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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.

CONTENTS

From the Chairman's Desk

During Jan.-Jun., 2009, two Board meetings were held: one at Nuclear Fuel Complex (NFC), Hyderabad in January 2009 and another at Mumbai in May 2009. During the meeting at Hyderabad, the members visited a few of the fabrication facilities at NFC.

A workshop was organized in AERB on 'Establishment of Directorate of Radiation Safety (DRS) in the States' on January 2, 2009. The objective was to assess the progress made and the difficulties faced by the States in setting up the DRS for safety surveillance of radiodiagnostic facilities in their respective States. The State of Kerala has already set up the DRS while other States are in different stages of setting up the DRS.

On March 6, 2009, AERB organized the annual Industrial Safety Awards function. Shri Apurba Saha, Executive Director (Mumbai High), Oil and Natural Gas Corporation Limited, was the Chief Guest and presented awards to the winning Units. The awards are given every year to the DAE units who achieve high level of performance in industrial safety. Kaiga Generating Station 3&4 in Construction Group, Heavy Water Plant, Manuguru and Madras Atomic Power Station in Production Units–I Group, Nuclear Fuel Complex, Hyderabad, in Production Units-II Group and Indira Gandhi Centre for Atomic Research, Kalpakkam in Research Units Group were the winner Units for the year 2008. Besides, AERB released a compilation entitled 'Industrial Safety Statistics - 2008 of DAE Units'. This compilation provides analysis of industrial safety incidents and number of injuries and man-days loss caused by various factors.

On April 17, 2009, AERB organized Fire Safety Awards function in which Shri P. S. Bhargava, Executive Director - Mumbai Refinery, Bharat Petroleum Corporation Limited, Mumbai was the Chief Guest and distributed the Awards to the winner units of the DAE. TAPS-1&2, Tarapur and NFC, Hyderabad in the high risk units category and KGS-3&4, Kaiga in the low risk category were the winners for the awards for the year 2008.

On April 09, 2009, a workshop on "Radiation Safety in Interventional Radiology including Catheterisation Labs" was organized to apprise all the stake holders, including cardiologists, interventional radiologists, suppliers of Catheterisation Labs, technologists, biomedical engineers and supplier of personal protective devices on radiation safety and regulatory requirements for interventional radiology.

A few incidents of presence of low level radioactive contamination in steel products exported from India were reported recently. AERB investigated these incidents which revealed that the problem arose due to presence of disused radiation sources in metal scrap imported by the steel recycling industry in India. AERB has advised all concerned industries to carry out thorough radiation check on incoming metal scrap as also on the finished and packaged products before releasing them for export.

Two feature articles on 'Regulatory Aspects of Radioactive Waste Management in Nuclear Facilities', and 'Assessment of Digital I&C Systems for Safety Applications in Indian NPPs' are also presented.

(S. K. Sharma)

SAFETY REVIEW AND REGULATION

AERB Board Meetings

The ninetyseventh and ninetyeighth meetings of the Board were held on January 16, 2009 and May 15, 2009 at NFC, Hyderabad and AERB, Mumbai, respectively. In the 97th meeting, the Board approved the publication of the revised safety code (AERB/SC/QA) on 'Quality Assurance in Nuclear Power Plants (NPP)' and the Safety Document Development Proposal (SDDP) for the Safety Code on 'Radiation Protection for Nuclear Fuel Cycle Facilities'.

The revised code, AERB/SC/QA, includes additional requirements on Quality Assurance for establishment, implementation and continual improvement of QA programme at all stages of NPP, i.e., siting, design, construction, commissioning, operation and decommissioning. This document has been harmonized with the IAEA Safety Requirements documents on Management for Safety in Facilities and Activities and on QA in NPPs and other installations. A new section on Process Implementation has been added and the overall emphasis has been shifted from 'Documentation' to 'Performance'.

The proposed Safety Code on 'Radiation Protection for Nuclear Fuel Cycle Facilities' will specify role and responsibilities of plant management, requirements for monitoring and surveillance of radiation protection measures for occupational workers, the public and the environment and preparedness in case of emergencies for nuclear fuel cycle facilities.

In the 98th meeting, the Board approved the proposal for start of Erection of major Equipment (EE) for the Prototype Fast Breeder Reactor (PFBR) and granted Siting Approval for the Kakrapar Atomic Power Project 3&4 units (KAPP-3&4), each of 700 MWe Capacity. The approval for EE for PFBR is given by the Board after the required design and construction safety review of the project is completed for this stage this is the last of the three sub-stages (Excavation, First Pour of Concrete and EE) of construction clearance for the project.

The Siting approval of KAPP - 3&4 was issued by AERB after satisfactory review of Site Evaluation Report submitted by NPCIL, by the Site Evaluation Committee of AERB. The Board also took note of the progress made in AERB on various activities and was briefed on topics that included R&D through AERB's Safety Research Program and instances of presence of low level radioactive contamination in steel products exported by Indian industries. The Board was informed that as per its directive given in one of the earlier meetings, campaign was launched for disposal of disused radiation sources lying in radiotherapy institutions and this work has now been completed.

⇧ The Board Meeting in progress at AERB
(L to R): Dr. Om Pal Singh, Secretary; Shri S. K. Chande, Ex-Offico Member, Shri S. K. Sharma, Chairman; Prof. J. B. Joshi, Member; Dr. K. V. Raghavan, Member; and Dr. K. A. Dinshaw, Member.

DOCUMENTS PUBLISHED

'Quality Assurance in Nuclear Power Plants'
(AERB/NPP/SC/QA-Rev.-1)

This safety code provides basic requirements to be adopted for establishing and implementing quality assurance programme for assuring safety. These requirements apply to QA programme of the responsible organization as well as any other organization in each stage of the life of the nuclear power plant such as siting, design, construction, commissioning, operation and decommissioning. This code is a revision of the 1988 edition of code of practice on Quality Assurance for safety in Nuclear Power Plant (AERB Code No. SC/QA). This revision is issued to reflect developments that have taken place over the years.

