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AERB Newsletter

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ATOMIC ENERGY REGULATORY BOARD

Mission: The mission of Atomic Energy Regulatory Board is to ensure that the use of ionizing radiation and nuclear energy in India does not cause unacceptable impact on the health of workers and the members of the public and on the environment.

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From the Chairman's Desk

Greetings to all.

The period post-Fukushima has heralded nuclear power into a regime of enhanced safety in design, operation and management. It has also triggered increased international co-operation in safety and regulatory practices. The global nature of nuclear power and the common concern for utmost safety in nuclear power have contributed to these renewed interactions. One such forum was the extraordinary meeting of the Convention for Nuclear Safety (CNS), held at Vienna in August 2012, where-in a congregation of sixty-four contracting parties of the CNS, including India, participated. The deliberations were on topics related to nuclear safety such as external event, reactor design, severe accident management and recovery, emergency preparedness, emergency response and post-accident management.

The other notable event, for India, towards fostering of international cooperation in nuclear safety was the signing of Memorandum of Understanding (MoU) with Governments of Romania and Ukraine. AERB signed the MoU with National Commission for Nuclear Activities Control (CNCAN), Romania, and State Nuclear Regulatory Inspectorate of Ukraine (SNRIU) for information exchange in various areas related to nuclear and radiation safety.

AERB had also hosted an IAEA International workshop on the safety of multi-unit Nuclear Power Plant (NPP) sites against external natural hazards, with sizeable participation from different countries. The outcome of the deliberations would form the inputs for international guidance on carrying out safety assessment in relation to external events of NPP sites with multiple units.

The detailed reports on the international forums are given in this newsletter.

Judging from the response from the media and public, it is encouraging to see that there is a definite interest and awareness of nuclear power and its benefits to society. This notwithstanding, it is the responsibility of the utility and the regulatory body to periodically evolve their public communication strategies towards providing information that is "*Pro-active, Prompt, Precise and People-friendly*". AERB has recently brought out a popular version of its Annual Report, in an easy to understand format. This report readily furnishes the reader with a comprehensive over-view of the country's nuclear power program and its safety status. AERB intends to bring out the popular version, annually, in various regional languages such as Hindi, Marathi and Tamil, for better out-reach.

In the past few years there has been a steady growth of the use of radiation sources in medicine, i.e. in the fields of radiotherapy, nuclear medicine and diagnostic radiology. To keep pace with the increasing regulatory span of control, AERB has fast-tracked its regulatory process, has streamlined its regulatory processes in accordance with the radiation hazard involved to the patient, radiation worker & public, and has updated its safety documentation. Also, at the forefront, are the decentralization activities; i.e. setting up of Regional Regulatory Centers and State Directorates of Radiation Safety. There is also the advanced software based system, the e- Licensing of Radiation Applications (e-LORA), for source tracking and utility licensing, which will be in operation shortly. Further, AERB has revised provisions in regulatory policy, based on operational experience feedback, for setting up of calibration facilities, authorization of service agencies and qualification of radiation workers. All these developments will enable the stakeholders to follow regulations based on the current scientific understanding. This issue of newsletter gives glimpses of the policy changes in these areas that are underway.

The importance of human resource for any organization cannot be over-emphasized. AERB has always created various avenues to promote the academic excellence and the scientific spirit amongst its employees. A new step in this direction is the institution of an award scheme, and for the first time this year, awards were given away under various categories.

Every year AERB confers the green site awards to deserving institutions, during the safety professionals meet. This year onward the 'Green Site Award' was re-christened as 'Environment Protection Award'. The assessment for the winners of this award not only includes the efforts taken for greenery development as was the criteria for 'green site award' but also various other parameters such as efforts put in for resource conservation, energy conservation and mitigation measures to prevent pollution of the environment. The details of the safety professionals meet and the awards are part of this newsletter.

This issue of the newsletter has articles on 'Severe Accident Analysis for CANDU6 Station Black Out event" and "Online Decision Support System for Off Site Emergency Conditions" amongst others.

(S.S. Bajaj)

Safety Review and Regulation

AERB Board Meeting

The 107th Board meeting was convened on August 9, 2012. This meeting saw the review of activities related to preparedness for according approval towards "Initial Fuel Loading" and "First approach to Criticality"(IFL & FAC) of Kudankulam (KK) Nuclear

AERB Board Members at the Board Meeting

Power Plant Unit-1. Based on the AERB's reviews and recommendations of the Advisory Committee on Project Safety Review (ACPSR), the Board accorded Clearance for IFL and FAC for KK NPP Unit-1 subject to various stipulations including the time bound implementation of recommendations for safety enhancements, as recommended by the High Level Expert Committee set up after Fukushima accident.

The Board also reviewed a proposal to amend certain sections of the AERB Safety Code for Medical Diagnostic X-ray Equipment and Installation, AERB/SC/MED-2(Rev.1) 2001. The amendments were proposed to provide an optimized regulatory framework of the Diagnostic Radiology practice. The important areas proposed to be revised were a) Licensing of Manufacturers/Suppliers/ QA service providers of X-ray equipment b) Consenting process c) area and shielding requirements d) qualification and experience requirements of radiation workers e) requirement of NOC for import of X-ray tubes. The Board was informed that the amended requirements are user friendly, and their implementation would bring the Diagnostic Radiology facilities under regulatory control without compromising radiation safety. Agreeing to this proposal, the Board recommended that qualification & experience requirement for X-ray technologists and service engineers may not be made part of the Code and can be prescribed by AERB from time to time.

While reviewing the annual report 2011-2012, the Board recommended that a popular version of annual report, in an understandable and public friendly format, be published. The "aerb bulletin" for the year 2011-12 has since been published. This bulletin in popular format will be published every year.

The overall safety status of Operating Nuclear Power Plants (NPPs) was presented by Shri S. Duraisamy, Chairman SARCOP and Vice-Chairman, AERB. The Board, in particular, noted the progress made in the implementation status of different recommendations for safety up-gradation of Indian NPPs after Fukushima accident.

Consents Issued by AERB

1) Initial Fuel Loading (IFL), Closure of Reactor Pressure Vessel Top Head and post-IFL heat up of Reactor Coolant System of Kudankulam Unit -1.
2) In-situ concreting of Roof Slab and Rotatable Plugs (LRP & SRP) of PFBR, Kalpakkam
3) Regular operation of Interim Fuel Storage Building, Kalpakkam
4) Operation of Compact Reprocessing of Advanced Fuel Lead Cell (CORAL) facility for one year to reprocess FBTR spent fuel, Kalpakkam
5) Resumption of 20th irradiation campaign of FBTR, IGCAR, Kalpakkam
6) Regular operation of AFR at TAPS-1&2, Tarapur
7) Extension of license for operation of Tarapur Atomic Power Station-1&2 up to June 2013
8) Extension of license for operation of Rajasthan Atomic Power Station-3&4 up to December 2013.

Regulatory Inspections

AERB officials carried out periodic Regulatory Inspections as well as special inspections at Nuclear and Radiation facilities to review the safety status and verify compliance with the regulations. In addition, industrial safety aspects were inspected every month for Nuclear Projects. Unannounced inspections also were carried out for selected radiation facilities.

Human Resource Development and Safety Research Programme

AERB Training Activities

AERB Orientation Course for Regulatory Process (OCRP-2012) was conducted during September to December 2012 for forty new scientific officers/scientific assistants who joined various divisions of AERB during last one year. Forty-five lectures were delivered by in-house faculty which was followed by examinations. As part of the course, site visit to TAPS 1& 2 and TAPS 3&4 were arranged for the participants. One day visits were arranged to ACTREC, Kharghar and Dhruva, BARC to have familiarization of radiation facilities and research reactor.

Eight stipendiary trainees (Cat-I) from the panel of Nuclear Fuel Complex, Hyderabad, joined AERB during July-October 2012. The candidates were given one-year training course in AERB before their regular appointment as 'Scientific Assistant-B' in AERB. The classroom training was divided into following three modules and was completed by December 2012.

MODULE -1	BASICS: Reactor Physics, Instrumentation, Electrical, Mechanical, Electronics, Civil, Chemical and Computers
MODULE-2	POWER PLANT ENGINEERING: Basics, Nuclear Power Plant Engineering & NPP Systems
MODULE -3	SAFETY ASPECTS: Nuclear safety, Radiation safety, Industrial safety etc.

Dr. A. Ramakrishna, Head, TS and RPS delivering talk during OCRP-2012

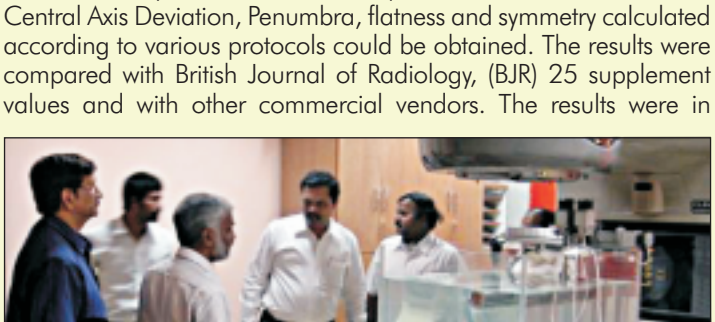
Safety Research Progamme (SRP)

Committee for Safety Research Program (CSRP) of AERB reviewed the progress of on-going projects, in the presence of project coordinators and principal investigators, and recommended approval for four on-going projects. The committee agreed for funding of two new project proposals as below:

Sl. No.	Project Title	Principal Investigator
1.	Effect of Radiolytic Products and Metal Nitrates on Red Oil Forming Reactions in Fuel Reprocessing	Dr. M. Surianarayanan, CLRI, Chennai
2.	Development of Thermal Hydraulics Model and Coupling of AERB 3D Kinetics Code, "TRIKIN"	Dr. Arun Kumar Saha, IIT-Kanpur

Development and Testing of Indigenous Cost Effective Three Dimensional Radiation Field Analyser (3DRFA)

