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AERB Newsletter

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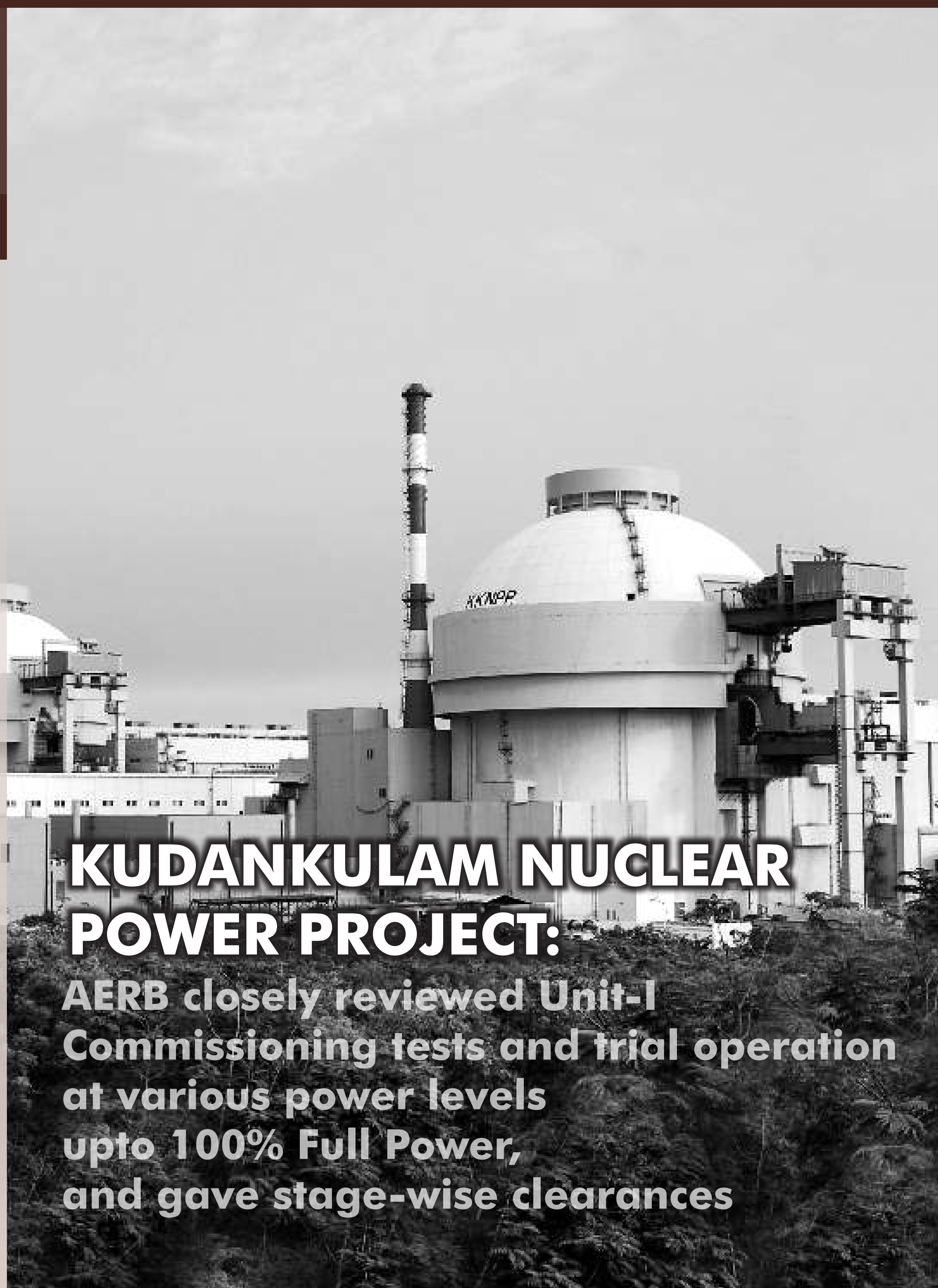
ATOMIC ENERGY REGULATORY BOARD

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 undue risk on the health of the workers and the members of the public and on the environment.

CONTENTS



KUDANKULAM NUCLEAR POWER PROJECT:

AERB closely reviewed Unit-I Commissioning tests and trial operation at various power levels upto 100% Full Power, and gave stage-wise clearances

From the Chairman's Desk

Greetings to all!!!

The past six months have seen realizing of AERB initiatives and opening up of new vistas. One such is the request for peer-review of the Indian nuclear regulatory system by the Integrated Regulatory Review Service (IRRS) mission, IAEA. The IRRS team comprises of senior regulatory experts from other countries with broad knowledge of the regulation of nuclear and radiation safety and extensive experience in specialized areas. These missions, carried out at many countries, provide regulators an opportunity to benchmark their system against international best practices, harmonizing regulatory approaches and creating mutual learning opportunities. The IRRS peer review mission is expected during March 2015. As a first step, a preparatory seminar with IAEA officials was organized this March at AERB.

Another prestigious international forum that AERB has been participating is the Convention of Nuclear Safety (CNS) at IAEA, Vienna, which is an incentive instrument that commits participating countries (76 as of March 2014), operating nuclear power plants to maintain a high level of safety. In the 6th review meeting of CNS held in April this year, India presented the national report highlighting a) the enhancements of safety systems in Indian NPPs post-Fukushima, b) system of licensing of Indian NPPs which on periodic basis assess NPPs performance vis-à-vis latest safety standards and practices.

AERB was involved in the follow-up mission of first ever Operational Safety Review Team (OSART) review by IAEA at Rajasthan Atomic Power Station 3&4. Earlier, OSART had carried out a full scope peer review of RAPS-3&4 and covered nine major operational areas. AERB's involvement was to the extent of reviewing OSARTs comments for adequacy of AERB regulatory documents, processes and ensuring through safety review and regulatory inspections that OSART recommendations / suggestions will be satisfactorily addressed by all operating NPPs.

The other notable international forums which AERB participated were the WWER forum for Kudankulam type reactors and the NEA Multi Design Evaluation Programme (MDEP). Details of the international forums form part of this newsletter.

Owing to the global nature of nuclear power these peer reviews and regulatory exchanges readily provide AERB valuable insights into a) the efficiency and effectiveness of the present legal governmental framework for nuclear regulation b) regulatory infrastructure for safety c) potential improvement strategies. d) Fostering accountability. With these initiatives the rhetorical question "Who regulates the Regulator?" may perhaps be addressed to a good extent!!

