was held on January 29, 2004. The committee invited Principal Investigators involved in the project work based on dosimetry to make presentation on the progress of their projects.

Committee after detailed discussion and taking the comments made by referees approved the project titled "Estimation of Thick Target Neutron yields from charged particle reactions for accelerator Safety Research: Comparison of Nuclear Reaction Model codes" by Visva-Bharati, Santiniketan, West Bengal.

Committee also approved the renewal/ extension of the ongoing projects after a detailed discussion on the progress of the work carried out till date.

Committee recommended and approved grants for the following Seminar/ Symposium/ Conference:

1.	START-International conference by IIT-Kharagpur - 3-5 January, 2005
2.	"Radiation and Biomolecular Techniques in Animal sciences and Human Health" by College of Vety. Science, A.A.U, Assam 10-12 March, 2004

Uranium-233 can fuel the battle against Cancer

A.R. Sundarajan, Former Director, Radiological Safety Division, AERB

Uranium-233, like plutonium-239 is a man-made fissionable material. KAMINI reactor at Indira Gandhi Centre for Atomic Research at Kalpakkam is the only operating reactor in the world today with uranium-233 as the fuel. ^{233}U is produced by the neutron bombardment of ^{232}Th in a reactor. India's future nuclear power programme heavily depends on the production of ^{233}U and the large scale utilization of thorium from huge monazite deposits on the beaches of Kerala, Tamilnadu, Andhra Pradesh and Orissa.

According to recent reports from Oak Ridge National Laboratory which is the US-Department of Energy's largest science and energy laboratory at Tennessee, ^{233}U could also be a boon for millions of cancer patients. ^{233}U is the only ready source for the isotope ^{213}Bi which can be used in radio-immuno-therapy (RIT) technique for cancer cure.

Methods for treating localised cancers using conventional radiotherapy techniques are incapable of distinguishing tumour cells from healthy ones. The Radio-immuno-therapy (RIT) technique consists of tagging radioactive atoms to monoclonal antibodies capable of recognising cancerous cells. Injected into the patient, these "cellular missiles" then go off in search of their tumour targets and destroy them with the ionising radiation they carry along.

The RIT treatments applied up till now are based principally on the use of beta-emitters for marking. This type of radioactive source has made it possible to obtain significant results - but the technique has certain limitations. A promising alternative consists of replacing the beta emitters with alpha emitters. Because the high-energy alpha particles have a radiation range of only five cell diameters, they concentrate more radiation on the cancer cells and do not significantly damage healthy surrounding tissue. This results in very low side effects, making alpha particle immuno-therapy (APIT), one of the most targeted and effective cancer treatments in development. Radiopharmaceuticals based on alpha emission are generally easier to handle for hospitals and patients because they require less shielding of patient environment compared to beta emitting compounds due to their lower penetration range. But the main problem is to get an appropriate source of alpha emitters.

Initial tests using ^{213}Bi for APIT carried out at the Memorial Sloan-Kettering Cancer Center in New York, have produced very encouraging results. The objectives of the tests were to see if the technique did more harm than good in the treatment of acute myeloid leukemia. The results proved that the therapy was not only safe, but leukemia cells were eliminated in the blood stream and reduced in the bone marrow of 13 of the 18 patients undergoing trials. According to Dr. Joseph Jurcic, one of the researchers, this alpha particle immuno-therapy with ^{213}Bi has broad implications for the whole field of oncology, not just for leukemia alone. It is likely that bismuth therapy may not replace chemotherapy or surgery. But certainly it has tremendous potential in cleaning up residual cancer cells that are remaining behind after primary treatments and which are responsible for relapse in large number of cases. Patients trials will continue at Sloan-Kettering for another three years.

The problem encountered by the researchers has been in getting more bismuth-213, an exotic isotope which has a 46-minute half-life that makes it perfect for injecting into patients, because it quickly dissipates. That also makes it difficult to acquire. Bismuth-213 can be obtained in what physicists describe as a decay chain from uranium-233.

Decay chain from Uranium-233.

$^{233}U\ (\alpha) \rightarrow {}^{229}Th(\alpha) \rightarrow {}^{225}Ac(\alpha) \rightarrow {}^{221}Fr\ (\alpha) \rightarrow {}^{217}As(\alpha) \rightarrow {}^{213}Bi$

$^{213}Bi\ (\beta) \rightarrow {}^{213}Po\ (\alpha) \rightarrow {}^{209}Pb(\beta) \rightarrow {}^{209}Bi$ **(Stable isotope)**

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HOME PAGE

New appointments in AERB during January-March 2004

Name	Grade	Date of Joining AERB
Dr. Om Pal Singh	SO/H	19/02/2004
Shri M. Senthilkumar	SO/C	29/03/2004
Kum. Arati Kulkarni	SO/C	31/03/2004
Kum. Dipali Choudhary	SO/C	31/03/2004
Smt. Dipika Bokade	SA/B.	30/01/2004