A project entitled, 'Development and Testing of Indigenous Cost Effective Three Dimensional Radiation Field Analyser' was sanctioned by AERB during January 2010 to Kidwai Memorial Institute of Oncology, Bangalore. The aim of the study was to design and validate an indigenous three dimensional Radiation Field Analyser (3D RFA). 3D RFA is a part and parcel of modern radiation therapy during commis-sioning of the state-of-the-art linear accelrators and other telecobalt therapy machines. 3D RFA system includes: Acrylic Water Phantom, Mobile Cart with lifting mechanisms, Water Reservoir, Controller, Data Detection and Acquisition Systems, and Software Modules. The acrylic phantom with dimensions of 800 mm x 750 mm x 570 mm was made with thickness of 20mm. The telescopic column lifting unit was designed using linear actuation technology for lifting the water phantom. The feed system was made for X, Y and Z axis movements is of lead-screw with deep ball bearing mechanism made up of stain less steel driven by Stepper motors with high precision and accuracy better than 0.5 mm. The software modules were developed in visual basic platform, classified into two types, viz. beam analyzer module and beam acquisition module. The premeasurement checks were performed as per American Association of Physicists in Medicine (AAPM) Task Group TG-106 recommendations. The physical parameters of photon Percentage Depth Doses (PDD) such as Dmax, D10, D20 and Quality Index and for electron PDD such as R50, Rp, E0, Epo and X-ray contamination values could be obtained instantaneously. Also the results for profile data such as field size, Central Axis Deviation, Penumbra, flatness and symmetry calculated according to various protocols could be obtained. The results were compared with British Journal of Radiology, (BJR) 25 supplement values and with other commercial vendors. The results were in agreement within 2% and 2 mm. The outcome of the project would help in providing an affordable RFA to all radiotherapy centers in the country which would reduce the burden of treatment cost considerably. The study was selected for presentation in best paper session in the annual conference of AMPI held at Mangalore, the work is being processed for publication in a reputed indexed journal.



Dr.K.M.Ganesh, the Principal Investigator, demonstrating the indigenously developed RFA to the AERB official and other associated professionals

(Principal Investigator: Dr.K.M.Ganesh, Associate Professor, Kidwai Memorial Institute of Oncology

Co-investigators: Mr.A.Pichandi, HCG, Bangalore, Mr.T.Vijayareddy, KMIO, Bangalore

Coordinators: Dr.R.M.Nehru, AERB and Dr.K.V.Subbiah, SRI, AERB)

Current AERB Board

The Atomic Energy Regulatory Board was constituted by a notification issued under the Atomic Energy Act, 1962 to carry out certain regulatory and safety functions for administering nuclear and radiation safety in the facilities under its jurisdiction. The Board is also vested with powers for enforcement of the Factories Act, 1948 in units of Department of Atomic Energy, under its jurisdiction.

Presently the Board of AERB consists of seven members including four members from outside Department Of Atomic Energy. The Board members have outstanding ability, impeccable integrity and standing with distinguished professional record and vast experience in Government, industry, academic institutions or national laboratories in varied disciplines .

	**Shri S.S. Bajaj** Chairman, AERB	Chairman
	**Shri S. Duraisamy** Chairman, Safety Review Committee for Operating Plants (SARCOP), AERB	Ex-Officio Member
	**Dr. G.K.Rath** Professor and Head, Department of Oncology, AIIMS, New Delhi	Member

	**Dr. K.V. Raghavan** Former Chairman, Recruitment & Assessment Centre, Defense Research & Development Organisation, Ministry of Defence, New Delhi	Member
	**Prof. Devang V. Khakhar** Director, Indian Institute of Technology, Bombay	Member
	**Dr . Harsh K. Gupta** Member, National Disaster Management Authority, NDMA Bhavan, A-2, Safdarjung Enclave New Delhi	Member
	**Shri R.Bhattacharya** Director, ITSD & IPSD, AERB	Secretary

Official Language Implementation

Along with the regulatory and other scientific activities which form its primary goal, Official Language Implementation is very much a top priority in AERB. Ensuring the same, an array of events was taken up by the Official Language wing of AERB and is as follows:

- Hindi Day was celebrated on September 14, 2012 and organized by AERB on behalf of the Joint Official Language Co-ordination committee of the four units of DAE situated in Anushaktinagar. Shri S.S. Bajaj, Chairman, AERB graced the function as a Chief Guest. Dr. Vijay Bahadur Singh, Ex- Director, Bharatiya Bhasha Parishad, Bhopal, Madhya Pradesh was also invited to deliver a lecture on "Jan Jan ki Bhasha Hindi"
- Shri K. Zahir Hussain, AD(OL), AERB was awarded the first position in the event of Scientific Translation Competition (Officer's Category) conducted by Department of Atomic Energy and was felicitated with prize and certificate during the 14th All India DAE-Official Language Conference, held on January17-18h, 2013 at Atomic Minerals Directorate for Exploration and Research (AMD), Jaipur.
- Two Hindi workshops were conducted in Administrative Training Institute on behalf of Joint Official language implementation committee in this period. Also, a Hindi workshop was organized for the UDCs, Stenographers and Personal Secretaries working in AERB on 10th October. The main objective of this workshop was to address the issues commonly encountered while preparing the Quarterly Hindi Progress Reports and also to impart training on Unicode.
- As part of the Hindi talk series in AERB, a talk was organized on December 18, 2012 on "Pranayam and Mental Stability". Shri Sheikh Mohammed Sabir from Yoga Vidya Niketan, Vashi was invited as the Guest Speaker.
- Twenty eight AERB safety Codes, Guides and Standards have been successfully translated in Hindi and sent for printing.
- DAE Incentive Scheme for working in Hindi has been introduced in AERB and employees of various divisions of AERB are actively participating in the scheme. Two employees were awarded in this scheme. Two employees of AERB (01 each for Praveen and Pragya) have completed their training.
- Hindi books on various subjects, viz., Literature, Science, Computers, Official Language etc., were procured during this period.

Dignitaries on the dais at 'The Hindi Day' celebrations

Shri Zahir Hussain, AD (OL), receiving the award from Shri P.S.Parihar, Director, AMD, Hyderabad during the All India DAE-OLIC Conference at Jaipur

Extraordinary Meeting of the Convention on Nuclear Safety

India is a signatory to the Convention on Nuclear Safety (CNS) and ratified the Convention in March 2005. The Convention legally commits the participating countries to maintain a high level of safety in their nuclear power plants and obligates them to submit national report on the safety of their NPPs every 3 years to demonstrate that the obligations under the various articles of the CNS are appropriately fulfilled.

India submitted the first National Report in September 2007 that was reviewed in the fourth Review Meeting of CNS held in April 2008. The second national report of India was reviewed in the fifth Review Meeting on CNS held in April 2011. During the fifth Review Meeting, the contracting parties had agreed to hold an Extraordinary Meeting with the objective of reviewing and discussing lessons learnt from the accident at TEPCO's Fukushima Daiichi nuclear power plant in Japan, and to review the effectiveness of the provisions of the Convention.

India submitted the National Report on 'Actions taken for Indian NPPs subsequent to Fukushima Nuclear Accident' for review by contracting parties to the convention (Report is available at http://www.aerb.gov.in/cgi-bin/conferences/conventionnew.asp). India received a total of 25 questions / comments from three of the contracting parties, the responses to which were posted on the CNS website.

The Extraordinary Meeting was held from 27 to 31 August 2012 at the IAEA Headquarters in Vienna, Austria. More than 600 participants from 64 Contracting Parties to the CNS participated in the meeting. A thirteen member Indian delegation led by Shri S.S.Bajaj, Chairman, Atomic Energy Regulatory Board, participated in the meeting.

Participants discussed a range of nuclear safety-related topics including external events, reactor design, severe accident management and recovery, emergency preparedness, emergency response and post-accident management, as well as international cooperation. The Contracting Parties also made several revisions to the procedures and guidance documents of the convention.

The contracting parties established a working group open to all Contracting Parties with the task of reporting to the next Review Meeting of the convention on a list of actions to strengthen the peer review process and on proposals to amend, when necessary, the Convention.

IAEA press release on the second extraordinary meeting is available at http://www.iaea.org/newscenter/pressreleases/2012/cns-prstatement310812.pdf

IAEA International Workshop on the Safety of Multi-Unit Nuclear Power Plant Sites against External Natural Hazards

There is an increasing trend to have multi-unit nuclear power plants (NPPs) sites and other co-located nuclear installations.

Indian and IAEA delegates at the IAEA International Workshop on the Safety of Multi-Unit Nuclear Power Plant Sites against External Natural Hazards

This poses additional challenges to safety assessment of a multi-unit site over those with a single-unit NPP for external hazards. Multiple external hazards makes the task of safety assessment even more complex .The impact of the Niigataken Chuetsu-oki (NCO) earthquake in July 2007 on the Kashiwazaki-Kariwa NPP of Japan highlighted the need for developing a methodology and detailed guidelines for the safety assessment of sites housing multi-unit NPPs and other nuclear installations for multiple correlated hazards generated by an external event (e.g. earthquake induced ground motion and fire). The Fukushima Daiichi nuclear accident caused by the Great East Japan Earthquake and Tsunami on March 11, 2011 underlined the importance of initiating a comprehensive safety assessment of multi-unit sites for multiple hazards and share experience and ideas of the international nuclear community.

AERB hosted an IAEA workshop to share information among the international nuclear community on the scientific and technical issues related to the safety of multi-unit NPP sites against external natural hazards that need to be addressed following the Fukushima Daiichi nuclear accident. The workshop also highlighted the activities undertaken by the IAEA and its Member States to meet the challenge of ensuring the safety of multi-unit sites against multiple external hazards.

The workshop covered the following main topics: lessons learned from past earthquakes affecting NPPs; assessment of external natural hazards at a site housing multi-unit NPP(s) and other nuclear installations; external event probabilistic safety analysis ; risk integration; and external event site safety assessment.

About 80 participants including about 30 from overseas attended the workshop. The discussions provided direction for development of guidance material for the safety assessment of

NPP sites, especially multi-unit sites, in relation to external events under the activities taken up in Work Area 8 of the IAEA's International Seismic Safety Centres Extra budgetary Programme.