'Nuclear Power Plant Operation'
(AERB /NPP /SC /O-Rev.-1)

This safety code lays down the requirements for safe operation of Nuclear Power plant to ensure protection of the public, environment and the site personnel from any undue radiological consequences, prevention of accident conditions and mitigation of the consequences of any accident in the unlikely event of its occurrence. The safety code was initially published in 1989. This revision is issued to reflect developments that have taken place since then. Specifically, aspects of new requirements arising out of operational safety experience feed back, renewal of authorization, plant life management and probabilistic safety assessment are included.

SAFETY REVIEW AND REGULATION

Revised Licensing Procedure for Beach Sand Minerals Facilities in India

[Issued by Chairman, AERB on July 20, 2009 under the Atomic Energy (Radiation Protection) Rules, 2004]

The licensing procedure for Beach Sand Minerals (BSM) facilities under the Atomic Energy (Radiation Protection) Rules, 2004 is revised as under.

1. Facilities carrying out or planning to carry out only mining of beach sand minerals

BSM facilities carrying out or planning to carry out only mining of beach sands minerals (without any physical separation and/or chemical processing) do not require license under the Atomic Energy (Radiation Protection) Rules, 2004 from the Atomic Energy Regulatory Board (AERB).

2. New BSM facilities planning to carry out mining as well as mineral separation

New BSM facilities planning to carry out mining as well as mineral processing (physical separation and/or chemical processing) are required to obtain license under Rule 3 of the Atomic Energy (Radiation Protection) Rules, 2004 from the Atomic Energy Regulatory Board (AERB) after the mining lease is granted by the State Government but prior to setting up the mineral processing plants. Towards this, a copy of the mining lease granted to the BSM facility will be forwarded to AERB by the State Government authorities.

3. New BSM facilities planning to carry out only mineral processing

New BSM facilities planning to carry out only mineral processing (physical separation and/or chemical processing) are required to obtain license under Rule 3 of the Atomic Energy (Radiation Protection) Rules, 2004 from the Atomic Energy Regulatory Board (AERB) prior to setting up the mineral processing plants.

4. Existing BSM facilities

All existing BSM facilities carrying out mineral processing of BSM (physical separation and/or chemical processing) are required to obtain license under Rule 3 of the Atomic Energy (Radiation Protection) Rules, 2004 from the Atomic Energy Regulatory Board (AERB).

Applications by BSM facilities for obtaining license from AERB for carrying out Physical Mineral Separation (other than monazite) shall be submitted in AERB/IPSD/BSM/FORM-1 and those for carrying out Chemical Processing (other than monazite/thorium compounds) will be submitted in AERB/IPSD/BSM/FORM-2. These forms can be obtained from Head, Industrial Plants Safety Division, Atomic Energy Regulatory Board, Niyamak Bhavan, Anushaktinagar, Mumbai-400 094 and can also be downloaded from the AERB website www.aerb.gov.in.

This supersedes the requirements on the subject specified vide No. CH/ AERB/ IPSD/ 65/2008/3349 dated April 02, 2008.

Authorisations Issued

- Licence, under the Factories Act 1948, to Kaiga Generating Station-3&4 till January 5, 2014.
- Renewal of Licence for Operation of Heavy Water Plant – Manuguru till June 2010.
- Authorisation for Commissioning of Uranium Mill at Turamdih.
- Authorisation for Light Water Draining from Moderator System of KGS Unit-4.
- Authorisation for Storage of Fresh Fuel Assemblies at KK-NPP.
- Renewal of Authorisation for Operation of NAPS till July, 2013.
- Siting Clearance for KAPP-3&4.
- Approval for Publication of Revised AERB Safety Code, AERB/SC/QA, on 'Quality Assurance for Nuclear Power Plants'.
- Approval for Safety Document Development Proposal for Safety Code on 'Radiation Protection for Nuclear Fuel Cycle Facilities'.

Regulatory Inspections

Unit	No.
Nuclear Facilities	
UCIL-Jaduguda Mill, Turamdih Mill and Bagjata Mine	1 each
IREL, OSCOM and Udyogamandal	1 each
Beach Sand Minerals Facilities	2
Nuclear Fuel Complex	1
HWPs-Kota, Baroda, Tuticorin, Manuguru, Talcher, Hazira	1 each
RAPS-1&2, RAPS-3&4, MAPS-1&2, NAPS-1&2, KGS-1&2, KGS-3, KAPS-1&2, TAPS-1&2, TAPS-3&4	1 each
FBTR, KAMINI and IGCAR facilities	1 each
RAPP - 5&6	2
KK-NPP, KGS – 4, PFBR, DFRP and IFSB	1 each
Special monthly inspections on Industrial Safety for projects under construction	21
Radiation Facilities	
Industrial Radiography Facilities	30
Medical Installations • Nuclear Medicine Facilities • Diagnostic X–Rays Facilities • Radiotherapy Facilities	 30 20 7
Industrial Gamma Irradiators	2
Installations using Nucleonic Gauges	6

TRAINING

Training Activities

The Orientation Course for Regulatory Processes (OCRP-2009) was conducted during January/February 2009. A total of 12 participants attended the course where 52 lectures were delivered by 29 lecturers and 16 examinations were conducted. The Course covered topics like 'Issue of Consent', 'Regulatory Inspection', 'Safety Documents', 'Accident Analysis', 'Transport of Radioactive Material', 'Reactor Physics', and 'Radiation Protection'. The valedictory function was held on March 17, 2009. Shri S. K. Sharma, Chairman, AERB distributed the Certificates to the candidates who had completed the course successfully. A visit to Tarapur site was also organized as part of OCRP-2009. Site visits covered TAPS-1&2, TAPS-3&4, Advanced Fuel Fabrication Facility (AFFF) and Environment Survey Laboratory (ESL) at Tarapur. During TAPS-1&2 and TAPS-3&4 visits, participants were introduced to the plant systems in a nuclear power plant. During the visit to AFFF, the trainees were familiarized with the various steps and procedures involved in MOX Fuel Fabrication. The Trainees also familiarized themselves with various activities carried out at ESL like environmental sample analysis, and radiation detectors used in ESL. Feedback was taken from the trainees on different areas of the course to improve the training process in the future.