Closer home, AERB has recently released a policy document "Policies Governing Regulation of Nuclear and Radiation Safety". This document consolidates the safety policy objectives, stated in the Atomic Energy Act, 1962, the Rules, Codes & Standards of AERB, into a single document. The aim of this document is to enhance openness in the conduct of regulatory activities and to reduce communication gaps while interacting with its stakeholders as well as outside agencies.

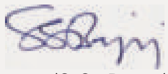
AERB has also cleared major proposals after extensive and all-encompassing multi-tier review by experts. Thus, AERB has granted the Siting clearance for Nuclear Fuel Complex (NFC), Kota, clearance for erection of major equipment at Kakrapara 3 & 4 site and clearance for raising reactor power upto 90% Full Power and for a limited duration 100% Full Power at Kudankulam NPP, as part of the Commissioning. Review of proposal for site evaluation for a Nuclear power plant at Gorakhpur, Haryana, is in full progress.

Another initiative by AERB, which is showing favorable results, is the institution of e-LORA (e-Licensing of Radiation Applications), the e-governance portal for licensing of utilities using radiation sources for various medical, industrial and research applications. It is encouraging that the number of X-ray equipment declared in this portal is increasing. AERB is steadily deploying the other modules of e-LORA and is hopeful that the comprehensive e-LORA system will be operational by the end of next year.

The extensive use and transport of radiation sources in public domain could pose a security hazard. AERB conducted an information session wherein users of high hazard potential sources and law & enforcement authorities, Mumbai region, were addressed together. They were briefed on their overall roles & responsibilities to ensure security of these sources and plan of action in case of emergencies, such as loss of source. It is planned to extend this program to other metros as well.

As has been the norm, this year too, AERB has given away Industrial and Fire safety awards to deserving units of the Department of Atomic Energy. It is indeed to the credit of all the DAE establishments that their industrial safety indicators have consistently been better than that of similar other industries in the country.

This edition of newsletter has interesting feature articles that spotlight AERB's contribution in improvement of safety in design/ operation of both a complex Nuclear power plant and a relatively simple X-ray equipment.



(S.S. Bajaj)

Safety Review and Regulation

AERB Board Meeting

The 111th Board meeting of AERB was held on May 23, 2014. The Board took note of the safety status of all operating Nuclear Power Plants (NPPs) and appreciated the 657 days of continuous safe operation (as on May 22, 2014) of Rajasthan Atomic Power Station (RAPS-5). The Board was informed about the in-depth safety review and assessment carried out by respective technical divisions of AERB and associated safety committees based on which various licenses were granted or renewed. The Board noted that Off-Site and Site Emergency Exercises (OSEE & SEE) were conducted at all NPP sites as per schedule. With regard to Post Fukushima measures, Board noted that short term measures have been implemented. Implementation of medium & long term measures is in progress and being monitored by AERB.

With regard to nuclear power projects, the major issues which emanated during the safety review for granting Major Equipment Erection clearance for KAPP 3&4 (Kakrapar Atomic Power Project) were briefed to the Board. The Board endorsed the recommendations of ACPSR-PHWR (the second tier review committee) and agreed to the proposal of granting clearance for Erection of Major Equipment for KAPP-3&4 subject to compliance of the stipulations.

With regard to Fuel Cycle facilities, the Board reviewed the proposal for Siting clearance for Nuclear Fuel Complex (NFC), Kota. The project proposal aims at setting up a PHWR Fuel Fabrication Facility to meet the increased demand of nuclear fuel. Based on the review recommendations of safety committees and detailed deliberations, the Board agreed to the proposal of granting Siting consent for the said facility subject to compliance of ACPSR-FCF recommendations.

The Board also took note of the follow-up mission of the Operational Safety Review Team (OSART), an international peer review team of nuclear safety experts led by the IAEA, at RAPS-3&4 conducted during February 3-7, 2014. The follow up mission was carried out to assess the actions taken by the station to address the recommendations and suggestions made during 2012 OSART mission. The Board was also apprised of the review and appreciation of the India's National Report presented during the 6th review meeting of IAEA's Convention on Nuclear Safety (CNS). A fourteen member delegation led by Chairman AERB participated in the CNS review meeting.

AERB Board Members discussing at the 111th Board Meeting

KK NPP-1Commissioning

The Kudankulam project KK NPP-1&2, 1000 MWe VVER Pressurized Water Reactor of Russian design is designed as per the Russian standards and additional requirements of the Indian Regulatory Body and current international safety requirements have been addressed as applicable.

After completion of all major construction and equipment erection activities for KK NPP Unit#1, consents were earlier issued in stages for hydro-testing, containment testing, hot run and Initial Fuel Loading. All heat-up and associated tests were completed during December 2012 - June 2013 as part of Phase A commissioning.

KK Unit#1 achieved successful criticality on July 13, 2013. Various reactor physics related tests were conducted subsequent to criticality. This established performance of reactor control & protection and certain safety systems as part of Phase B commissioning. The results were reviewed by safety committees of AERB.

Further, power was raised as part of Phase-C1 commissioning stage in steps to 33% of Full Power (FP) and synchronized with the Grid at about 150 MWe (electrical power). The power was raised up to 50 % FP and various commissioning tests were conducted. Subsequently, as part of commissioning Phase C-2, power was raised upto 75% FP and associated tests were conducted. Test results of Phase C-1 & C-2 stages were analyzed by NPCIL and detailed reports were submitted to AERB for review.

NPCIL submitted an Application for Authorization to raise Reactor Power upto 100% FP (Commissioning Phase-C3) for further tests to be conducted to check the performance of various systems. Based on review of Phase-C2 stage commissioning test results, Phase-C3 test procedures along with the Application, AERB granted Clearance for "Raising Reactor Power upto 90 % FP and upto 100% FP for limited period to conduct specified Tests (Phase-C3) for KK NPP Unit # 1", subject to compliance of stated stipulations.