Design of safety related concrete structures of nuclear facilities

AERB published the safety standard for design of concrete structures important to safety of nuclear facilities, AERB/SS/CSE-1, in the year 2001. Since its publication, AERB/SS/CSE-1 has been used for design of safety related concrete structures of KAPP-3&4, RAPP-7&8, PFBR and FRFCF, thereby providing considerable experience on use of this standard. Based on the user feedback AERB is in the process of revising the standard. In this regard, a one day discussion meet on "Design of Safety Related Concrete Structures of Nuclear Facilities" was held at AERB on December 21, 2012. The following were addressed a) Adequacy of coverage of the design issues. b) Rationality of its provisions c) performance comparison of design provisions in AERB/SS/CSE-1 with similar standards worldwide.

Eighty five participants from AERB, DAE units (viz. BARC, IGCAR, BHAVINI, NPCIL, HWB and DCSEM) and consultants (viz. DCPL, TCE, STUP, PLE, and Spectrum techno consultants) participated in the discussions. Detailed presentations were made by the utilities and the consultants, which was followed by a panel discussion.

Panel Members at the Discussion Meet on "Design of safety related concrete structures of nuclear facilities"

AERB organises the 29th DAE Safety & Occupational Health Professionals Meet jointly with NPCIL & HWB at Rawatbhata Rajasthan Site (RR Site) during Dec 17-19, 2012

S.R. Bhave & Soumen Sinha

Industrial Plants Safety Division, AERB

To promote safety culture and sharing of new ideas among safety professional technical meets are organised every year by AERB together with a unit of Department of Atomic Energy (DAE) with varying themes related to Industrial Safety and Occupational Health. These meets provide platform for experience sharing and exchange of valuable information among the participants. These meets over the years have continued to encourage and motivate the Safety and Occupational Health professionals of DAE units and have garnered an overwhelming support from all the units of DAE which under the regulatory control of AERB. This year the 29th DAE Safety & Occupational Health Professionals Meet was jointly organized by AERB, Mumbai, Nuclear Power Corporation of India Limited (NPCIL) and Heavy Water Board (HWB), at Rawatbhata during December 17-19, 2012.

The theme for this year's three day Meet was "Emergency Preparedness for Chemical Industries and Emergency Medicine". About 150 delegates from various DAE Units and other institutes participated. The meet had witnessed galaxy of dignitaries from DAE units. Shri B. Bhattacharjee, Member, National Disaster Management Authority (NDMA) and former Director, Bhabha Atomic Research Centre was the Chief Guest of the Function.

In the inaugural session, there were addresses from Chairman, AERB, Chairman & Managing Director, NPCIL, Chairman & Chief Executive, HWB, Secretary, AERB, Site Director, Rajasthan Rawatbhata Site and Station Director, RAPS1&2. Shri Bhattacharjee delivered the Dr. S.S. Ramaswamy Memorial Endowment Lecture on 'Science and Technological Inputs for Emergency Preparedness in Chemical Industries'. A Monograph on "Hazardous Chemicals & Emergency Preparedness and Emergency Medicine" was released during the meet. A compendium prepared on the technical proceedings was also released and distributed to the participants. Prizes were distributed to the winners of logo competitions conducted for the Meet.

Dignitaries at the 29th DAE Safety & Occupational Health Professional Meet held at Kota, Rajasthan

Every year AERB distributes the green site award during the safety professionals meet. This year onwards, the 'Green Site Award' was re-christened as 'Environment Protection Award'. The assessment for the winners of this award not only includes the efforts taken for greenery development as was the criteria for 'green site award' but also various other parameters such as

Discussion Meet / Theme Meeting / Safety Promotional Activities

efforts put in for resource conservation, energy conservation and mitigatory measures to prevent pollution of the environment, amongst others. The winners of this year's Environmental Protection Awards were Indian Rare Earths Limited (IREL), Chavara, Narora Atomic Power Station and Kakrapar Atomic Power Project 3&4.

The inaugural session was followed by three technical sessions out of which two were on Emergency Preparedness and one on Emergency Medicine. Each of these technical sessions had invited lectures delivered by renowned experts from DAE as well non-DAE facilities such Institute of Chemical Technology, Mumbai, Bhopal Memorial Hospital and Research Centre, Bhopal and Narayana Hrudayalaya Hospital, Jaipur.

Second day of the meet had dedicated plenary sessions on various topics such as injury and occupational health statistics, hazard identification, risk assessment & emergency preparedness, process safety & case studies on accidents, emergency medicine, hazardous waste Management and contract safety management. The plenary sessions were interactive with active participation of the safety and occupational health professionals. There were about 50 presentations by various professionals from DAE units and AERB. The last day of the meet was concluded by a valedictory session wherein prizes were distributed to the winners of poster and slogans competition held among DAE employees.

A Technical Exhibition on nuclear technology, safety appliances, public awareness and regulatory aspects was organised during the Meet. About 20 exhibitors including NPCIL, HWB, AERB and other manufacturers/suppliers had displayed their exhibits.

The meet received an overall positive feedback from the participants and was quite successful in imparting significant updated knowledge to the safety and occupational health professionals on various aspects related to handling chemical emergencies.

International Co-operation

AERB signs MoU with National Commission for Nuclear Activities Control of Romania

A Memorandum of Understanding (MoU) was signed between Atomic Energy Regulatory Board (AERB) of the Government of India and National Commission for Nuclear Activities Control (CNCAN) of the Government of Romania for the exchange of information and co-operation in the field of regulation of nuclear activities for peaceful purposes.

India and Romania have adopted the Pressurized Heavy Water Reactor (PHWR) technology to produce power from natural uranium. Recognising the importance of mutual co-operation, both the countries entered into MoU for information exchange on the regulatory process of PHWRs, application of radiation for societal benefit in industry, medicine, agriculture and research & field of regulating nuclear and radiation safety for peaceful purposes. It was signed on Sep.19, 2012 by Chairman AERB and President CNCAN at Vienna.

Shri S. S. Bajaj, Chairman, AERB exchanging the MoU with Dr. Ing. Constantin POPESCU, National Commission for Nuclear Activities Control (CNCAN) of the Government of Romania at Vienna

AERB signs MoU with the State Nuclear Regulatory Inspectorate of Ukraine

Shri S.S. Bajaj, Chairman, Atomic Energy Regulatory Board (AERB) of India and Chairperson of the State Nuclear Regulatory Inspectorate of Ukraine (SNRIU) of Ukraine inked a Memorandum of Understanding (MoU) on December.10, 2012 at New Delhi for the exchange of information and co-operation in the field of regulation of nuclear activities and radiation protection for peaceful purposes.

Recognising the importance of mutual co-operation, both the regulatory bodies entered into MoU for information exchange on the regulatory process, nuclear safety, radiation protection, waste management, transportation, physical protection, emergency planning, environmental impact evaluation of nuclear facilities, quality assurance and sharing of operating experience including information concerning research and development programs.

Shri S. S. Bajaj, Chairman, AERB and Mrs. Olena A, Mykolaichuk , Head of the State Inspectorate for Nuclear Regulation of Ukraine, signing the MoU in the presence of the Prime Minister, Dr. Manmohan Singh and the President of Ukraine, Mr. Viktor Yanukovych, in New Delhi

Safety Status on Radiological Facilities

Diagnostic Radiology

AERB organized a special meet with the Manufacturers/Suppliers of Diagnostic X-ray Equipment on October 11, 2012. The main objective of this meet was to introduce the revised regulatory requirements for diagnostic radiology practice as incorporated as Amendment to Safety Code on Medical Diagnostic X-ray equipment and Installations [AERB/SC/MED-2 (Rev.1), 2001]. The amendments are introduced mainly to regulate Diagnostic Radiology (DR) practice more effectively based on regulatory experience and feedback received from the stakeholders. A series of presentations were made on topics such as, revised regulatory requirements for diagnostic radiology practice, e- Licensing for Radiation Applications (e-LORA), and feedback from manufacturers and suppliers on the revised requirements. The meet was attended by Chairman, AERB; Head, Radiological Safety Division, AERB and representatives of leading manufacturers/suppliers of diagnostic radiology equipment. The meet proved to be successful with useful interactions between the stake holders and the regulatory body.

AERB officers delivered talks on following topics to spread awareness on radiation safety and maintaining quality assurance at various forums such as

a) All Odisha Radiographer Service Association, Bhubaneshwar,
b) Directorate of Radiation Safety, Kerala in Kottyam December 22, 2012.
c) Deenanath Mangeshkar Hospital & Research Centre in Pune on October 13, 2012
d) "Green Health 2012" in Mumbai on September 07, 2012
e) Workshop on Hands-On Experience on Mammography and DEXA Imaging Equipment held at PGIMR, Chandigarh on August 25, 2012

Nuclear Medicine

In order to familiarize the technical staff of Nuclear Medicine facilities with respect to the Quality Control tests on the PET-CT/SPECT-CT imaging equipments as per NEMA 2004 protocol, the results of which would form one of the pre-requisites for issuance of license for the PET-CT/SPECT-CT, the Nuclear Medicine group of RSD, AERB conducted a one day workshop on July 27, 2012 at AERB, Mumbai. About 90 delegates from different parts of the country attended the programme.

AERB officers also delivered talks on the awareness programme, held by M/s JSL Ltd., Hissar on September 14, 2012.

Shri S. A. Hussain (formerly Head, RSD, AERB) addressing the gathering at the workshop on 'Quality Control of Nuclear Medicien Equipments (PET-CT /SPECT-CT)

A One Day Awareness Programme on Use of Radioisotopes and General Practices for Laboratories handling "open Radioisotopes" at the Division of Biological Science, Indian Institute of Science, Bangalore, on October 05, 2012

Lectures were delivered on a) Legislation and Regulatory Requirements in Handling Radioisotopes used in Research Applications & Planning of Research Laboratories b) Radiation Quantities & Radiation Detection and Measurements c) Disposal of Radioactive Waste and Workplace Monitoring of Research Laboratory and Transport of Radioactive Materials Nucleonic gauges.

Southern Regional Regulatory Centre

Southern Regional Regulatory Centre, AERB, Chennai conducted a One Day Awareness Programme on 6.12.2012 at the Salem Steel Plant- a unit of SAIL - which employs different kinds of nucleonic gauges. The awareness programme was on regulatory and radiological safety aspects of nucleonic gauges and comprised of three modules, namely: (1) Basic Radiation Theory and Radiation Protection Aspects, (2) Evolution of Regulatory Framework in India on Radiation Protection And Role And Responsibilities of AERB Vis-A-Vis Nuclear And Radiological Facilities and (3) Facility Specific Regulatory Aspects on Nucleonic Gauges.