AERB Technical Talks

The following technical talks were organized during January to June 2009.

a) 'Introduction to Incore Monitoring System in Kudankulam Reactors' and 'Algorithms to Calculate Linear Heat Generation Rate and Departure from Nucleate Boiling Ratio in Kudankulam Reactors' by Shri Y. K. Pandey, NPCIL on February 13, 2009.

b) 'Commissioning Aspects for Pressurized Water Reactors' by Shri D. Bhattacharya, AERB on April 13, 2009.

c) 'How the Internet Works?' by Shri V. P. Gholap, AERB on April 23, 2009.

d) 'TRIVENI - A Computer Code for Core Simulations of PHWR' by Smt. Reeta Malhotra, AERB on May 26, 2009.

⇧ **Shri S. K. Sharma, Chairman, AERB presenting Certificates to the candidates who successfully completed the Orientation Course in Regulatory Processes.**

SAFETY RESEARCH PROGRAMME

AERB Committee on Safety Research Programme (CSRP) met twice during the period. Fourteen new safety research project proposals were considered for funding and after deliberations, the Committee recommended for approval the following three projects. Also, the Committee suggested revisions in eight projects and approved the renewal of grant-in-aid for four on-going projects. Extension was granted to one of the on-going projects.

New Projects Approved by CSRP

Sr. No.	Title	Principal Investigator / Institute
1.	Investigations on Startup Transients in Natural Circulation Boiling Water Reactor	Dr. Man Mohan Pandey, IIT-Guwahati, Guwahati
2.	Retrospective Assessment of Indoor Radon Exposure in Garhwal Homes by Measurements of Po-210 implanted on Glass Surface	Dr. R. C. Ramola, H.N.B. Garhwal University, Tehri Garhwal
3.	Reliability Assessment of Large Complex Computer Codes	Dr. R.B. Misra, IIT-Kharagpur, Kharagpur

PRESS RELEASES

March 2, 2009

Low Level Radioactive Contamination in Steel Products

Recently, a few incidents of presence of low level radioactive contamination in steel products exported from India to some European countries have been reported. Atomic Energy Regulatory Board (AERB) has investigated these incidents and has also taken measures to prevent their recurrence.

The radioactive contamination was of very low level and insignificant to cause any health hazard to the personnel involved in manufacturing and handling these products or to the public at large. However, such incidents need to be prevented. Also, these incidents have economic impact on the Indian exporters as sometimes such consignments are not accepted by the importers and are returned.

The metal recycle industry in India imports large quantities of steel scrap which is melted and used for manufacturing various steel products. Such incidents occur due to lost or abandoned radioactive sources used in industry which sometimes get mixed with steel scrap. Even though a Government of India notification exists requiring all imported material to be free of radioactivity, it appears that some of the steel scrap exporters abroad are not checking the material carefully.

AERB has advised all concerned industries in India to carry out a thorough radiation check on incoming metal scrap as also on the finished and packaged products before releasing them for export. This has been done through awareness programmes conducted by AERB with the help of industry associations like the All India Induction Furnace Association, Engineering Export Promotion Council of India and the Leather Export Council of India. Information articles on the subject by AERB staff have also been published in the newsletters of some of the associations. Actions have also been initiated to install portal radiation monitors at all entry ports of the country to detect any presence of radioactive material in imported consignments.

March 6, 2009

AERB Industrial Safety Awards

Atomic Energy Regulatory Board (AERB) presents Industrial Safety Awards to the Department of Atomic Energy (DAE) Units every year who achieves high levels of performance in Industrial Safety. The Industrial Safety Awards for the year 2008 were presented at a function held on March 6, 2009 at AERB, Mumbai. Shri Apurba Saha, Executive Director (Mumbai High), Oil and Natural Gas Corporation Limited presented the Awards. The Kaiga Generating Station 3&4, in Construction Group, Heavy Water Plant, Manuguru and Madras Atomic Power Station, in Production Units–I Group, Nuclear Fuel Complex, Hyderabad, in Production Units-II Group and Indira Gandhi Centre for Atomic Research, Kalpakkam, in Research Units Group were the winner units.

On this occasion, Shri S. K. Sharma, Chairman, AERB released a compilation entitled "Industrial Safety Statistics - 2008 of DAE Units". This compilation provides analysis of industrial safety incidents and number of injuries and man-days loss caused by various factors. The data is also compared with units outside DAE. It is seen that Industrial Safety performance of DAE Units is significantly better as compared to other similar industries in the country.

Shri S. K. Chande, Vice-Chairman, AERB delivered the welcome address and Shri R. Bhattacharya, Head, Industrial Plants Safety Division, AERB proposed vote of thanks.

⇧ **Release of "Industrial Safety Statistics - 2008 of DAE Units" during the Industrial Safety Awards Function.**
((L to R): Shri S.K.Chande,Vice-Chairman, AERB, Shri Apurba Saha, Executive Director (Mumbai High), ONGC, Shri.S.K.Sharma, Chairman, AERB and Shri. R.Bhattacharya, Head, IPSD, AERB.

April 20, 2009

AERB Fire Safety Awards

Atomic Energy Regulatory Board (AERB) presents Fire Safety Awards every year to the units of Department of Atomic Energy (DAE) which excel in fire prevention and protection measures. This year, the Fire Safety Awards presentation function was held on April 17, 2009 at AERB Auditorium, Mumbai. Shri P. S. Bhargava, Executive Director, Mumbai Refinery, Bharat Petroleum Corporation Limited (BPCL), Mumbai as Chief Guest of the function presented the Awards to the winner units of the DAE.

For the purpose of award all DAE Units are divided into two categories depending upon their fire risk.

Based on assessment for achieving high levels of performance in Fire Safety, Tarapur Atomic Power Station - 1&2 and Nuclear Fuel Complex at Hyderabad received the award jointly in the High Risk Units category. Also, Kaiga Generating Station - 3&4 received the award in the Low Risk Units category.

On this occasion, Shri S. K. Sharma, Chairman, AERB addressed the gathering. Shri S. K. Chande, Vice Chairman, AERB delivered the Welcome Address and Shri R. Bhattacharya, Head, Industrial Plants Safety Division, AERB proposed the vote of thanks.