700 MWe PHWR Units - KAPP-3&4 Construction

Kakrapar Atomic Power Project-3&4 (KAPP-3&4) is the first twin unit project in a series of 700MWe PHWR Units (other 2x700 MWe Units are under construction at RAPP-7&8, Rajasthan). This is an evolved design from 540 MWe PHWR (TAPS-3&4, Tarapur). A number of First Of A Kind (FOAK) systems/ features have been introduced in 700 MWe PHWR design viz. steel lined containment, containment spray system (CSS), passive decay heat removal system (PDHRS), partial boiling at the outlet of coolant channels, mobile fuel transfer machine, forced evaporation of tritiated liquid waste for discharging to air route through stack, use of super heavy concrete (SHC) for construction of shielding structure of Fuel Transfer (FT) Room.

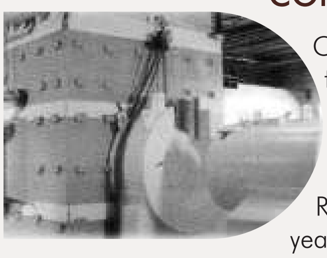
The mock-ups/ experiments to qualify these FOAK features/ systems have been reviewed and accordingly further mock-ups/ experiments are planned. The mock-up related to constructability of lined containment and qualification of SHC mix were completed before start of construction above 91.7 m EL of Reactor Building, as stipulated at the time of clearance for 2nd sub-stage of construction i.e. first pour of concrete (FPC).

Full height experiments of PDHRS were completed in two phases at IIT Bombay and NPCIL R&D centre at Tarapur. Further experiments on PDHRS are planned at NPCIL R&D centre at Tarapur. Experiments related to CSS were conducted at full ring header facility at Kakrapar and CSS droplet size measurement experiments at IIT Bombay. Further experiments to demonstrate CSS capability are planned at IIT Bombay. Performance tests of other FOAKs are also in progress.

Based on Post-Fukushima safety review, certain safety enhancements such as provision of reactor trip on seismic parameter, air-cooled DG located at higher elevation and water hook-up connections to various systems are included in design.

Design of all systems of KAPP-3&4 is finalized and review of the same has been carried out as per established procedures specified in safety guides. NPCIL submitted application for seeking clearance for Erection of Major Equipment at KAPP-3&4. Based on the detailed reviews carried out in 3-tier review process, the Board of AERB in its 111th meeting held on May 23, 2014 granted Clearance for 3rd sub-stage of construction i.e. Erection of Major Equipment for KAPP-3&4 subject to compliance with the stated stipulations.

CORAL: Experimental Facility for Reprocessing spent fuel of FBTR



Compact Reprocessing of Advanced fuel in Lead Mini cell (CORAL) was setup in Reprocessing Development Laboratory (RDL) at Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam in the year 2003. The objective of this facility is to reprocess the spent fuel discharged from FBTR on experimental basis.

Till now AERB has been issuing 'Authorization for Operation' campaign wise to CORAL facility. During these years of operation, several modifications/ replacements were carried out in order to improve performance and reliability of the systems and enhancement of safety after detailed review in AERB. It was noted that the performance of CORAL was satisfactory during these years.

It is the first time that AERB issued the 'License for Operation' to CORAL facility. Based on the requirements specified in AERB Safety code titled 'Regulation of Nuclear & Radiation Facilities' (AERB/SC/G) and Safety Guide titled 'Consenting Process for Nuclear Fuel Cycle Facilities & related Industrial facilities other than Nuclear Power Plants & Research Reactors' (AERB/SG/G-2).

"First License of operation for CORAL

Consents Issued

Radiation Facilities /Activities

Type of Facilities / Equipments	No of Facilities / Equipments	Type of Consents
Radio therapy facilities	17	License
Medical Cyclotron facility	3	License
Interventional Radiology	120	License
Computed tomography	217	License
PET-CT and SPECT-CT	16	License
Manufacturing facilities of diagnostic x-ray equipment	5	License
Industrial Radiography Facilities	26	License
HDR Brachytherapy	3	Authorisation
Authorisation of agencies for QA of Diagnostic X-ray equipment	18	Authorisation
Well Logging	24	Authorisation
Facilities using unsealed radio-isotopes for research	9	Registration
IRGD (Nucleonic gauges) Facility	37	Registration
Diagnostic X-ray facilities	1545	Registration

Nuclear Facilities

(a) Concurrence for Containment testing (Strength and Integrated Leak Rate Test) of KK NPP Unit # 2 issued on January 18, 2014

(b) Clearance for Raising Power up to 75% Full Power for KK NPP Unit # 1, issued on January 24, 2014

(c) Clearance for Raising Reactor Power beyond 90% FP and - for limited duration up to 100% FP for conduct of specified tests (Phase-C3) of Kudankulam Nuclear Power Project Unit-1 - Extension of Validity period issued on June 13, 2014.

(d) Clearance for Erection of Major Equipment at KAPP 3&4 issued on May 26, 2014.

(e) License for operation of CORAL up to December 2014

(f) Renewal of license for operation of MAPS-1&2 up to December 2015

(g) Consent for Siting & Construction of 3 TPA Niobium Thermit Production Facility at Nuclear Fuel Complex (NFC), Hyderabad was extended up to March 31, 2015.

(h) License for enhanced uranium ore production capacity of Turamdih mine of UCIL (from 550 TPD to 1000 TPD) was granted on January 07, 2014 which is valid upto December, 2018.

(i) Consent for commissioning of Tummalapalle mill was extended till April 30, 2015.

(j) Consent for siting of 500 TPA PHWR Fuel Fabrication Facility (PFFF) and 165 TPA Zircaloy Fabrication Facility at NFC-Kota, Rawatbhata, Rajasthan was issued on May 28, 2014 and is valid till May 31, 2017.

REGULATORY INSPECTIONS

AERB officials carried out periodic Regulatory Inspections as well as Special Regulatory 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. Unplanned inspections were also carried out for selected nuclear and radiation facilities.

International Cooperation

With a view to harmonise and promote high level of nuclear safety worldwide, AERB participates and contributes in the activities of several international agencies / organizations and has entered into bilateral agreements with regulatory authorities of other countries and such international organizations. During the first half of year 2014, few of which have been highlighted below:

India Participates in the Sixth Review Meeting of 'Convention on Nuclear Safety'

Shri S.S.Bajaj, Chairman, AERB along with the Indian delegations at the sixth review meeting of CNS

India is a Contracting Party of the Convention on Nuclear Safety (CNS) since March 2005. The Convention which entered into force in 1996 is an incentive instrument that aims to legally commit participating countries operating land-based Nuclear Power Plants (NPPs) to maintain a high level of safety. As of March 2014, there are 76 countries to the convention. The Convention obligates Contracting Parties (CPs) to submit a 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. The National Reports are peer reviewed by other CPs and then orally presented in the Country Group sessions in the Review Meetings (RM) of CPs.