Investigation on Steel Contamination

In recent years, cases of radioactive contamination in the finished steel products made from the recycled metal have been reported in some countries. Though the radioactivity levels in these contaminated steel products were too low to pose any significant hazard to the handling personnel, the users and public, its presence is undesirable.

In India, even though recycling metal industries are not the licensees of AERB, whenever such incidents are brought to the notice, AERB officials are immediately deputed for the investigation. While investigating such incidents, no abnormally high radiation levels were observed in the steel manufacturing plants, steel rolling facilities, suppliers' places and suspected foundries. In some cases, contaminated steel pieces (left out) could be found. Such identified contaminated items are always segregated and kept in isolated rooms, pending safe disposal.

AERB has been interacting with representatives of the recycling industry to sensitize them to the fact that contamination in recycled steel howsoever trivial is not acceptable.

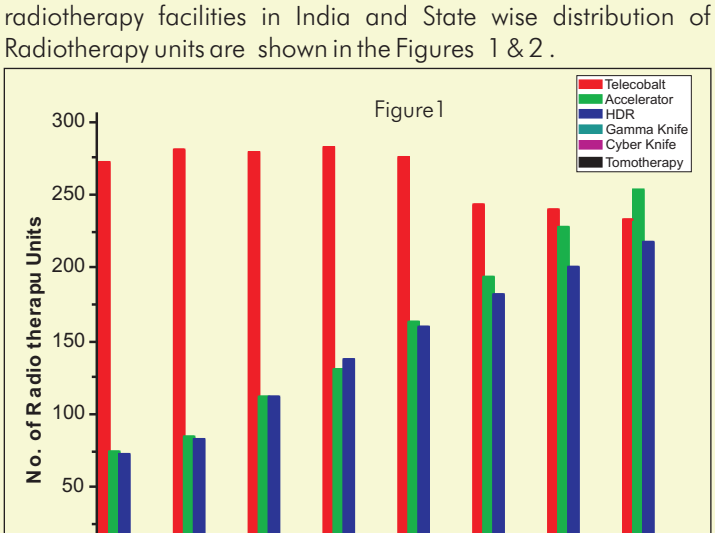
AERB has been coordinating with the relevant ministries/government agencies to effectively prevent the incidents of steel contamination. AERB is also coordinating with Metal Recycling Association of India (MRAI) and other associations on the above issues.

Status of radiotherapy facilities in the country

In mid 1930s, use of radiation therapy was started as an adjuvant to radical mastectomy. In 1951, Cobalt-60 teletherapy was first put to clinical use in London, Ontario. It was adopted with tremendous enthusiasm in the treatment of malignant disease. At present, radiation therapy alone or in conjunction with surgery or chemotherapy is one of the principal modalities for the treatment of cancer. In India first telecobalt machine was installed at Cancer

Safety Status on Radiological Facilities

Institute, Chennai in 1956. The first megavoltage linear accelerator was installed in London in 1952. At present there are 337 radiotherapy centres having 253 Medical Linear Accelerators, 4 Cyber Knife units, 3 Tomotherapy units, 232 Telecobalt units and 8 Gamma Knife units. In addition to the above, teletherapy units, 218 HDR Brachytherapy units are also available in the different hospitals across the country. Growth of radiotherapy facilities in India and State wise distribution of Radiotherapy units are shown in the Figures 1 & 2 .



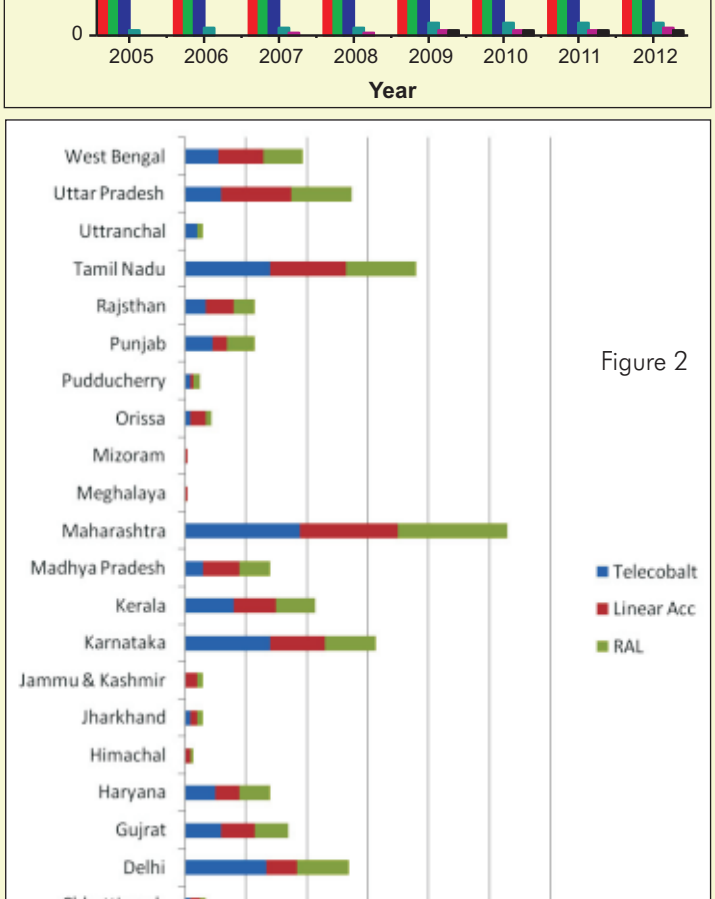


Figure 2

Special review of new type of Medical Linear Accelerator

Standard medical electron linear accelerators (linacs) with flattened photon beams are in clinical use from last six decades for treatment of cancer. The purpose of using flattening filter is to convert the forward peaked MeV bremsstrahlung photon intensity into uniform intensity pattern for obtaining clinically acceptable beam profile. However, recently introduced advanced techniques of radiotherapy are based on the further modulation in the intensity pattern of the flattened photon beam indicating that flattening of initially produced unflat beam is not necessary for such advanced treatment techniques. Based on the studies, it was demonstrated that the removal of the flattening filter (FF) results in significant increase in dose rate by a factor of about 2 - 4, softening of the x-ray spectra leading to reduction in scattered radiation as well as reduction in neutron and photon leakage from the treatment head. Encouraged with such findings, manufacturers came forward with a modified version of linac designs incorporating the options of generating both flattened and un-flattened photon beam for clinical use. This development has necessitated the modification in the evaluation criteria of the medical linacs prior to their clinical use. It is well known that the flattening filter in a standard linac acts as an attenuator, beam hardener and the scatterer. Due to removal of the FF, the dosimetric parameters such as field size definition, beam quality, surface dose, off axis ratio (OAR), beam flatness, symmetry and penumbra as well depth dose profiles of un-flattened beam differs from flattened beam. As of now no standard/acceptance test protocol is available for un-flattened beam from the standard medical linac, the Atomic Energy Regulatory Board (AERB) of India constituted a Task Group (TG) comprising experts from regulatory agency, advisory body/research and technical institutions, and radiotherapy centres in the country to evolve and recommend the acceptance criteria for the flattening filter free (FFF) photon beams. The Task Group approached manufacturers/ suppliers of standard medical linac for obtaining technical details about the technology of their FFF beam linac as well as their view points in evaluating the characteristics of FFF photon beams. The information received from the manufacturers/ suppliers as well as the data available in the literature were thoroughly reviewed and acceptance criteria for FFF photon beam from standard medical linac were evolved. Performance evaluation of FFF photon using above acceptance criteria is accepted for issuance of permission for patient treatment.

Invited talk on proton beam therapy

The world's first hospital-based proton therapy center was built in 1990 in the USA. However, no proton therapy facility for patient treatment is available in India. Recently, AERB received proposals for establishing Proton Therapy facilities. To have better understanding about the facility for its effective regulation in India, AERB invited Dr. Dupont Claude Camille Leopold, Vice President, Integration & Sales Support Department of IBA Particle Therapy, Belgium (major manufacturer of the Proton Therapy facility to deliver a lecture on "Proton Beam Therapy" at Niyamak Bhavan-B auditorium on December 12, 2012.Large number of officers from RSD, AERB, RP&AD, BARC and Tata Memorial Hospital (TMH), Mumbai attended lecture and participated actively in the technical discussion.

Chairman's address at the 34th National Conference of the Association of Radiation Oncologists of India (AROICON -2012), Kolkata on 29.11.2012

It is my great pleasure to be here to attend the Inaugural Ceremony of the 34th National Conference of the Association of Radiation Oncologists of India, organized at the Science City Main Auditorium, Kolkata. I thank the Organizing Committee of this Conference for inviting me as the Guest of Honour in this prestigious event. It is indeed my privilege to address this august audience on this occasion

The profession you represent commands extremely high regard in society and the role played by you in giving life and hope to thousands of cancer patients across the country is unparalleled. As per statistics put up by the Indian Council of Medical Research (ICMR) India recorded about 9.5 lakh new cases of cancer in 2010 which is an increase of about 80, 000 cases as compared to 2009. In India there are 25 lakh cases of cancer at any point of time and an estimated 4 lakh people die of cancer every year in the country. In this scenario, the role of oncologists assumes great significance in tending to the patients suffering from this disease, which is like a traitor within the human body.

Apart from the technical & scientific challenges in grappling with cancer, we have to overcome several non-technical challenges to deal effectively with cancer patients such as lack of proper awareness and education among the public about the importance of early detection of cancer, economic condition of majority of the patients and limited resources available with us.

I am glad to note that the Association of Radiation Oncologists of India (AROI) has laudable objectives and responsibilities of advancing the specialties of Radiotherapy & Oncology and disseminating information in this area. I am sure these objectives are being met very effectively, this conference being a clear example. I understand that AROI attaches very high importance to academic & research activities and also publishes peer reviewed quarterly journal called the Journal of Cancer Research and Therapeutics (JCRT) which enjoys a large readership among radiation oncologists in India and abroad.

Coming to the status of radiation therapy in India, today there are over 330 Radiotherapy centres in the country having around 500 teletherapy units, which include telecobalt units, linear accelerators, apart from a few specialized equipment like gamma knife, tomotherapy etc. There are also more than 200 afterloading brachytherapy units, and 130 facilities with manual brachytherapy sources. These numbers are increasing at a rapid rate and the treatment technologies are advancing impressively.