⇧ **Inauguration of Fire Safety Awards Function for DAE units**
(L to R): Shri S.K.Chande,Vice-Chairman, AERB, Shri P. S. Bhargava, Executive Director – Mumbai Refinery, BPCL, Shri.S.K.Sharma, Chairman, AERB and Shri. R.Bhattacharya, Head, IPSD, AERB.

WORKSHOPS / SEMINARS

Workshop on "Establishment of Directorate of Radiation Safety (DRS) in the States"

The workshop was held on January 02, 2009 in AERB. The main objective of the workshop was to take stock of the efforts put in by the various State Governments in establishing the Directorate of Radiation Safety for the implementation of radiation surveillance of Medical Diagnostic X-ray Installations in their respective States and the steps to be taken for speedy implementation of the objective. Thirty-nine representatives of different States attended this workshop.

Dr. Om Pal Singh, Secretary, AERB, in his inaugural address, emphasized the importance of setting up of DRS in all the States. He emphasized the need for early setting up of DRS and suggested that all efforts should be made by the participants in the workshop to follow-up the matter with the concerned authorities. Shri S. P. Agarwal, Head, RSD, AERB explained that preferably a senior medical physicist of the State should be in-charge of DRS in the State. DRS should work as an independent body under the Department of Health and Family Welfare of the State. The candidates having B.Sc. (Physics, Chemistry, Maths)/ B.Sc (Radiodiagnosis) after successful training on radiation safety in medical diagnostic X-ray facilities should be appointed as regulatory inspectors in the DRS. Registration fees and inspection charges shall be decided by the DRS. All the matters related to violations shall remain under the purview of AERB. The DRS should carry out their work in close coordination with AERB.

⇧ **Dr. Om Pal Singh, Secretary, AERB, addressing the participants of the Workshop.**
Seated (L to R): Shri V.S. Iyer, RSD, AERB; Shri S. P. Agarwal, Head, RSD, AERB and Shri. R. Kannan, RSD, AERB.

Seminar on "Regulatory Requirements in Radiotherapy Facilities"

AERB organised a one day seminar on regulatory requirements in radiotherapy facilities on April 15, 2009 at AERB to address some of the regulatory issues, pertaining to radiotherapy as also the diagnostic and nuclear medicine facilities.

- Requirement of Radiation Field Analyser (RFA).
- Feasibility of HDR unit as a mobile unit to treat patient.
- Requirement of adequate number of Medical Physicist(s).
- Recognition of additional Medical Physics Courses.
- Requirement of Medical Physicists in Diagnostic and Nuclear Medicine facilities.

Fifty-seven participants attended the program. Participants included 37 Medical Physicists, 6 Radiation Oncologists and 14 representatives of suppliers of Medical Linear Accelerators, Remote afterloading Brachytherapy units and RFA.

The above issues were discussed at length and the debate on the above issues was very constructive. Since a consensus could not be generated among the participants, it was felt that feedback from the Medical Physicists and Radiation Oncologists of all the Radiotherapy Centres in the country need to be taken. Accordingly, AERB has sent feedback forms to all Medical Physicist(s) and Radiation Oncologist(s) of all the centres. This would help AERB to collect wider opinion on the subject to help review the guidelines of AERB for regulatory control on Radiotherapy Facilities.

Workshop on "Radiation Safety in Interventional Radiology including Catheterisation Labs"

AERB organized a workshop on 'Radiation Safety in Interventional Radiology including Catheterisation Labs' on April 09, 2009 at AERB. The objective of the workshop was to apprise all the stake holders, including cardiologists, interventional radiologists, suppliers of Cath Labs equipment, technologists, biomedical engineers and supplier of personal protective devices for interventional radiology. A total of 26 professional representing the above facilities attended the workshop.

Dr. K. S. Parthasarathy, Former Secretary, AERB made opening remarks and Dr. V. Karira, Head, Medical Division, BARC inaugurated the workshop. In his inaugural address, Dr. V. Karira explained that side effects associated with interventional radiology procedures should be briefed to patient and his family members. Shri S. P. Agarwal, Head, RSD, AERB, mentioned that as there is potential of high radiation doses to patients, cardiologists and other staff in Cath Labs procedures including fluoroscopy and cine angiography, it is essential to optimise the doses in interventional radiology practices. Dr. K. S. Parthasarathy shared his experience on reports of radiation injuries to patients and staff reported in some of the Cath Labs procedures which is attributed to poor quality of Cath Labs equipment and lack of knowledge on radiation safety. Dr. Haresh Mehta, a noted cardiologist from Dr. Balabhai Nanavati Hospital, Mumbai made a presentation on the current scenario of handling Cath Labs units by cardiologists.

A very active feedback session was held after the presentations. It was noted that there is need to enhance radiation safety awareness among radiation cardiologists and technical staff of Cath Labs. It was also suggested that all consultants performing Cath Labs procedures must use TLD badges for personal monitoring. Periodic quality assurance of Cath Labs and fluoroscopic units needs to be done. Suppliers of Cath Labs equipment should also be made responsible to ensure that the hospital requesting for installation of interventional radiology X-ray unit meets with all the safety requirements and should provide radiation protection accessories as an integral part of the Cath Labs unit to the diagnostic centers. It was suggested that Medical Council of India should be advised to include radiation safety chapter in the syllabus of cardiologists course.

FEATURE ARTICLE

Regulatory Aspects of Radioactive Waste Management in Nuclear Facilities

George Thomas (Retd.) and S. N. Rao
Operating Plants Safety Division, AERB

1.0 Introduction

Radioactive wastes get generated during operation of Nuclear Power Plants (NPPs) and associated facilities. These wastes could be in solid, liquid and /or gaseous state and may have radioactivity levels varying from extremely high as in the case of spent fuel reprocessing facilities to very low levels as associated with radioisotope applications. Equally broad is the spectrum of half-lives of the radionuclides associated with these wastes. It is essential to regulate the generation and disposal of radioactive wastes as it is hazardous to the people and environment if not disposed in a controlled manner.

2.0 Regulatory Control Mechanism

2.1 Legal Framework – Act, Rules and Regulations

The Atomic Energy Act of 1962 enacted by the Central Government provides basic regulatory framework for all activities pertaining to atomic energy programme in India. The disposal of radioactive wastes is governed by the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules 1987 (GSR-125). These rules were promulgated under the Atomic Energy Act to have a uniform national policy for management of radioactive wastes in accordance with international practices. Chairman, AERB is the Competent Authority to enforce these rules.