India regularly submits National Reports since 2008 and the latest one (third in series) was submitted in August 2013 for the sixth review meeting of the convention held during March 24 - April 4, 2014. Besides presenting compliance with the obligations of CNS, the report also described Post Fukushima actions highlighting measures taken on safety upgrades at operating NPPs, strengthening of emergency preparedness, transparency and public awareness. The report also brought out the updates on challenges and planned measures identified in previous review meetings. These include strengthening legislative framework, Periodic safety reviews of four twin-units NPPs, Probabilistic safety analysis, equipment qualification, severe accident management, development and revision of safety documents, human resource augmentation in regulatory body, design support to operating NPPs.

Subsequent to uploading of India's National Report on CNS website, India's report was reviewed by other contracting parties and 154 questions were raised. The national outreach program initiated by NPCIL and AERB in response to Fukushima accident and approval of annual dose budget for NPPs by AERB were considered good practices by some of the contracting parties. The answers to these questions were posted by India on 28th February, 2014 as per CNS deadline. The members of Review Group (RG) and Working Group (WG) reviewed the national reports of other contracting parties and raised a total 103 questions on them.

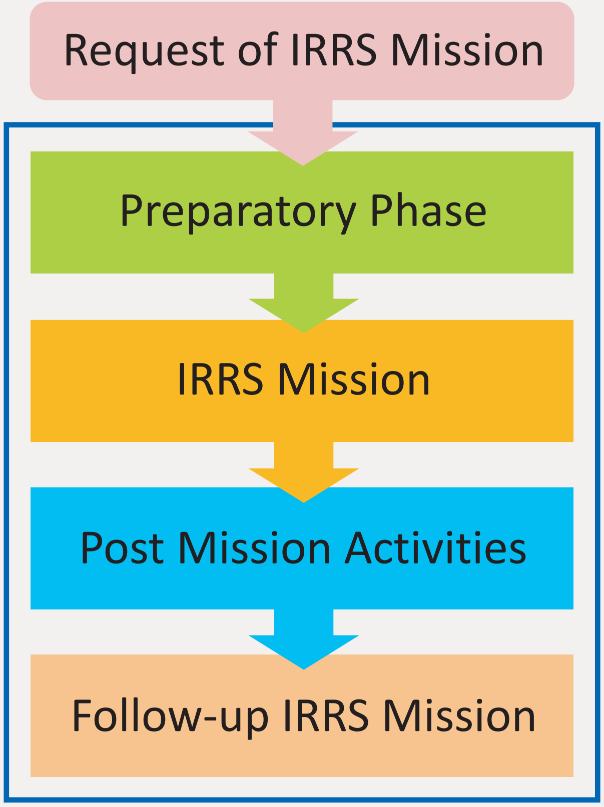
A fourteen member delegation lead by Shri S. S. Bajaj, Chairman, AERB attended the meeting, wherein about 800 participants from 69 CPs took part in peer review process.

India's presentation was scheduled on March 27th and was well attended. India presented its National power program covering safety aspects of design, construction, commissioning and operation of NPPs, R&D support of BARC to AERB, current status on the planned measure and challenges identified in previous review meetings, thematic responses to the questions raised by the other contracting parting on India's national report, planned measures and challenges identified for the 7th CNS review meeting, good practices of India.

The safety improvements carried out in the Indian NPPs as a result of Periodic Safety Reviews, safety enhancement measures taken post Fukushima accident, conduct of first OSART mission, public outreach program and human resource development were acknowledged by the contracting parties. The convention also recognised India's efforts for meeting the challenges identified in the previous CNS review meetings.

During the review process contracting parties asked further questions in the areas of legal status of AERB, NSRA Bill, PSR review process, national action plan on post Fukushima upgrades, revision of regulatory documents, quality assurance etc. Indian delegation members provided appropriate responses to these questions.

India decides to host IRRS Mission



IAEA-IRRS Process

The International Atomic Energy Agency (IAEA) conducts an Integrated Regulatory Review Service (IRRS) in countries with Nuclear Power Plants and radiation facilities to review the common aspects of the State's national, legal and governmental framework and regulatory infrastructure for nuclear and radiation safety against IAEA Standards and Guidance. It is a peer review and is conducted at the request of a country, which is a member of IAEA. An expert peer review of the current extent of compliance with IAEA Standards and Guidance provides a good indicator of the effectiveness of the regulatory oversight for various facilities /activities in the country.

Pursuant to its commitment made in IAEA General Conferences held in 2011, 2012 and 2013, India has decided to host the IRRS Mission and has already submitted a formal invitation to IAEA to review the activities of AERB in respect of the regulatory system and activities related to safety of Nuclear Power Plants in India.

IAEA experts meeting with Shri S.S.Bajaj, Chairman, AERB at the National Self-Assessment Seminar

As a first step in this direction, AERB organized a 'National Self-Assessment Seminar' during March 4-6, 2014 in order to communicate greater understanding of the Mission's expectations. Three IAEA officials elaborated the process and procedures of the IRRS Mission, requirements and stipulations made in IAEA standards, the mission's expectations and explained the use of SARIS (Self Assessment of Regulatory Infrastructure for Safety), a software-tool, developed by IAEA for carrying out the Self-Assessment process which is an integral part of IRRS mission. The officials from various governmental agencies involved in the regulation of NPPs, participated in the seminar. After the seminar, a meeting was held between the IAEA officials and the senior management of AERB to discuss the scope and schedule of IRRS Mission in India and the preparations required to host the same.

IRRS Reviewer Training

One official from AERB participated in the 'Training Course for Integrated Regulatory Review Service (IRRS) Reviewers' held at IAEA's Headquarters in Vienna from October 21-24, 2013. During the training, the procedures and review mechanisms of IRRS mission were elaborated and the expectations from various government agencies were highlighted. This course was aimed at training the regulators from different Member States of IAEA for creating a pool of IRRS reviewers to carry out IRRS mission in different countries.