Rapid advances in radiotherapy technology in recent years have resulted in equipment and practices which deliver more powerful, controlled and precise doses to the target tissue. To keep pace with these technologies, last year, AERB has brought out an updated Regulatory code in this area "AERB Safety Code on Radiation Therapy Sources, Equipment and Installations (2011)".

New technology is a double edged sword. Use of such equipment correctly and safely requires enhanced knowledge and expertise. Mistakes with such powerful machines can be costlier and more harmful. While design requirements ensure built-in safety of the equipment and installation, radiation safety also requires availability of competent personnel, with adequate training to the professionals involved (Radiation Oncologist, Medical Physicist & Radiotherapy Technologist) and use of requisite quality assurance tools and practices in order to achieve the desired precision in dose delivery, and to avoid errors.

Shri S. S. Bajaj, Chairman, AERB releasing the 'Journal of Cancer Research and Therapeutics' at the AROI Conference held in Kolkata on Nov. 29, 2012

AERB's mandate is to ensure that use of ionizing radiation does not cause unacceptable impact on people and environment. With regard to radiotherapy and diagnostic radiology practices, AERB performs its regulatory role by ensuring that the equipment is qualified (through type approval process), and further by ensuring that the facility layout and design meet necessary requirements, including shielding, and that there are adequate QA practices, and availability of qualified personnel, and so on. Through this process, the workers' safety is perhaps addressed adequately; and patient safety to some extent. However, the onus of ensuring and maintaining operational safety rests heavily on the institutions involved.

As all of us in this field know, the culture of radiation protection is based on the principles of justification and optimization and dose limitation. When applied to medical field, this translates to justification of specific medical procedures, and optimization of doses delivered to patients, as well as to health professionals carrying out the procedures. Dose limitation, of course, does not

Chairman's Address

apply to patients but applies to others.

It is an unfortunate fact that this culture of justification and optimization is not as widespread in the medical field as it should be.

This culture is crucial to safety of patients from unwarranted radiation, and much more is required to be done in this area. **Cases of patient over exposure and wrong exposures are known to occur, and they have to be minimized. This aspect cannot be addressed through traditional regulatory prescriptions or framework. Willing and enthusiastic and collaborative participation of all stakeholders (i.e. institutions, professionals and manufacturers) is a pre-requisite. And learned professional association like AROI can lead such initiatives.**

Some practical initiatives could be: (1) Development of guides for good practices in various activities: choice of equipment, equipment maintenance, proper QA, technique & procedures to use, control of treatment preparation, and delivery process, (2) Development of comprehensive QA practices to cover all steps involved in delivery of prescribed dose, (3) Insistence on rigorous use of existing good practices, including strict use of checklists, (4) Introduction of clinical audits to evaluate professional practices by independent bodies/ committees, (5) Ensuring practice of internal notification of malfunctions and errors and using the experience feedback for prevention of such malfunctions.

In the nuclear power plant industry which also AERB regulates, we have a strong mechanism of learning from operating experience feedback whereby all unusual events, big or small, are reported, recorded, analyzed and lessons learnt from them disseminated to all concerned so that all can adopt corrective measures to improve their system and minimize the possibility of such events happening again.

Adoption of such a system in radiotherapy practice can play a tremendous role in improving safety of patients as well as safety of occupational workers. **While reporting of accidents or major events is a regulatory requirement, it is the tapping of the less significant, but more numerous events which can serve as a gold mine for drawing lessons to regulator, designer/ manufacturer and operating organization and help in continually improving our practices. Here again the medical fraternity & their Association can play a leading role in establishing a system of reporting on voluntary basis, for the purpose of learning.**

Worldwide there are several systems which collect and disseminate such data.

ROSIS (Radiation Oncology Safety Information System): Voluntary web-based safety information database for radiotherapy, developed by a group of Health professionals in Europe and supported by European Society for Therapeutic Radiation Oncology.

Safety in Radiation Oncology (SAFRON): It is a user system developed by the IAEA for improving the safety and quality of care in radiation therapy through sharing knowledge about incidents and near misses.

Report to Congress on Abnormal Occurrences published by USNRC for the fiscal year 2011 is worth reading for participants of this august gathering.

Coming to other issues; an important one is safety and security of radiation sources. When you use radiation sources, you have the responsibility to ensure that the sources are handled safely and securely all the way from cradle to grave. Disused sources must be disposed off safely. Not doing so can lead to serious consequences. Security of sources from possible malevolent acts is an important responsibility of the licensee. The guidelines for establishing typical security plan for radiotherapy facilities is given in the AERB Safety Guide on Security of Radiation Sources in Radiation Facilities, published in 2011. (eg. failure to visualise the prostate before implanting I-125 seeds, incorrect measurment of catheter length)

AERB has taken serious note of disused sources not being disposed off in timely manner, and at times has stopped granting regulatory clearances to non compliant institutions for their other activities, till the disused sources are disposed safely.

I am aware of the problem of availability of accredited agencies for calibration of protection and dosimetric equipment and survey meters. We are taking corrective action in this regard. AERB has recently brought out the document entitled, "Recognition and consenting requirements of calibration laboratories for radiation survey instruments and pocket dosimeters". This will facilitate several entrepreneurs to establish calibration labs across the country, which can be accredited.

Coming back to AROI, and this conference, Radiation Oncology is a challenging and rapidly evolving field. I compliment the organizers of this conference and wish all the best to the distinguished delegates participating in the conference. I am sure that AROICON 2012 will be a grand success in achieving its objectives.

Before closing, I wish to make use of this platform and opportunity to re-emphasize the need for strengthening the culture and mechanisms for patient safety. And to call upon the fraternity of radiation oncologists and all others engaged in medicine using radiation, to develop initiatives in this regard. AERB will be more than eager to partner with you in this endeavour.

Extracts from an interview-cum-article of Shri S. S. Bajaj, Chairman, AERB, published in Power Line Magazine - October 2012.

Rebutting hypothetical arguments with reason is difficult. If anti-nuclear power groups spread information about the dangers of nuclear power plants that is entirely speculative and not based on evidence, then it is almost impossible for scientists like Satinder Singh Bajaj, Chairman, Atomic Energy Regulatory Board (AERB), to counter them successfully. Another difficulty is that nuclear power is too complicated for most ordinary people to understand, so when scientists speak in their own language – beyond a certain point, a layperson's vocabulary becomes inadequate – the public struggles to grasp the technical details. As someone who has spent his entire life working in the area of safety regulation of nuclear and radiation facilities, reactor safety analysis, system thermal-hydraulic, plant transient studies, probabilistic safety assessment, and system safety studies, Bajaj's voice on safety, in light of recent anti-nuclear agitations, is a weighty one.

Bajaj says that, apart from the innate complexity of the subject, a further complication is that agitations such as the one around the new Kudankulam plant in Tamil Nadu which will start producing electricity soon tend to be hijacked. It started off as a local agitation but was later exploited by other outside groups and interests to whip up anti-nuclear sentiment. The fact that Fukushima happened helped them, says Bajaj, in his office at AERB in Mumbai.

But he acknowledges that the nuclear establishment did not succeed in conveying reassuring messages about nuclear power in India, largely because of a lack of communication skills and also because it woke up rather late to the need to communicate information to correct misconceptions. **We know the effect of radiation at a high level. It's not possible to see what the effect is at a very low level of exposure because when it is so low, it gets masked by other factors. We work on the assumption that even a tiny amount could cause cancer. This is a deliberately conservative approach, which as a philosophy for radiation protection is very good, but it scares people, he says.**

Despite being slow to communicate with the public over Kudankulam, the board responded swiftly to the issues raised by the Fukushima disaster. Expert groups and committees were formed to examine all the issues and decide what needed to be done. The Board conducted a detailed review of all the existing plants in the country and those under construction to understand how the country's reactors stood on safety following Fukushima. They are all well designed to withstand earthquakes and floods but this time, the Board had to imagine a Fukushima-like situation where all normal cooling provisions collapsed due to a loss of electrical supply.

There are several levels of safety that we look at, depending on different contingencies. We found that, on all four levels, we were in very good shape but we had to address what everyone globally in the industry also had to address, namely a prolonged station black out as happened at Fukushima. For that, we made recommenda-tions for additional features to be added to withstand such remote possibilities, he says.

Some of these additional safety features have already been installed; others will be completed in the next two to three years. Oddly enough, some of these extra features involve installing such routine commonplace things as portable diesel generators, along with an arrangement for hooking them up to the electrical systems at the plant.

While talking about the radiological incident in the scrap market at Mayapuri in Delhi, he says "It was challenging on several fronts. One, because we didn't know where the radioactive cobalt material, which was discovered, had come from. Second, we didn't know how much more of the material might be lurking elsewhere. Third, we had to assure the public that we were in control of this situation and that there wasn't any further danger," he says.

It took intensive efforts before Bajaj could announce conclusively that the material had emanated from some research equipment at Delhi University. "We were able to locate the original supplier, who had given it to the university in the 1960s, and got details of it. We counted each and every piece. Being able to tell the public that it was all safe, about a full month later, was a landmark, he says.

Following the incident, AERB revamped its systems to ensure that all radioactive material came under its regulatory control, including material used in radiotherapy equipment for cancer treatment.

Post-Fukushima, the Board took up an intensive review of India's nuclear plants and procedures, and shared the findings with international bodies to get the country's nuclear safety status peer reviewed and validated. "What our review revealed was that our safety status was ahead that of many other countries whose reviews had still not been fully completed to enter the implementation phase. Our findings were endorsed internationally and that was a source of great satisfaction to me and everyone at the Board, he says.

The Board also reviewed radiotherapy equipment in government and private hospitals. The equipment was checked and carefully inventoried. We know how many machines there are and where they are. The problem is X-ray machines because there are tens of thousands of them from since before regulation was introduced, and so not all are on our list. One of our challenges is to get them all registered, he says.

In terms of expansion, he says it is undoubtedly easier for India to add more units at existing sites than to build new ones, given the controversies relating to land acquisition. But NPCIL, has also identified new sites such as one in Haryana.