The rules require that for disposal/ transfer of any radioactive waste, an authorisation is to be obtained from the Competent Authority and the radioactive wastes can be disposed/ transferred only in accordance with the terms and conditions specified in the authorisation. Further, the rules also stipulate the requirements related to record keeping, reporting, inspection of records and facilities, and environmental surveillance. The Competent Authority is empowered to cancel or suspend an authorisation in case of non-compliance of the terms and conditions of authorization.

There is provision in the Rules for institutions such as hospitals and tracer research laboratories handling small quantities of radioisotopes of short effective half life to dispose liquid waste into sanitary sewerage system, dispose solid waste by burial into pits or incinerate radioactive wastes after obtaining authorization from Competent Authority. These are subject to limits specified in the Rules.

Further detailing of the regulations for safe management of radioactive wastes has been laid down in the Safety Code on Radioactive Waste Management. The Safety Code (AERB/NRF/SC/RW) specifies the requirements to be met during management of radioactive wastes by nuclear and radiation facilities. It also specifies the requirements for radiation protection in design, construction and operation of waste management facilities and the responsibilities of different agencies involved. AERB has prepared several Safety Guides (Table 1) which detail various methods of implementation of the regulatory requirements of the Safety Code. Some of these provide guidance on classification of radioactive wastes, safety of near surface disposal of solid wastes and predisposal management of low, intermediate and high level wastes.

2.2 Effluent Release Criteria

The disposal of radioactive wastes can cause radiation exposure to the members of the public through various pathways such as terrestrial, aquatic and atmospheric. The control of exposure to a member of public in all normal situations is exercised by the application of controls at the source. AERB, in line with the recommendations of International Commission on Radiological Protection (ICRP), has prescribed an annual effective dose limit of 1 mSv for a member of the public, at the site boundary of a nuclear facility for normal operating conditions.

The dose limit of 1 mSv applies to a site as a whole, which may comprise a number of nuclear facilities. The general practice is to apportion the dose to the different facilities and further to various pathways and radionuclides to be released in a conservative manner. The apportioned doses are translated into discharge limits and specific concentrations of various radionuclides

Table 1: List of Safety Guides relevant to Radioactive Waste Management

Sr. No.	Title	Reference code and the year of publication
1.	Management of Spent Radioactive Sources and Radioactive Waste arising from the Use of Radionuclides in Medicine, Industry and Research, including Decommissioning of such facilities	AERB/RF/SG/RW-6 (2008)
2.	Predisposal Management of Low and Intermediate Level Radioactive Waste	AERB/NRF/SG/RW-2 (2008)
3.	Management of Radioactive Waste From Mining and Milling of Uranium and Thorium	AERB/NF/SG/RW-5 (2007)
4.	Near Surface Disposal of Radioactive Waste	AERB/NRF/SG/RW-4 (2006)
5.	Management of Radioactive Wastes arising during operation of PHWR Based NPPs	AERB/NPP/SG/O11 (2004)
6.	Liquid and Solid Radwaste Management in Pressurised Heavy Water Reactor Based Nuclear Power Plants	AERB/SG/D-13 (2003)

based on standard environmental models. The main governing principles for effluent releases are source control, application of dose limit and releases as low as reasonably achievable (ALARA).

2.3 Monitoring and Control

In order to comply with the regulations, all effluents have to be discharged only after monitoring. The activity of radionuclides discharged into the environment is assessed by means of continuous measurement or by batch sampling, as appropriate. Provisions for prompt detection of a significant increase above the normal rates of radioactive discharges and for identification and assay of the important radionuclides involved are made for both gaseous and liquid effluents. If the prescribed discharge limit has been exceeded, plant management is required to take mitigatory measures, investigate the root causes and report to AERB.

2.4 Implementation Procedures

i) Issuance of Authorisation

AERB has established procedures for implementation of the provisions of GSR-125. Specific forms have been devised for the purpose of application for authorisation (Form-I), issuance of authorisation (Form-II), monthly records to be maintained by the facility (Form-III) and quarterly/ annual returns to be submitted to AERB (Form-IV). These forms are available on AERB website, www.aerb.gov.in.

The nuclear facility generating radioactive wastes has to furnish adequate information for assessing the suitability of the installation for direct disposal of radioactive waste and/ or its transfer to another agency. In case it is required to dispose radioactive wastes exceeding the authorised limits, special authorisation has to be obtained.

ii) Record Keeping and Reporting

Maintaining proper records is an important regulatory requirement. The records of radioactive wastes disposed contain details such as, quantity, physical state, chemical characteristics, mode of disposal, concentration of radioactive material, site of disposal, data on periodic surveillance around the disposal site, etc. Quarterly and annual reports of the radioactive waste disposed/ transferred are required to be sent to the Competent Authority. In addition, documentation required under the Safety Code and Guides on Radioactive Wastes are also maintained by the facility.

iii) Inspection

In order to ensure compliance of regulatory requirements and the enforcement of GSR-125, AERB conducts regulatory inspections of the waste management plant of the nuclear facility on an annual basis. The records on radioactive wastes disposed/ transferred are audited. In addition, operational records of the waste management plant, operational manual, QA manual are also inspected. The solid waste disposal site, main out fall sampling facility, stack monitoring system, etc., are inspected for compliance with regulatory requirements.

3.0 Assessment of Public Dose

An environmental monitoring programme, including a pre-operational survey to establish baseline data, is established and implemented at major nuclear sites in accordance with the requirements of AERB. The samples of various environmental matrices are analysed for radioactivity to assess the impact of operation of the nuclear facility on the environment. These results are used in conjunction with dietary survey to estimate the dose to members of the public due to radioactive discharges into the environment.