Participants of National Self-Assessment Seminar held at AERB

21st Annual Meeting of WWER Forum

Shri S.S. Bajaj, Chairman, AERB and Shri K. J. Vakharwala, Director, NPSD, AERB represented India in the 21st Annual Meeting Forum of the State Nuclear Safety Authorities of the Countries Operating WWER Type Reactors held during June 16 - 18, 2014 at Helsinki, Finland. Nine member countries (Armenia, Bulgaria, Czech Republic, Finland, Hungary, India, Russian Federation, Slovak Republic and Ukraine) and 2 observers (GRS and IAEA) participated in the 21st Annual Meeting of WWER Forum.

Delegates at the 21st Annual Meeting of WWER Forum

India's participation in MDEP activities

Two AERB officials attended the first meeting of the VVERWG during January 2014. The representatives from five countries namely; Russia, Finland, India, Turkey and UK (as observer) participated in the meeting. Participants exchanged information on licensing process and the status of VVER review in their countries. Technical discussions also took place on differences in VVER design in each country. In subsequent meetings of the working group, technical topics for further discussion were identified.

Public Communication

The objective of CNRA Working Group on Public Communication of Nuclear Regulatory Organizations (WGPC) is to provide support to improve communication of Nuclear Regulatory Organizations through exchange of information and experience and to maintain a network among working group members. One official from AERB attended the 15th meeting of the working group (WGPC) during May 14-16, 2014 at OECD headquarters, Paris.

AERB's involvement in follow up mission of India's First Operational Safety Review Team (OSART) review by IAEA

A full scope OSART mission for peer review of RAPS-3&4 was conducted by 12 members team of IAEA during October 29 to November 15, 2012 at RAPS-3&4 based on the decision of the Government of India. It covered nine operational areas: Management, Organization and Administration; Training and Qualification; Operations; Maintenance; Technical support; Operational experience feedback; Radiation protection; Chemistry; and Emergency Planning and preparedness. The OSART method involves not only the examination of documents and interviewing of staff but also reviewing the quality of performance. The OSART team made seven recommendations, seven suggestions and identified thirteen good practices and offered fourteen "encouragements" in various areas during the mission. AERB reviewed all the recommendations and suggestions made by OSART for adequacy of AERB regulatory documents / processes. AERB further ensured through safety review and regulatory inspections that these recommendations / suggestions should be satisfactorily address not only at RAPS-3&4 but also other operating NPPs.

After fifteen months, a team of four IAEA members visited RAPS-3&4 on a follow up mission from February 3rd to 7th, 2014 to assess the progress made by RAPS-3&4 in addressing the issues identified in the original OSART mission. Director Operating Plant Safety Division, AERB alongwith other AERB representatives were present at the site during last two days of the follow up mission and in exit meeting.

Shri P. R. Krishnamurthy, Director, OPSD addressing the OSART members

The team noted that 79% of the issues were fully resolved. There was satisfactory progress in 21% of the issues. The results were termed as excellent by the team.

OSART team appreciated the cooperation from management & staff of RAPS-3&4 and took a positive note with the action taken to analyze and resolve the findings of the original mission. In addition, team concluded that the managers and staff were open and transparent during the mission.

Discussion Meet/Seminar/Awareness Programme

Discussion Meet on "Engineering of foundations for NPP structures in alluvial soils"

Engineering of foundations for NPP structures in alluvial site needs to be addressed comprehensively in design safety review of civil engineering structures. As of today, there is limited experience of soil-structure interaction issues for heavy foundations in alluvial sites, particularly with respect to ground motion modifications and soil-foundation-structure interaction effects. There are technological challenges, particularly if use of piles is necessitated along with raft in deep alluvium.

Expert Panelists at the Discussion Meet

In this regard a discussion meet on "Engineering of foundations for NPP structures in alluvial soils" was organized by AERB on January 24, 2014. The primary objective of this meet was to deliberate engineering challenges for foundations of NPP in alluvium compared to those in rock, so as to have regulatory focus on safety of NPP foundations in alluvium during the review process. Major topics of the discussion included:

1. Evaluation of earthquake motion in alluvial sites.
2. Modeling and analysis for soil-structure interaction in alluvial sites.
3. Soil-pile-structure interactions.
4. Geotechnical investigations for NPPs on alluvial sites.
5. Static analysis and settlement behavior in design of raft/pile foundations in alluvial sites.

Around 85 delegates from AERB, DAE units (viz. BARC, IGCAR, BHAVINI, NPCIL, HWB and DCSEM), Academic Institutions (IIT Roorkee, IIT Bombay) and Consultants (viz. TCE, STUP, L&T etc) participated in the discussions. Detailed presentations made by experts were followed by a panel discussion.

Discussion Meet on "Assessment of Structure under Impact and Blast loads"

External events considered in design of Nuclear Power Plant (NPP) structures are categorized as natural and human induced events. Missile impact and blast loading constitute important human induced events to be considered for safety of NPP. Containment shall be protected against or designed to resist safely the human induced events of concern depending on the nature and extent of the risks posed by the site environment. Hence, structural integrity assessment of NPP structures against such dynamic loads is important. These transient dynamic analyses require state-of-art methodology incorporating high strain rate effects.

In this regard a discussion meet on "Assessment of Structure under Impact and Blast loads" was organized at AERB on March 18, 2014. The primary objective of this meet was to understand state-of-art methodology in modeling and analysis for aircraft impact and blast loading and related advancements and to formulate an approach paper for such analysis and design. Major topics of discussion were related to:

1. Characterization of loading.
2. Challenges in numerical simulation of such transient dynamic analysis.
3. Assessment of structural integrity for impact and blast loads.

Around 40 delegates from various organizations like AERB, BARC, IGCAR, NPCIL and DRDO participated in the discussion.

Awareness Programme on 'Security of Radioactive Material (RAM) at Radiation Facilities (RFs) and during Transport of RAM'

The use of ionising radiation sources for various applications in industry, medicine, agriculture, research and education are increasing steadily. Thus, ensuring security of radioactive source(s) is important for overall protection of radiation workers, public and environment, the primary responsibility of which is with the owner of the radiation facility.