The Board has also expanded over the past couple of years, increasing the workforce by almost 50% to be able to cope with the needs of more and more complex regulation and the fact that the nuclear power programme is proceeding apace, requiring more reactors and other radiation applications in medicine and industry to be monitored.

The basic technology of nuclear plants is not, says Bajaj, going to change drastically. There will be incremental improvements but nothing revolutionary is expected. The next big thing will be Generation 4 reactors, which will be as parlance goes, inherently safe. These are on the drawing board and at the research stage globally. It will be another 20 years before the first Generation 4 reactor comes up.

[Acknowledgement: Reproduced with permission from the POWER LINE Magazine]

Feature Article

e-Governance Initiatives at AERB

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The word e-Governance stands for "electronic Governance", which implies application of Information and Communication Technology (ICT) for delivering government services, exchange of information, communication transactions, integration of various stand-alone systems and services between Government-to-Citizens (G2C), Government-to-Business (G2B), Government-to-Government (G2G) and Government-to-Employee (G2E). Government of India has published its National e-Governance Plan in May 2006 with a vision to "Make all Government services accessible to the common man in his locality, through common service delivery outlets and ensure efficiency, transparency & reliability of such services at affordable costs to realize the basic needs of the common man" and has been taking a holistic view of e-Governance initiatives across the country, integrating them into this vision.

AERB has taken-up the following activities as a first step towards e-Governance:-

a) e-Licensing for Radiation Applications (eLORA)

b) Office Automation System (OAS)

c) IT Infrastructure Revamping

e-Licensing for Radiation Applications (eLORA):

This is a web-based Information and Communication Technology application for the automation of regulatory processes for various Radiation Facilities located across the country, computerizing the end-to-end licensing process for Radiological Safety Division (RSD) of AERB. The objective of the project is to enhance the efficiency and transparency in the regulatory processes of Radiological Safety Division (RSD) of AERB. In addition to providing the general information like Public Notifications, Safety Awareness Programs notices, Codes / Guides & Manuals related to the regulatory process etc. eLORA will also display the list of the recent consents given to the various radiation facilities along with its validity period, which will be very valuable for the common public.

The radiation facilities will get a lot of benefits after implementing the eLORA because of the end-to-end computerization in the consenting process. eLORA will establish a medium for exchanging information among AERB and the Radiation Facilities. To get these benefits, all the facilities will have to first register themselves in the eLORA system. Once the registration is approved, they will be given unique user IDs and passwords, with which the facilities can submit all their applications for various regulatory clearances (including the relevant attachments, safety status reports and other related information) on-line through eLORA system. They will be given auto-acknowledgements when the submissions are accepted in the system and can also see the current processing status of their submissions in the system. They can also file the Incident Reports for any unusual occurrence related to radiological safety through eLORA and can coordinate with AERB for the regulatory inspections. eLORA will also issue auto-alerts through email/SMS to the facilities informing the completion/rejection of various important transactions in the system.

For RSD's internal work, eLORA will be very useful to improve the efficiency and transparency. The system will Improve the data validation and authentication process through on-line checks, ensure data consistency and reliability at time of scrutiny to expedite review process and improve internal operational efficiency through tracking mechanism, discussion forum, auto-alerts and reminders for pending tasks and dashboards for better performance. It will also help to manage centralized data repository, generate standard and ad-hoc report from database for better decision making, established interoperable and easy contact with Regional Regulatory Centre (RRCs) of AERB and other regional regulatory agencies such as Directorate of Radiation Safety (DRS) for active exercise of regulations and provide access to regulatory information from the site of inspection through internet.

The system is going to be implemented phase-wise for various practices. The first Go-live for the Radio Therapy practice is expected by March 2013. By July 2013, the Licensing work for all the Radiation Facilities across India is expected to be carried out through eLORA.

Office Automation System (OAS):

It is also planned to computerize various internal processes of AERB in Administration and Accounts divisions. The system shall also cover following miscellaneous technical processes like Committees & Meeting Management, Document Lifecycle Management, Movement & Status Tracking of Files, Tours & Air Ticket Booking, Utility Provisioning & Complaint Management, Purchase, Stores & Contract Management, Safety Research Projects & Grant Management, RTI & Parliamentary Questions Database, Transport Management, Security Management, Time Attendance & Absentee Management etc. which are common to all divisions at AERB.

This task is going to be accomplished using an Enterprise Resource Planning (ERP) package based Office Automation System. The system shall be providing facilities like non-redundant data entry, authenticated access to data, reliable information that can available instantly, role based work-flow implementation, automated planning /scheduling and alerts and effective tracking of status for tasks/cases. It will also enable faster processing & communication of data along with efficient analysis and dynamic query features. All the employees shall have an Employee Self Service Portal (ESSP) A/c in the System. After logging-in the system through username and password authentication, various Forms shall be available for the users. The eForms shall be filled-up on-line by the users and pushed in a workflow system for further action. Workflow can be either pre-defined or ad-hoc. All the transactions are proposed to be paper-

less. Users can upload the scanned copies of the attachments (like Ticket, Boarding Passes, Bills etc.) along with the on-line applications. In case, the signed papers/hardcopies are essential, they will be sent directly to the sanctioning authority. In such cases, final sanction shall be given only after receipt of paper document & on-line approval.

This system will be an attempt towards implementing paper-less office at AERB.

IT Infrastructure Upgradation:

For ensuring the performance and security of the existing IT Infrastructure in view of implementing the above applications and foreseeing the remote connectivity of AERB users to the internal resources as well as anticipating the connectivity between various remote locations of AERB like Safety Research Institute (SRI), Kalpakkam and Regional Regulatory Centers (RRCs), the AERB's IT infrastructure needs a major reform. Following are some major areas:-

I. Secured Network Access Control System:

This system is intended to ensure trusted and streamlined access to AERB's internal resources. Any client on the network can not use the resources without having a registered account in the system. Apart from permitting the access to the individual PC on the network, this system can also force some group-based policies on the user. It can monitor the security posture of the individual clients on the network with respect to the use of authorized softwares, antivirus programs, regular updates of these softwares etc. and also enforce strict controls on the usage of USB drives on the network. The system shall provide a feature of isolating the client from the network when its security posture is not matched with the organizational policy or if the client is trying to spread some malicious activity on the network.

II. Secured Remote Access Control System:

Once the eLORA & OAS systems are in place, the remote centers of AERB (e.g. Safety Research Institute, Kalpakkam or Regional Regulatory Centers placed in southern, eastern & northern regions of India) will need to have access to these systems. Also, there is a long-pending demand from many touring officers of AERB to provide them the access to the IT AERB's resources from their tour location. This can be accomplished by installing a Secured Remote Access Control System at AERB. This system will have features like multi-factor authentication (using automated dongle or mobile application), end-to-end encryption for the data and will provide access only to pre-registered remote systems.

III. Upgradation of some existing infrastructure:

Once the eLORA and OAS are implemented, ensuring the availability of the infrastructure will be of prime importance. Therefore, it is planned to upgrade the edge routers of AERB network to have a connectivity of dual leased lines from different service providers. It is also proposed to replace the core switch with a redundant pair of switch having new high availability. It is also planned to establish a Disaster Recovery Center (DRC) at one of the remote locations to ensure the availability of data.

Severe Accident Analysis for CANDU6 Station Black Out event

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After three historical severe accidents in nuclear power plants (TMI-2, Chernobyl and Fukushima) the nuclear industries and regulators worldwide are emphasizing on studies for analyzing such accident progression. The results of such studies will help in understanding and improving nuclear safety by enhancing prevention, mitigation and management measures applicable to severe accidents (SAs).

SAs are defined as nuclear facility conditions beyond those of the design basis accidents causing significant core degradation. The design requirements (as per AERB/NPP-PHWR/SC/D, Rev. 1, 2009) call for addressing the behaviour of the plant under specified beyond design basis accidents including selected severe accidents. These selected low probability plant states that arise owing to multiple failures of safety systems involving significant core degradation may threaten the integrity of many or all the barriers to the release of radioactive material. Requirements include consideration of the severe accident sequences, using a combination of engineering judgment and probabilistic methods, to determine those sequences for which reasonably practicable preventive or mitigatory measures can be identified. Acceptable measures need not involve the application of conservative engineering practices used in setting and evaluating design basis accidents, but rather should be based upon realistic or best estimate assumptions and methods. On the basis of operational experience, associated safety analysis and results from safety research, design activities for addressing severe accidents shall take into account the following:

(i) Important event sequences that may lead to severe accidents shall be identified using a combination of probabilistic methods, deterministic methods and sound engineering judgment.

(ii) These event sequences shall then be reviewed against identified set of criteria aimed at determining which severe accidents should be addressed in the design.

(iii) Potential design or procedural changes that could either reduce the likelihood of these selected events or mitigate their consequences, should these selected events occur, shall be evaluated, and shall be implemented.

(iv) Consideration shall be given to the plant's full design capabilities, including the possible use of some systems (i.e. safety and non-safety systems) beyond their originally intended function and anticipated operating conditions, and the use of additional temporary systems to return the potential accident conditions to a controlled state and/or to mitigate the consequences, provided that it can be shown

that the systems are able to function in the expected environmental conditions.

(v) For multi-unit plants, consideration shall be given to the use of available means and/or support from other units, provided that the safe operation of other units is not compromised.

(vi) Accident management procedures shall be established, taking into account representative and dominant severe accident scenarios.

Several studies, both analytical and experimental, have been started/carried out by regulators, utility and TSOs for covering all aspects of severe accidents in various types of reactors used in Indian nuclear power plants. In the same line in AERB a study of severe accident for a CANDU 6 plant (similar to PHWR) initiated by Station Black Out (SBO) has been carried out.

With the objective of improving severe accident analysis capability for Heavy Water Reactors (HWRs) and benchmarking the development of Severe Accident Management Guideline (SAMG), analysis of SBO event, in which all the AC power sources are lost, leading to severe accident for a generic CANDU 6 plant is carried out without crediting crash cool down and firewater injection. This analysis is carried out using Reactor Excursion and Leak Analysis Program (RELAP5/SCDAP Mod3.4). One primary loop of the plant with 190 channels, generating thermal power of 1030 MW, is simulated in the present study. Apart from the fuel channels, the primary heat transport system loop simulation includes pumps, headers, inlet and exit feeders, end fittings, steam generator tubes, pressuriser, surge lines and feed and bleeds system. The steam generator secondary side simulation consists of main and auxiliary feed water system, downcomer, riser, steam separator, steam drum and the turbine as boundaries. The fuel channels are modelled at different elevations along with calandria to simulate the progressive uncovering of the calandria tubes during the accident progression.