4.0 Effectiveness of Regulatory Control

Since 1992, as a result of implementation of GSR-125, an effective regulatory control mechanism has been established for disposal/ transfer of radioactive waste. The waste management scheme has been well established in all the nuclear facilities. As per regulatory requirements, the inventory of wastes disposed/ transferred is maintained by the facility in a systematic manner and the summary reports are sent to AERB on a quarterly and annual basis. Over the years, the nuclear facilities have achieved reduction in generation of radioactive wastes by effecting source control and employing volume reduction techniques, reduction in the generation of Ar-41 by design modifications and adopting environment friendly methods such as incineration of organic wastes, etc.

5.0 Conclusion

A proper regulatory control mechanism with adequate legal framework has been established to control the generation and the disposal of radioactive wastes. It ensures adequate protection of the public and the environment with respect to radiological safety. This should provide adequate assurance and confidence to the public that the management of radioactive is generated from the operation of nuclear power plant and associated nuclear facilities are being carried out in a safe manner.

QUALITY MANAGEMENT SYSTEM OF AERB

AERB was awarded ISO-9001: 2000 certification on Nov.15, 2006. Since then, AERB has been carrying out periodic internal and external audits of its Quality Management System. Internal audits of different Divisions of AERB were carried out in March 2009 and all the non-conformances identified were rectified. Input for Management Review regarding performance of QMS of AERB has been prepared and will be discussed in the Executive Committee of AERB. Revised standard (IS/ISO 9001:2008) have been procured and activities for revision of different documents as per the new standard have been started.

FEATURE ARTICLE

Assessment of Digital I&C Systems for Safety Applications in Indian NPPs

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1.0 Introduction

Instrumentation and Control (I&C) systems are essential part of a Nuclear Power Plant (NPP) as they perform reactor protection, control, monitoring and display functions. I&C systems act as main support to the operators both during normal and emergency operations. Classical analog I&C systems are now facing several challenges like mechanical failures, environmental degradation due to ageing and obsolescence. Modern digital I&C systems have several advantages over the existing analog counterparts. Their performance in terms of accuracy, computational capabilities and data archiving capability for future diagnosis is high. Added advantages in digital systems are fault tolerance, self-testing, signal validation capability and process system diagnostics. They have opened up new possibilities like symptom based guidance for handling plant emergencies, configuration management based on living Probabilistic Safety Assessment, etc. Such advanced features also add complexity to digital I&C systems and pose new challenges for the industry and regulators in assuring safety, reliability and quality requirements. Use of software based systems in NPPs is thus an international issue at present. IAEA also has issued Tech Docs/ Safety Guides useful for licensing NPPs with Digital I&Cs. In this article, the various aspects and challenges in the review of digital I&C and the involvement of Atomic Energy Regulatory Board (AERB) are discussed.

2.0 Indian Scenario

The following table highlights the increasing trend in use of digital I&C in Indian NPPs over the years.

3.0 Challenges to successful Introduction of Digital I&C

With increasing demand for improved nuclear safety and human factors, the use of advanced technological solutions offered by digital I&C systems can never be denied. But, presently the nuclear industry as well as the regulators face a number of challenges in introducing Digital I&C systems, such as difficulty to achieve adequate quality of software by controlling the software development process and verifying the end-product, potential for new failure modes may be introduced and methods to evaluate the reliability of the software based systems are at evolving stage.

4.0 Response to the Challenges

Software review process can give a reasonable solution to the present challenges in the digital I&C systems. It is a rigorous set of activities which ensures completeness, quality and reliability of software development processes and products. This is accomplished by guaranteeing conformance to all requirements, standards, procedures, and regulations. The Software review activity encompasses all phases of software development, including hardware-software integration activities. It integrates the concepts of quality assurance, safety analysis and independent verification and validation as shown in Fig 1.

Fig.1 Software Review Process

Software Quality Assurance (SQA) is a systematic process that evaluates processes and products with emphasis on monitoring to ensure the quality of the delivered product and compliance to standards and procedures.

	Reactor Trip System	Reactor Power Regulation System (RRS)	Channel temperature monitoring (CTM)
Prior to 1981: (RAPS-1&2 and MAPS-1&2)	ANALOG	ANALOG	ANALOG
During 1981 – 84: (MAPS-1&2)	ANALOG	ANALOG	First 8 bit microprocessor based CTM system for Display
During 1989 – 91: (NAPS-1&2)	ANALOG	First 8 bit microprocessor based RRS	16 bit microprocessor based CTM for Display
During 1991 – 93: (KAPS-1&2)	First 8 bit microprocessor based Programmable Digital Comparator System (PDCS)	8 bit microprocessor based RRS Inter-channel communication via RS-232	16 bit microprocessor based CTM for Display
During 1993 -2000: (KGS-1&2 & RAPS-3&4)	16 bit microprocessor based PDCS	16 bit microprocessor based Dual Processor Hot Standby system RRS	Introduction of setback through microprocessor (For Power Reduction)
During 2000- 2008: (TAPS-3&4 and KGS-3)	Two 16 bit microprocessor based PDCS	Computer based RRS	32 bit microprocessor based CTM

FEATURE ARTICLE

Verification and Validation (V&V) is an engineering process for evaluating correctness and ensuring quality of the software. Verification is the process of ensuring the correctness based on written specifications and requirements. Validation is the process of ensuring that digital system will function as intended.

5.0 Existing and Emerging Guidelines

Like introduction of any new technology, digital I&C also brought a set of new issues that led to the revision of old guidelines incorporating the new standards. AERB guide on Computer Based systems for PHWRs (AERB/SG/D-25-draft) provides guidance for design, development & implementation and licensing of Digital I&C Systems. The guide mentions the system safety classification & types of Digital Systems that are commonly used in NPPs and elaborates requirements with respect to that. Besides providing general recommendations on design and development, the Guide deals with Safety Cases for Digital I&C Systems performing safety functions. Comprehensive standards for qualification developed by IAEA, USNRC and IEEE are also useful in conducting the safety review of Digital I&C systems.