With an objective to

(i) bring the Law and Enforcement authorities and radiation facility owners to a common platform and inform security aspects of radioactive material and during their transport

(ii) familiarize them with the requirements for security of radioactive material in radiation facilities and their enforcement as per the AERB Guides on Security of radioactive sources (Ref: AERB/RF-RS/SG-1 and AERB/NRF-TS/SG-10 respectively)

(iii) inform on the responsibilities of Law and Enforcement authorities and radiation facilities for ensuring the security of RAM all the time,

Atomic Energy Regulatory Board (AERB) organized an awareness programme on February 7, 2014 at Mumbai on 'Security of Radioactive Material at Radiation Facilities and during Transport of Radioactive Material' for Law and Enforcement Authorities as well as for owners of Radiation Facilities (mainly Category-1 & 2) located in Mumbai region.

There were participants from Police authorities comprising DCPs, ACP and senior Police Officers of different zones of Mumbai police; different radiotherapy facilities; industrial radiography facilities; Gamma Radiation Processing Facilities (GRAPF) and

Gamma IC & Well Logging facilities. Representatives from radiation source / equipments suppliers (Category-1&2) located in Mumbai region also attended the awareness programme.

Shri S. S. Bajaj, Chairman, AERB inaugurated the programme. Chairman, AERB informed the participants on the stringent regulatory control in place over use of radiation sources and the physical security measures recommended in the AERB security guides. Chairman highlighted the graded concept of security measures based on the potential hazard and the vulnerability of the source or the device, as well as the potential consequences of malevolent actions He also elaborated about the role of radiation facilities, Law and Enforcement Authorities and radiation source / equipment manufacturer / supplier for ensuring the security of radioactive sources.

(L to R) Shri R.K. Singh, Shri S.S. Bajaj, Shri Anil Kumar, and Shri Fredric Lall at the inauguration ceremony

Chief Guest of the programme, Shri Anil Kumar, IG (Security), DAE delivered the key note address. He informed the participants that Ministry of Home Affairs (MHA) has already circulated to all concerned in the state level for implementation of the relevant clauses of AERB Security Guides by the respective law and enforcement authorities. He explained the role of law and enforcement authorities for security of radioactive sources and in scenarios when radioactive source is lost.

It has been planned that such awareness programme for Law and Enforcement Authority will be conducted in a phased manner at Chennai, Kolkata and New Delhi and subsequently in the cities with large number of radiation facilities.

AERB Joint Seminar with NISST

Radioactive contamination in metal is a growing concern. During the past few years, cases of radioactive contamination in ferrous and non-ferrous items have been reported to AERB, arising from re-cycling steel industries. Radioactive contamination in steel occurs due to accidental melting of radioactive source along with contaminated scrap.

In view of the above, AERB had earlier in the year signed a MoU with National Institute of Secondary Steel Technology (NISST). One of the terms of this MoU was to organize six cluster level programmes throughout the country in consultation with AERB to educate the industry on the ill effects of such contamination and preventive measures to be adopted.

As part of the series of such seminars, NISST organised a seminar on "Cost and Quality Improvement in Steel Manufacturing" dated February 22, 2014 in association with Atomic Energy Regulatory Board. Chief Guest of the function was Shri Rajesh Prasad, IAS, Commissioner, Industry & Commerce, Govt. of Assam. Shri R.K Bagchi, Director NISST, Shri M. U. Ahmed, Addl. Commissioner, Industry & Commerce, Shri R. Bandopadhaya from Joint Plant Committee, Shri B. P. Muktieh, CMD of M/s NADFi, Shri D. Goenka, Director of M/s K. D. Iron Steel Co. and Shri A. Mohindru, Dy. Director (E) NISST were amongst the other dignitaries who attended the seminar.

AERB officer delivered a talk on detection, response and measures for prevention of radioactive contamination in metal recycling industries highlighting the initiatives taken-up by AERB in this regard.

Awareness Program on Radiation Safety Practices in a Medical Cyclotron Facility

A one day awareness program on 'radiation safety practices in medical cyclotron facilities' was conducted by AERB in collaboration with RMC, Parel on March 29, 2014. RMC Parel, is the first of its kind medical cyclotron in the country and caters to the Radiopharmaceutical (primarily FDG) requirements at various hospitals in and around Mumbai. The F-18 labeled Radiopharmaceuticals produced at RMC are being used for research also.

Dr. Pankaj Tandon addressing the participants. (L to R): Dr. M.G.R.Rajan, Dr. N. Ramamurthy, and Shri A.K. Kohli are on the dais.

The objective of the workshop was to apprise the stakeholders on the regulatory and radiation safety requirements owing to the increasing Medical Cyclotron facilities in the country. As per Atomic Energy (Radiation Protection) Rules, 2004, the Medical Cyclotron falls under "Licence category" which implies high radiation hazard potential and calls for comprehensive safety review at all stages.

The program was inaugurated by Dr. A.K. Kohli, CE, BRIT. Dr. N. Ramamurthy, Senior Technical Advisor to Chairman, AEC, delivered the keynote address. Dr. M.G.R. Rajan, Head, RMC addressed the physics and design aspects of the medical cyclotron and the latest technological advances. Dr. M. R. Iyer, Chairman of AERB's Safety Committee on Medical and Industrial Accelerators, emphasized on maintaining the public doses well within the stipulated limits. Concerned AERB officer cited regulatory requirements at each stage of the licensing process and the common deficiencies observed in the applications. RMC officers also delivered talks on short-lived isotopes, their application for various medical purposes and radiation safety aspects. The workshop was attended by around seventy members from different medical cyclotron facilities in the country.

Theme Meeting on 'Revised Criteria for use in Preparedness and Response to Nuclear or Radiological Emergencies'

Emergency planning, preparedness and basis for prompt response have undergone many changes all over the world in last two decades. In order to make the Emergency Preparedness Plans for nuclear and radiation installations more effective, enhance awareness and understanding of all concerned agencies, a need was felt to revise the existing AERB safety guide titled 'Intervention levels and Derived Intervention Levels for Off-site Radiation Emergency' (AERB/SG/HS-1).