The SBO severe accident event is modelled with the following assumptions: Class IV power is unavailable, reactor shutdown is initiated after accident initiation, moderator cooling is assumed unavailable, shutdown cooling system is unavailable, main and auxiliary feed water pumps are unavailable, SG main steam safety valves are available, turbine main stop valves are closed after accident initiation, no operator interventions are credited, emergency core cooling system is unavailable, crash cool-down system is not credited and pressuriser steam bleed valves are considered unavailable.

Two separate transient analyses have been carried out in the present study. Base case analysis is to study propagation of the severe accident leading to overheating of the fuel channels, subsequent fuel failure, hydrogen generation and debris formation. The second transient is to study the effectiveness of fire water injection in to the calandria in mitigating the severe accident progression.

The results of the SBO event analysis leading to the severe accident are as follows. During the first 1.7 hour of the transient the secondary steam generator inventory is able to remove the primary decay heat and is able to maintain the primary system pressure at about 80 bar. Due to the failure of the secondary feed pump, the steam generator inventory is lost through the safety relief valve due to boiling off. Natural circulation flow is established and maintained in the primary heat transport system due to the heat removal through the secondary side of the steam generator. The primary heat transport system pressure increases to the safety relief valve set point as soon as the heat transfer to SG secondary side is over due to the boiling off of the complete secondary side inventory. Loss of primary heat transport system inventory continues through the primary safety relief valve and the primary pressure is maintained at the set point of the safety relief valve at around 101 bar. Voiding in the primary heat transport system and consequent fuel overheating follows. At around 3.6 hour of the transient the pressure tube temperature exceeds 627°C and pressure tube ballooning and full Pressure Tube – Calandria Tube (PT-CT) contact criteria is met. PT-CT contact increases the heat transfer to the moderator and thus a decreasing trend in the primary heat transport system pressure is predicted. Due to the unavailability of moderator cooling moderator temperature increases, boiling starts and pressure increases to force open the calandria rupture discs. This results in the loss of moderator inventory and uncovering of the calandria tubes leading to overheating of the fuel assembly and calandria tubes. At around 5.5 hours of the transient pressure tube failure is predicted and the system pressure is reduced close to atmosphere and the high temperature primary heat transport system inventory along with the moderator inventory is lost due to mainly flashing. The overheating of the PT-CT and fuel and clad is progressed and at around ~6.9 hour of the transient melting of the clad and PT-CT tube and debris formation in the calandria vessel is predicted. The transient is carried out upto 11 hour and though the fuel temperature at location exceeds the melting point, no amount of UO2 is found yet in the debris.

In the second transient, fire water injection of 10 kg/s at 2 bar pressure and 27°C is initiated into the calandria vessel at around 3.9 hours of the transient. Subsequently the calandria rupture discs open leading to a small reduction in the moderator inventory and during the rest of the transient upto 11 hour, the inventory remains constant. At the end of the transient the primary system pressure reduces to 20 bar and the fuel and clad temperature remains below 227°C. Study revealed that presence of large amount of moderator inventory in the Calendria vessel helps in preventing severe accident progression. Analysis demonstrated that the hookup schemes for firewater injection into the Calendria vessel can help in preventing severe accident progression in PHWRs/CANDU type reactors with the assumption of PT-CT full contact due to ballooning.

Feature Article

Online Decision Support System for Off Site Emergency Conditions

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The Nuclear power plant in India incorporates the concept of defence in depth philosophy during design and operation stage of the NPP to ensure highest level of safety. This ensures that the probability of any severe accident is extremely low. Despite all these efforts, if nuclear accident occurs adequate mitigating measures are required to be provided for beyond design basis accident.

If nuclear accident occurs, then to protect the general public from the harmful effects of radiation the civil authorities have to implement countermeasures. While implementing countermeasures they will have to take into account several factors such as health and psychological effects, public acceptability of their actions, optimisation of available resources and financial implications etc.

A Decision Support System (DSS) for nuclear emergencies is intended to provide comprehensive and timely information to emergency managers on an emergency situation arising from a nuclear accident. It is essentially a software and hardware tool that combines the elements of source term, weather, dispersion and deposition in the environment, exposure of the population, and the effect of emergency measures on potential dose. It is meant to operate from early to late phase of an accident, and to have a spatial range from meso-scale to the regional. The information is presented on a Geographic Information System (GIS) platform in such a manner that the decision-making after an accident is facilitated.

The effective functioning of DSS requires basic inputs regarding source term, meteorological parameters, Geographical Information System, suitable dispersion models etc. These are elaborated as follows;

- Data management that puts plans, inventories, lists and other details;
- Geographical maps showing the managers where the crisis is occurring, locality that is likely to be affected, the help line information and so forth;
- Atmospheric dispersion models to predict the radiological impact; on-line access, assimilation and display of the field measured radiation data; and
- The communication network for instant sharing of critical information within the organisations and for revealing relevant information to the public.

Many advanced decision support system for offsite nuclear emergency management have been developed in many countries over the past decade and are increasingly being installed for operational use. The Decision Support Systems used in different countries and their important features are provided in the following table:

DSS Models and Country features for Radiological Emergencies

DSS Models and Country	Features
SPEEDI (System for Prediction of Environmental Emergency Dose Information) Japan	Real-time 3 Dimensional Diagnostic wind field Terrain based Particle dispersion model Dose assessment for air borne plume and deposited activity
RODOS (Real-time On-line Decision Support system) European Union / Germany	Local Regional and European scale dispersion forecast system using Lagrangian puff model and ECMWF meteorological data.
NARAC (National Atmospheric Releases Advisory Center), U.S.A	3-D atmospheric forecast model with Monte Carlo particle dispersion model and on-line display of the impact
OPDM (Operational Puff Dispersion Model) Holland	3 Dimensional multiple puff model for dispersion and dry/wet deposition
RADIS (Regional nuclear Accident consequence analysis model) Hong Kong	2 Dimensional Lagrangian trajectory model for dispersion and dry/wet deposition
CARE (Computerized technical Advisory system for Radiological Emergency) KINS, Korea	On-line radiological monitoring and atmospheric forecast system using a net work of field gamma monitors and meteorological towers

In India two decision support systems developed by BARC and IGCAR are installed at Narora Site and Kalpakkam sites respectively on experimental basis.

The DSS developed by BARC, India is a system similar to an operational European emergency response system (RODOS) and is named as Indian Real Time Online Decision Support System (IRODOS). This is an online system, which senses a nuclear accident based on the data available from Environmental Radiation Ring Monitors and communicates to emergency response centre on real time basis. It also estimates radiological conditions due to release of radioactivity into the environment, predicts the most affected sectors and suggests the counter measures to be taken, along with the availability of logistics, in order to assist the emergency response team to minimise the radiological exposure to the public and to the environment.

The IRODOS system has 72 hours meteorological forecast from National Centre for Medium Range Weather Forecasting (NCMRWF), Noida, with hourly resolution and update every 24 hours. The dose calculation will be carried out for all fission products independently as well as collectively.

IGCAR developed the DSS in collaboration with institutes within DAE and other national institutes (e.g. ISRO, RRSSC, NCMRWF, and MATSCIENCE). The system is web enabled and has online access.

The codes and models used in the system for meteorological and dispersion modelling are rigorously validated for Kalpakkam site under BRNS sponsored research projects involving premium institutes of country like IIT's.

The recent Fukushima accident in Japan and the related emergency response experience highlighted the importance of a reliable post accident decision support system to facilitate the decision making and timely implementation of suitable counter measures in nuclear emergency situation.

In order to have a broader consensus on the above subject, AERB had organised a one day Discussion Meet on "Online Decision Support System for Nuclear and Radiological Emergencies" on 19th July 2012. The scope of the meet broadly addressed the experience of "Online Decision Support System" established at Narora and Kalpakkam site on experimental basis, the regulatory requirements regarding decision support system, international approach on the subject and review of the existing methodology of emergency preparedness and response plan. The participants include members from NPCIL, fuel cycle facilities, BARC, IGCAR and AERB. During the discussion, experts opined that there is a need to identify the system requirements, site specific requirements, surveillances and the feasibility of implementation of such a system.

Currently work is in progress towards developing specifications for such a Decision Support System (DSS).

HONOURS & AWARDS

As part of India-Korea Nuclear Cooperation, AERB sponsors its candidates for 'International Nuclear Safety Master's Degree Programme' organized by Korea Institute of Nuclear Safety (KINS) in collaboration with Korea Advanced Institute of Science & Technology (KAIST). The programme is divided into four semesters including an independent research work and paper presentations papers in local and international conferences. Major courses include Nuclear safety regulation, Nuclear safety policy issue-Non-proliferation, Next Generation nuclear power plants, Nuclear engineering, Risk and Reliability Engineering, Scientific writing etc.

Smt. Sonal Gandhi

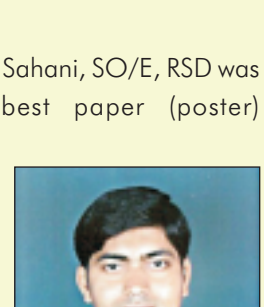
Smt. Sonal Gandhi, scientific officer (E) from Operating Plants Safety Division of AERB after successful completion of the course was awarded the Master's Degree in Nuclear Safety in December 2012.

Two officers working with Radiotherapy group of Radiological Safety Division received awards in the 33rd National Conference on "Frontiers in Medical Physics- Innovations and Challenges" (AMPICON 2012) held at Mangalore during November 1-3, 2012. The conference was jointly organized by the Association of Medical Physicists of India (AMPI), Kasturba Medical College & Hospital, Mangalore and Shirdi Saibaba Cancer Hospital, Manipal.

Shri Ghanshyam Sahani

Shri Ghanshyam Sahani, SO/E, RSD was awarded for best paper (poster) presentation on "Optimization of Leaf End Shape of a Multi-leaf Collimator (MLC) for a Telecobalt Machine" among 167 papers presented.