Retirements from AERB during January-March 2004

Name	Grade	Date of Retirement
Dr. K.S. Parthasarathy	SO/H	31/01/2004

Deputation/Delegation sent abroad during January-March, 2004

Sr. No.	Name of the Officer	Purpose
1.	Dr. A.N. Nandakumar	Consultancy services to IAEA Iregarding Action Plan on Safe Transport of Radioactive Materials, Vienna
2.	Shri R.S. Rao	To undergo graduate studies for a period of one year at Royal Institute of Technology, Stockholm, Sweden.
3.	Dr. P.Sasidhar	Second Research Co- ordination Meeting (RCM) of IAEA-CRP on Application of Safety Assessment methodologies for near Surface Radioactive Waste Disposal Facilities, Vienna
4.	Dr. P.C. Basu	1) Second RCM of IAEA-CRP on Safety Significance of Near Field Earthquakes, Italy 2) American Concrete Institute (ACI Centennial Convention, USA. 3) International symposium on advances in Concrete Through Science and Engineering (ACTS), USA.
5.	Shri S.K. Sharma	1) IAEA Biennial Meeting of the International Nuclear Event Scale (INES) 2) INSAG Meeting

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Safety Review of Projects of Front End Nuclear Fuel Cycle Facilities

estimating consequences of accident and furthermore the population distribution around site should be established for assessing societal risk, if desired. To determine the damage from an incident, many techniques are needed to cope with variation of possible cases e.g. discharge rate models are required for pressurised liquids and gases, for refrigerated liquefied gas a vaporisation model is needed, then a model of the dispersion process is required.

In general, estimation of the consequences consists of

- estimating the opening in equipment/pipeline
- calculating the amount of material released
- categorising material according to flammability and toxicity.
- computing the effect distance due to fire/explosion/toxicity.

2.3.3 Estimation of Frequency

The next step would be estimating the frequency of accidents sequences identified for which the consequence analysis has shown could lead to non-negligible consequences. It is first necessary to identify the initiating event, the intermediate events of the accident sequence and consequence. The techniques involve to find a) basic events for any accident to occur or b) sequence of events to occur for any initiating event and c) calculating the frequency of any accident event to occur from this branching. Defining events to be quantified is an important stage in the analysis and it is vital for a full analysis where the probabilities and consequences of the possible events are to be combined to produce an overall quantitative risk estimate. Initially a coarse estimate of the consequences of events is made to identify which of the events would be sufficiently damaging. Frequency assessment is first carried out with the use of statistical data on release frequency called the "historical approach" or generic data and such data are usually defined for specific break.

3. CONCLUSION

The review and assessment procedure described ensures that there is no unacceptable risk to personnel, the public and environment, by

- identifying the hazards by thorough review of the design, material, and equipment, and ensuring quality assurance.
- ensuring the elimination and mitigation of hazards by review of passive and active safety systems provided to prevent accidents, their functions and limitations.
- limiting the hazards by ensuring appropriate limiting conditions for operating the plants and suitable administration and management to run the facility.
- limiting the damage to personnel, public and environment in case & accident is limited by ensuring the availability of proper hazard control facilities and accident management systems. ●

AERB Staff Club picnic at Karnala Bird Sancturary

(Contd. from page 7...)

Uranium-233 can fuel the battle against cancer

Actinium-225 is extracted from thorium-229 obtained from aged uranium-233 solution and then the bismuth is extracted from the actinium. Oak Ridge's uranium-233 was made at the government's weapons fuel production plants in South Carolina and Washington State in the 1950s and 1960s, as currently uranium-233 is not being produced in any of the facilities in USA. While ^{213}Bi is only one of many sources of alpha particles, it is easier to handle than the others, and decays rapidly into a stable non-radioactive substance. As ^{213}Bi has an half-life of just 45 minutes, one has to develop an innovative transport system and hospital-friendly procedures which allow ^{213}Bi to be extracted just before treatment. Such radioactive generator-cows which will yield the desired radionuclides at the treatment centers are not new to the nuclear medicine community.

Both Bhabha Atomic Research Centre at Trombay and Indira Gandhi Centre for Atomic Research at Kalpakkam have the necessary remote cell facilities and process chemistry technology to supply bismuth-213 for similar studies at Radiation Medicine Centre, Mumbai. The day the nuclear medicine physician is provided this powerful bismuth-213 kit in his hand, the medical community will be grateful for adding one more to the myriad tools the atomic energy research has delivered to fight cancer, the mankind's most dreaded disease. ●

Printed and published by Shri P. K. Ghosh, Atomic Energy Regulatory Board, Niyamak Bhavan, Anushaktinagar, Mumbai-400094, Tel. & Fax 5516342 Res. No. 5584084. Printed at New Jack Printing Works Pvt. Ltd., Mumbai-400 013.