This new safety guideline provides 'generic criteria' in terms of radiation dose for implementation of protective actions and other response actions to meet the emergency response objectives of avoiding severe deterministic effects and limiting stochastic effect. It also provides Operational Criteria in terms of Emergency Action Levels (EAL), Operational Intervention Levels (OILs) and Observables at scene derived from generic criteria for effective implementation of response actions. New criteria are based on IAEA safety series IAEA/GS/G-2 (2011), lessons learned from past experiences and related scientific knowledge. The set of generic criteria and operational criteria included in this safety guideline addresses the requirements of IAEA GSR part-7 (revised GS-R-2), GS-G2, GS G2.1 GSR-part-3 (revised BSS), ICRP 111, ICRP109 and ICRP-103 for emergency preparedness and response.

This revision will enable the implementing agencies to update their site specific emergency response plans and also assist implementation of requirements of the AERB Safety Guidelines/Guides 'Preparation of Site Emergency Plans for Nuclear Installation' (AERB/SG/EP-1), 'Preparation of Off-Site Emergency Plans for Nuclear Installation' (AERB/SG/EP-2), 'Preparedness of the Operating Organisation for Handling Emergencies at NPPs' (AERB/SG/O-6) and 'Role of the Regulatory Body with Respect to Emergency Response and Preparedness at Nuclear and Radiation Facilities' (AERB/SG/G-5).

In view of obtaining feedback from NPPs, AERB, BARC, IGCAR and other DAE units on the new guidelines a theme meeting was organised at Niyamak Bhawan (AERB), Mumbai on January 24, 2014 (Friday).

Director OPSD, Shri P R Krishnamurthy briefed about features of the new guidelines and explained the need for revision of existing preparedness guideline AERB/SG/HS-1. Vice Chairman, AERB Shri S. Duraisamy briefed on revised IAEA and ICRP guidelines on emergency criteria and emphasised on Emergency Action Levels. He also stressed on development and use of Decision Support System (DSS) for better management of Nuclear and Radiological Emergency Situations.

Shri A. R. Sundararajan, Chairman SARCAR delivered the Keynote Address on the subject. He briefed about challenges in setting of and implementation of new emergency criteria for implementing protective measures. He also provided useful information about new guidelines by presenting comparison of emergency management actions at Chernobyl & Fukushima.

Expert faculties from AERB, BARC and NPCIL enlightened the participants by delivering lectures on Overview on Revised Criteria, Basic Consideration for Emergency Response and Generic criteria, Emergency Action Levels (EAL) for PHWR and PWR Reactors, Operational Intervention Levels (OIL) for use in Preparedness and Response, DAE-ERC etc.

Lecture session was followed by panel discussion, participated by Shri S Duraisamy, Vice Chairman, AERB; Dr D N Sharma, Director (HS&E), BARC; Shri A.R. Sundararajan, Chairman, SARCAR; Shri S.G. Ghadge, Director (Technical), NPCIL and Shri S.A. Hussain, former Head, RSD, AERB). Some of the major issues and queries raised by participants were : Inclusions of Fuel Reprocessing Plants in Hazard Categorisation, Inclusion of annexure in EP-5 for observables on the scene and OILs for radiological emergency.

Panelists at the theme meeting. (L to R): Shri S.A. Hussain, former Head, RSD, AERB); Dr D N Sharma, Director (HS&E), BARC; Shri S. Duraisami, Vice Chairman, AERB; Shri S.G. Ghadge, Director (Technical), NPCIL and Shri A.R. Sundararajan, Chairman, SARCAR, AERB

AERB Industrial and Fire Safety Awards

The annual function for presentation of Industrial Safety Awards and Fire Safety Awards for Department of Atomic Energy (DAE) units was held on April 22, 2014 at Atomic Energy Regulatory Board (AERB), Mumbai.

The Industrial Safety Awards are given for achieving high levels of performances in industrial safety activities. The awards for 'Production Units Group' comprising Nuclear Power Plants and Heavy Water Plants was bagged jointly by Tarapur Atomic Power Station 1&2 and Tarapur Atomic Power Station 3&4. The winner for 'Research and Low Risk Units Group' was Heavy Water Plant, Talcher.

Fire Safety Awards are given for achieving high levels of performance in fire safety aspects. The award for 'high fire risk units group' was given jointly to Heavy Water Plant, Kota and Rajasthan Atomic Power Station 3&4. Heavy Water Plant, Baroda was the winner in 'low fire risk units group'.

Shri S. S. Bajaj, Chairman, AERB released a booklet on the "Occupational Injury & Fire Statistics 2013 of DAE units" compiled and analyzed by IPSD, AERB. This compilation provides the information on industrial and fire safety performance of DAE units. It was once again observed that the industrial safety indicators of DAE units are better than that of similar industries in the country. Chairman, AERB presented the awards to the winning units and addressed the gathering. Shri S. Duraisamy, Vice-Chairman, AERB and Shri R. Bhattacharya, Secretary, AERB & Director, Industrial Plants Safety Division, AERB also spoke on various facets of industrial and fire safety at the award presentation ceremony. A short documentary film on fire safety in conventional industries was screened during the function to create awareness on fire safety aspects.

Shri S. S. Bajaj, Chairman, AERB (centre) releasing the "Occupational Injury & Fire Statistics 2013 of DAE units".
(L to R): Shri. S. Duraisamy, Vice-Chairman, AERB; Shri S. S. Bajaj, Chairman, AERB and Shri R.Bhattacharya, Secretary, AERB

ISO 9001:2008 Quality Management System (QMS)

AERB has opted for certification under ISO 9001 standard by Bureau of Indian Standards (BIS) for its consenting activities, regulatory inspection and preparation of regulatory documents since November 15, 2006. Again, AERB was recertified for ISO 9001: 2008 during the years 2009 & 2012. Under the purview of ISO standard, surveillance audit by BIS is carried out every year and internal audits are carried by trained auditors of AERB twice in a year.

AERB conducts the management review to ensure suitability, adequacy and effectiveness of QMS at AERB. This review includes assessing opportunities for improvement and the need for changes to the QMS, including the quality policy and quality objectives. Accordingly, the observations of internal audits carried out in 2013 were presented to the Executive Committee by Management Representative (MR) office of AERB on January 23, 2014. First internal audit of the divisions for the year 2014 was conducted during May 12 - 23, 2014.

The MR office of AERB organised an internal program on promotion of awareness on ISO 9001:2008 QMS on April 08, 2014. While delivering the welcoming address, Shri R. Bhattacharya, Management Representative, AERB-QMS reminded that conducting awareness program at least once in a year on QMS as per ISO 9001:2008 is mandatory as per Quality Manual of AERB. This was followed by two technical talks. The first talk was by Shri R. P. Gupta, NPSD, AERB on 'Quality Assurance Aspects'. The second talk was delivered by Shri Rakesh Kumar, IPSD, AERB on 'A Strategic Perspective for Effective Organizational Culture'.