Dr. Rajib Lochan Sha, SO (D) was awarded with "Dr. M.S. Aggrawal Young Scientific Investigator award" for his commendable research & development work in the field of medical physics.



Dr. Rajib Lochan Sha

Miscellaneous

Press Conference held at AERB

AERB held a press conference on September 13, 2012 to address the safety concerns in Kudankulam Nuclear Power Project (KKNPP) and related aspects. Media coverage was provided by inter alia DD news, Aaj Tak, ANI, The Hindu, Times Now, Sakal, CNN IBN, IBN-7, India Bulls, ETV, PTI, Times of India and Indian Express. Shri S.S. Bajaj, Chairman AERB addressed the press conference in presence of Vice-Chairman, Secretary and other Directors of AERB. He gave a presentation on the regulatory processes at AERB and explained the findings and recommendations of the high level committee constituted to review safety of Indian nuclear power plants including KKNPP against external events of natural origin, following the Fukushima accident at Japan. The presentation was followed by a question and answer session. The questions were based on the safety recommendations and its implementation on KKNPP, public unrest at KKNPP, CAG remarks on AERB, independence of AERB and offsite emergency at KKNPP site, which were responded by the Chairman. Interviews were given by Chairman in various news channels also on this occasion.

AERB accelerates formation of DRS in States/Union Territories

It is estimated that the number of X-ray equipment presently being operated in the country is more than 50,000. In view of the tremendous increase in number of medical diagnostic installations using medical X-ray units in the country, it is difficult for AERB to exercise regulatory control over all such installations. It was decided to decentralize the regulation of these units and AERB took several initiatives to establish Directorate of Radiation Safety (DRS) or Radiation Safety Agency (RSA) in all the States /Union Territories which shall function in close coordination with AERB for regulating the use of medical diagnostic X-rays in the respective states.

The first Directorate of Radiation Safety (DRS) was established in Kerala under the Department of Health & family Welfare, which has been functioning since 1999.The Second DRS in the form of Radiation Safety Agency (RSA) has been established in Mizoram: RSA in Mizoram was Authorized and made functional since Oct.12, 2011.

The various stages for establishment of DRS/RSA are as follows:

Stage 1: Signing of Memorandum of Understanding (MoU) between the States /UTs and AERB

Stage 2: Notification by the respective States /UTs to form DRS/RSA establishment

Stage 3: Recruitment of DRS/RSA personnel

Stage 4: Training of DRS/RSA personnel

Stage 5: Authorisation to Director, DRS or Head, RSA of respective States /UTs by AERB on their request/readiness of States/UTs

As on December 31, 2012, AERB has signed MoUs with the Governments of (1) Madhya Pradesh, (2) Tamil Nadu, (3) Punjab, (4) Chhattisgarh, (5) Gujarat, (6) Himachal Pradesh. The follow-up for other States and Union Territories is in progress.

ISO 9001:2008 Quality Management System (QMS) at AERB

AERB obtained certification under ISO 9001 standard from Bureau of Indian Standards (BIS) for its regulatory processes, namely consenting activities, regulatory inspections and preparation of regulatory documents in November 15, 2006.

AERB prepared Quality Manual as level-I document and thirteen procedures as level-II documents for implementation of Quality Management System (QMS) as per ISO 9001 standard at AERB. All the Level-I and Level-II documents have been revised and the QMS of AERB was recertified by BIS as per new ISO 9001: 2008 standard in November 2012 which is valid for another three years term.

As per the requirements laid in the ISO procedures and Quality Manual for AERB, internal audit for various divisions of AERB were carried out. All the observations of both the internal audits were complied with. A Renewal audit of Quality Management System (QMS) for entire AERB was carried out in October, 2012 by BIS team. No Non Conformance was observed in the BIS audit.

In order to enhance awareness level on QMS requirements and to improve competence of AERB personnel in performing their QMS functions a workshop on 'Promotion of Awareness on ISO 9001:2008 Quality Management System (QMS)' was organised at AERB. Training on QMS at AERB was also conducted for the new recruits in AERB.

QMS Monitoring Committee (QMS-MC) of AERB reviewed the audit observations arising from internal audits carried out in the year 2012. The following action points were identified and all these action points have been implemented.

- Completion of revision/ re-affirmation of QMS Level-I and Level-II documents through a committee
- Revision of Quality Objectives for various divisions of AERB with three years validity period
- Revision of format for Minutes of Meeting of Safety Committees through a committee
- Revision of Customer Feedback format

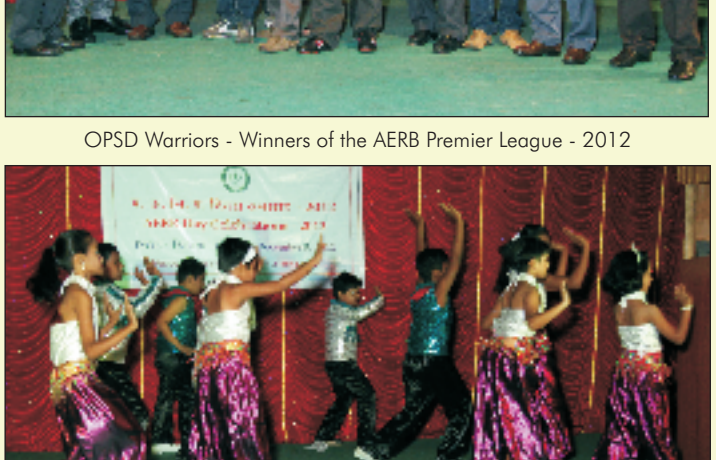
AERB Staff Club Activities

During the year 2012, sports tournaments were successfully completed for Cricket, Swimming, Brisk walk, Table Tennis, Badminton, Chess and Carrom. This year, AERB Staff Club introduced AERB Premier League, a cricket tournament for AERBites and swimming competitions. The AERB Day programme was celebrated on December 8, 2012 on AERB Lawns. Around four hundred and eighty persons, which included AERB staff and their family members, graced the occasion. The family members of AERB staff actively participated in this annual cultural programme. The winners of various sports tournaments conducted by Staff Club in the year 2012 were given away prizes. The meritorious children of AERB employees were also felicitated.

From this year onwards, AERB Awards were introduced and presented on the occasion of AERB Day by Chairman, AERB.

Dignitaries present for the AERB Day Programme

OPSD Warriors - Winners of the AERB Premier League - 2012



AERB staff children performing a dance programme

AERB Award Scheme

Annual award scheme has been formulated for AERB personnel to promote excellence in AERB Regulatory Work or associated Research and Development Work. The Scheme consists of a medal, citation and cash amount. The award Scheme has following categories:

(1) Young Scientific Officer Award,
(2) Outstanding Performance / Special Contribution Award.
(3) Leadership Award -1& Award-2,
(4) Meritorious Service Award, and
(5) Group Achievement Award.

This award scheme is implemented in AERB from the year 2012 onwards.

Shri S.S. Bajaj felicitating Shri R Bhattacharya with a Leadership Award.

Home Page

Personnel Joined (July – December, 2012)

Sl. No.	Name	Designation	Date of Appointment
1.	Shri Rupak Kumar Raman	SO(C)	23/07/2012
2.	Shri Vivek Kale	SO(C)	30/07/2012
3.	Shri Mahendra S. Patil	Driver (OG)	23/07/2012
4.	Shri Krishnan Kumar	SO/C	01/08/2012
5.	Shri Gade Venkata Rajeev	SO/C	01/08/2012
6.	Shri Ritu Raj	SO/C	01/08/2012
7.	Shri Soumen Koner	SO/C	01/08/2012
8.	Shri Pratik Kishor Gogad	SO/C	01/08/2012
9.	Kum. Sadhvi Srinivasan	SO/C	01/08/2012
10.	Kum. Pampa Singha	SO/C	01/08/2012
11.	Shri Ramesh Kumar	SO/C	01/08/2012
12.	Shri Jaydeb Mandal	SO/C	01/08/2012
13.	Shri Basuki Baral	SO/C	01/08/2012
14.	Shri Balbir Kumar Singh	SO/C	06/08/2012
15.	Smt. Hasna S. V. M	SA/B	01/08/2012
16.	Shri Krishna Kumar	SA/B	01/08/2012
17.	Shri Manoj Kumar	SA/B	01/08/2012
18.	Shri Swapnil M. Meshram	SA/B	01/08/2012
19.	Shri Arjun Nimba Mali	SA/B	01/08/2012
20.	Shri Gopal Jee	SA/B	01/08/2012
21.	Shri Vasudev	SA/B	01/08/2012
22.	Shri Mohd. S. A. Ansari	SA/B	16/08/2012
23.	Shri Gautam B. Jawale	SA/B	16/08/2012
24.	Smt. Minakshi Mishra	SA/B	16/08/2012
25.	Kum. Kalyani A. Angane	SA/B	Transferred to AERB on 03/09/2012 from HWP, Kota
26.	Shri P. Mohan Babu	CAO	Transferred to AERB on 11/10/2012 from AMDER, Hyderabad

Personnel Transferred / Retired (July – December, 2012)

Sl. No.	Name	Designation	Date of Transfer/ Retirement
1.	Shri S.K. Chande	Vice Chairman, AERB	31/07/2012
2.	Dr. P. Sasidhar	SO(G)	31/07/2012
3.	Shri S.A. Hussain	Head, RSD	31/07/2012
4.	Shri S. Krishnan	CAO	31/07/2012
5.	Dr. R. Dhayalan	SO/D	Transferred to IGCAR w.e.f. 01/08/2012.
6.	Shri Christopher J.	SO/D	Transferred to IGCAR w.e.f 01/08/2012.
7.	Shri Wani Prasad	SO/D	Resigned w.e.f. 22/11/2012.
8.	Shri D. Mukherjee	SO/D	Resigned w.e.f. 26/12/2012.

I. Shri G. Suresh Kumar, SO/D Shri P. Satish Kumar, SO/C and Shri Gopal Grandhi, SO/C have been transferred to AERB, Mumbai from SRI in the month of September, 2012.

II. Shri Arbind Krishnan, SO/C, Shri T. Ramesh, SO/C and Shri Rahul Shukla, SO/C have been transferred from SRI, Kalpakkam to AERB, Mumbai in the month of November, 2012.

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