6.0 Review process of digital I&C

AERB considers two major aspects: implementation of digital I&C technology in new plants and retrofits to existing I&C systems in operating plants. The various stages of the review processes followed are:

i) Review of Categorization of digital I&C: Based on the safety functions and integrity requirements (i.e., the effects of system malfunction), the digital I&C systems are categorized into four classes: IA, IB, IC and NINS (Not Important to Nuclear Safety), in line with AERB design guide (AERB/SG/D-1). The systems which play main role in NPP safety fall under class-IA, while the system which play complementary role to class-IA systems comes under class-IB. Class-IC applies to software based systems that play indirect role in achievement of safety in NPP.

ii) Review of Classification of Computer Based Systems: The computer based systems are classified as Custom Built, commercially off the Shelf (COTS), and Pre-developed systems (PDS). Custom Built software is developed for a specific application and not targeted to the mass market. Commercial, off-the-shelf (COTS) software or hardware is ready-made and available for sale to the general public. These systems have limitations as vendor controls its development and buyer has no access to source code for V&V.

iii) Review of Safety case: The utility submits a safety case to establish that the Digital I&C has been designed as per recommended standards and that the system is safe. The safety cases are demonstrated with the following approach.

- The software and hardware have been developed through a systematic, controlled and fully documented engineering process using standards compatible with the safety class of the system;
- Safety analysis of system design (hardware and software) indicates safe behavior of the system;
- Independent Verification & Validation has been carried out to ensure that all the observations are satisfactorily resolved.

iv) Review of Verification and Validation: Verification and Validation of a software based system is done to determine that the system requirements are correct and complete throughout the software design and development life cycle. The various phases of this development cycle are: Requirement, Design, Development, Implementation, Testing, Operation and Maintenance.

Verification ensures that the product at the end of each phase fulfils the requirements imposed by the previous phase. It ensures correct flow of information from the system requirements specifications phase through design to the operation, maintenance and modification phase.

Validation is the testing and evaluation of the software based I&C system to ensure compliance with functional, performance and intersystem interface requirements. It is performed after completing integration phase and before the resulting system is put into service. Utility is responsible for the development of the system and its V&V. AERB then reviews the system and its IV&V reports before approving it for its use in the NPPs.

The main focus of regulatory review is the acceptability of software systems from safety, quality and reliability point of view. AERB audits all the IV&V activities to check the compliance with the criteria and requirements given in AERB guide SG-D-25 (draft) and other regulatory documents.

v) Operation and Maintenance: During the Operation and Maintenance (O&M) phase systematic configuration management processes are adopted to implement any changes. Changes in the system software are carried out only after its V&V. Also the process includes an impact analysis which assures that the change done in some part of the software does not lead to malfunction of the other parts. This process is fully documented and all the previous documents of the system which were affected by the change are revised. Also in the O&M phase, regulatory inspections are carried out by AERB to check the performance of various computer based systems and compliance to configuration management procedures.

7.0 Impact of Reviews on Plant Safety

The elaborate reviews which are carried out on the computer based systems right from their inception phase to their operation phase help to develop a level of confidence that the system has been developed correctly in accordance with the specifications. Also, during the reviews, the weaknesses of the systems are identified and measures to overcome them are taken accordingly. With the input from these reviews and the regulatory inspections, various limiting conditions on the operation of these systems have been included in the plant Technical Specifications.

8.0 Conclusion

The acceptability of Digital I&C Systems in nuclear facilities, demand strict adherence to applicable standards, and high level of product quality and reliability. The systematic V&V and subsequent audit gives the necessary confidence for its use. Components of protection and control systems, including software installed as firmware are of major concern to the regulatory body. AERB safety guide AERB/SG/D-25 and IEC/IEEE standards are useful references during design, development and V&V of software based systems. Review experience shows that the above documents provide adequate guidance to qualify software based nuclear instrumentation and control systems. However, the use of Commercially Off The Shelf (COTS) software in safety applications at NPPs is still a concern.

9.0 Acknowledgement

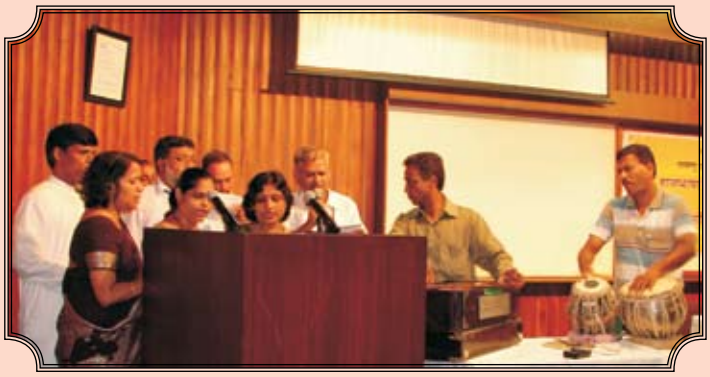
The authors are thankful to Shri S. D. Dhadopkar, RCnD, BARC, Mumbai for reviewing and giving valuable comments.

OFFICIAL LANGUAGE IMPLEMENTATION

The Official Language Implementation Committee had three meetings to have a detailed discussion on enhancing the use of Hindi in AERB. Two employees were deputed for training in Hindi Stenography and Hindi Typing. The new Hindi software "Aaj Ke Shabd" was procured and is being used for displaying Hindi meanings of English words on the display screen at the entrance of AERB office Building, Niyamak Bhavan.

On 28 May, 2009, Hindi Diwas was celebrated and was followed by a few competitions related to Hindi and the winners were awarded with suitable prize. A cultural programme was organised on this occasion in which AERB personnel participated enthusiastically.

⇧ **Inauguration of AERB Hindi Day Function**
(L to R): Shri S.P.Agarwal, Head, RSD and Chairman, OLC, AERB; Shri.S.K.Sharma, Chairman, AERB; Shri.V.M.Thomas, Administrative Officer-III, AERB and Shri.S.M.Gaikward, DCA, AERB.



⇧ **Cultural activities during the AERB Hindi Day Function.**

AERB along with DPS, DCSEM and HWP, Mumbai conducted two workshops on 20 to 23 January, 2009 and on 23 to 24 June, 2009 for imparting training to its staff in writing of letters and notings, etc., in Hindi. Three members of AERB participated in these workshops.

To encourage the use of Hindi by the officers and staff in AERB, Hindi Competitions such as Story Writing, Essay Writing, Scientific and Technical Translation, Noting and Drafting, Quiz etc. were organised in February 2009. A total of forty-three AERB personnel participated in these competitions.

Ten copies of the new Hindi software "Akruti Vistar" were procured. Unicode Font was also procured and the work on the Website of AERB bilingual is under progress. The work of publication of AERB safety documents in Hindi was continued.

THEME MEETING REPORT

Safety Research Institute, AERB, Kalpakkam in association with the Institution of Engineers (Kalpakkam Local Centre) organised a theme meeting on "Emerging Issues in Regulation of Nuclear Facilities" to mark the completion of a decade of Safety Research Institute, on February 20, 2009 at Kalpakkam. About 120 participants from various DAE units as well as academic institutions attended the meeting.

The workshop was inaugurated by Shri S. K. Sharma, Chairman AERB. Prof P. Rama Rao and Prof. S. P. Sukhatme, former chairmen of AERB addressed the gathering. Key note address on "R &D for Ensuring Safety in Fast Reactors and Associated Fuel Cycle Facilities" was delivered by Dr. Baldev Raj, Director, IGCAR, Kalpakkam. Shri S. E. Kannan, Director SRI gave an overview of the research activities currently being pursued at SRI as well as those that are planned to be taken up in near future. Prof. P. Rama Rao released `SRI Highlights-2009` brought out on the occasion.

There were two sessions on topics "Emerging issues" and "Role of R&D". In the first session, there were four invited talks covering the nuclear industry by speakers who are distinguished professionals in the respective fields. They clearly brought out some of the issues to be resolved / challenges to be met to achieve the planned growth of nuclear power generation in the country. In the second session, there were two talks and the distinguished speakers highlighted the role of R & D in regulation of Nuclear Poser Plants covering both national and international scenarios.

At the end, there was a panel discussion on the topic `The Role of R&D in Regulation`. The panel consisted of Prof. S.P. Sukhatme, Former Chairman AERB, as moderator and Shri S.K. Sharma, Chairman AERB, Shri S.K. Mehta, Chairman, ACPSR-LWR, AERB, Shri G. R. Srinivasan, Former Vice-Chairman, AERB and Shri S.S. Bajaj, Former Sr. Exe. Director, NPCIL as members. The discussions brought out some of the salient points such as:

- Development of in-house capability of safety review and analysis of LWRs in AERB.
- Making best use of PSA, keeping in view some of its limitations, in risk informed regulation.
- Hydrogen management under accident conditions in NPPs.
- Mock-ups and experimental studies related to safety, wherever possible, to get a greater insight into the issues of new design.
- Extending research and development work related to safety to demonstration stage.
- Development of computer codes for safety analysis and their validation.
- Participation in international co-operation programmes for updating knowledge and further development of expertise.

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Personnel Joined

Sl.No.	Name	Date of appointment
1.	Shri Pradeep Chandra Gupta, SA(B)	01/01/2009
2.	Shri V. V. Kulkarni, AD(OL)	27/01/2009
3.	Shri Kanwar Singh Chauhan, Jr. Hindi Translator	29/04/2009

Personnel Retired

Sl. No.	Name	Date of retirement
1.	Shri R. Venkataraman, Director, OPSD	31/01/2009
2.	Smt. B. Nagalakshmi, RSD	28/02/2009
3.	Shri George Thomas, OPSD	31/05/2009

On superannuation of Shri R. Venkatraman, Director, OPSD on January 31, 2009, Shri S. N. Rao has been appointed as Director, OPSD.

ANNOUNCEMENTS

International Workshop in January 2010

An International Workshop on "External Flooding Hazards at Nuclear Power Plant Sites in Commemoration of the 5 years of Indian Ocean Tsunami Event" will be organized jointly by Atomic Energy Regulatory Board (AERB), Nuclear Power Corporation of India (NPCIL), Indira Gandhi Centre for Atomic Research (IGCAR) and International Atomic Energy Agency (IAEA) from January 11-15, 2010. The purpose of the workshop is to share information within the international nuclear community on the scientific, technical and regulatory developments that were carried out during last 5 years, following to and as a consequence of the tsunami event of December 26, 2004 in the Indian Ocean. Approximately 70 persons from 40 countries are expected to attend.

Workshop on BSM Facilities in October 2009

In order to familiarize the operating Beach Sand Mineral (BSM) facilities as well the new BSM facilities regarding the regulatory requirements and radiological safety aspects, a one-day workshop on 'Awareness on Safety and Regulatory Requirements of BSM Facilities' will be organized at AERB, Mumbai during October, 2009.

The workshop shall have three technical sessions. Lectures in the first two sessions will be delivered by recognized experts from AERB and BARC on topics such as Natural Radioactivity & Fundamentals of Radiation Protection, Radiological Hazards, Waste Disposal, Monitoring and Dose Estimation in BSM Facilities, Safety during Transport of Radioactive Materials and, Licensing Procedures and Regulatory Requirements of BSM Facilities. The third Technical Session will have presentation from some of the operating BSM facilities on their operating experience. The Technical Sessions will be followed by a Panel Discussion.

26th DAE Safety & Occupational Health Professionals Meet – 2009

The 26th DAE Safety & Occupational Health Professionals Meet will be held at VECC, Kolkata during November 16 - 18, 2009 and will be ogranised jointly by Atomic Energy Regulatory Board and Variable Energy Cyclotron Centre, Kolkata. The themes of the Meet are "Cryogenic Safety & Electrical Safety" and "Ergonomics at Workplace". Chairman, Atomic Energy Commission, will inaugurate the Meet in the presence of Chairman, AERB. On the first day of the Meet, there will be an endowment lecture from an expert in the subject theme, followed by three technical sessions. Two sessions will be dedicated to Industrial Safety and one to Occupational Health. Eminent speakers will deliver invited talks and share their rich experiences. The Safety Professionals & Occupational Health Professionals will share their views and experiences to enhance the safety and medical management aspects in the next two days of the Meet.

INES : SCOPE EXTENTED

International Nuclear Event Scale (INES) has been recently named as International Nuclear Event and Radiological Scale. However the abbrevation INES has been retained. Initially the scale was applied to classify events at nuclear power plants and was later extended and adapted to enable it to be applied to all installations associated with the civil nuclear industry. Now the scale has been extended and further to include the communication of the significance of all events associated with the transport, storage and use of radioactive material and radiation sources.

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