Human Resource Development

AERB Training Activities

AERB Orientation Course for Regulatory Processes (OCRP-2014) was started at AERB, Mumbai on March 10, 2014. The course included class room lectures and familiarization site visits. Thirty four participants from various technical divisions of AERB participated in the course. In-house faculty delivered lectures on the topics, which included: Functions and Responsibilities of AERB, Regulatory Inspections of NPPs, Reactor Concepts and Systems, Accident Analysis, Basic & Operational Reactor Physics, Radiological Safety, Operational Health Physics, Industrial Plant Safety AE Act and Rules, Environment Protection Act and Rules, Civil Engineering Safety Aspects, Nuclear Security, QA Requirements of NPPs, Operation Experience Feedback (OEF) and Event Reporting. The participants were assessed based on written examinations. Site visits were arranged to Dhruva reactor, BARC, ACTREC, Kharghar and TAPP-3&4 NPP site.

A refresher course on "Regulatory Inspections (RIs) and Salient Recommendations" was organized in AERB Auditorium on February 28, 2014. Lectures were delivered by S/Shri Suneet Kavimandan, NPSD, P. S. Virdi, OPSD and H. K. Kulkarni, IPSD. In this refresher course, the speakers brought out the major RI findings made during the regulatory inspections of Nuclear Power Projects, Operating Nuclear Power Plants and Fuel Cycle Facilities.

Three technical talks on "Updated Status of Fukushima Daiichi Nuclear Power Station", "Radiation Protection & Waste Management Aspects", "Post Fukushima changes in Regulatory Framework and regulatory requirements in Japan" were arranged during the period. The talks were delivered by OPSD staff.

Three AERB colloquia were organized on "Control and Instrumentation aspects of PHWRs with emphasis on safety and regulatory requirements" by Shri Vineet Kumar Sharma, Chief Superintendent, KAPS-3&4, "Monitoring of Chemistry Parameters in NPPs - Role of COSWAC" by Dr. S.V. Narasimhan, Chairman, COSWAC and "Environmental Sustainability" by PadmaShree S. P. Kale, Head, Nuclear Agriculture and Bio-Technology Division, BARC.

AERB Efforts for Competency Development and Knowledge Management

To keep up with the pace of rapidly expanding nuclear power plants in the country, AERB took steps to augment and train its staff and as a part of competence development. In this regard, engineers were deputed to TAPS-3&4 (2 in number) and KK-NPP (2 in number) for obtaining for control engineer license for NPP operation. They have successfully completed the requirement of licensing and acquired control engineer license in minimum period. Two engineers were deputed to PFBR for obtaining control engineer license for PFBR operation. They have completed electrical authorization and they are undergoing field/ classroom training at PFBR with 6th batch of IGCAR training school and are involved in system commissioning works. Two officers from were deputed at TAPS 3&4 to get trained as the Operational Health Physicist and to learn Radiation Protection aspects of the Nuclear Power Plant. They have successfully completed their training.

The participants of OCRP-2014 at the ACTREC

Safety Research Programme (SRP)

One meeting of Committee for Safety Research Programmes (CSRP) was held at Mumbai to consider 7 new project proposals and renewal/approval requests for 5 on-going projects. After careful scrutiny, 1 project proposal was recommended for approval, 3 for revision and 3 for rejection. CSRP recommended for renewal of 4 on-going projects. Details of the approved new project are given below.

Title	Principal Investigator	Project Coordinators
Estimation and analysis of radiation doses associated with interventional cardiology and other fluoroscopy guided procedures	Dr. Satish C. Uniyal, HIHT University, Dehradun, Uttarakhand	Kum. Arti Kulkarni, RSD Dr. S. D. Sharma, BARC

In addition, seven sub-committee meetings were held for consideration of seminar grants.

Renewals

1. Leukocyte DNA damage as a biomarker for radiation exposure to the patients undergoing MDCT examinations (49/01) (PI : Dr. Anupama Tandon, Associate Professor, Dept of Radiology & Imaging, Delhi)
2. Evaluation & Intercomparision of QA measurements in Radiation Oncology (43/05) (PI : P. Krishna Reddy, MNJIO & RCC, Hyderabad)
3. A study on Radioactivity in Phosphogypsum based Building and Construction Materials and Indoor Radon Inhalation Dose Estimate in Tamilnadu (45/05) (PI: Dr. P. Shahul Hameed, J.J. College of Engineering & Technology, Tiruchirapali)
4. Effect of Radiolytic Products and Metal Nitrates on Red oil Forming Substances (52/04) (PI : Dr. M. Surianarayanan, Chemical Engg Dept, CLRI, Adyar, Chennai)

Chairman's Guest Lecture

Extracts from Chairman's Guest lecture at International Workshop on 'New Horizons in Nuclear Reactor Thermal Hydraulics and Safety', January 13-15, 2014, Mumbai, India

Compiled by: Dr. Obaidurrahman K., Nuclear Safety Analysis Division, AERB

It's heartening to be the part of this important event of International Workshop on New Horizons in Nuclear Reactor Thermal Hydraulics and Safety. This series of workshops on nuclear reactor thermal hydraulics over last few years has provided an important platform for exchanging innovative ideas and research findings to designers, researchers, academicians and regulators in the nuclear community, which has helped in an overall enhancement in the knowledge and understanding of several complex phenomenon associated with nuclear reactor thermal hydraulics and safety. Since its inception, overriding priority towards safety has been one of the most important pillars of nuclear industry and today there are well established safety principles, criteria and practices for design, operation and management of NPPs, which have evolved and strengthened over the five decades of thousands of reactor year operating experience. An important part of the design process is safety analysis, which is used to demonstrate safety of nuclear installations in a comprehensive manner over a broad range of operating and accident conditions. Several regulatory requirements have been kept in place to ensure that safety analysis performed for consenting process is reliable and adequate. This talk is going to provide a brief overview of basic regulatory requirements and expectations from safety analysis of present and future power reactors and AERB initiatives taken in some relevant key areas during the recent past.


Shri S.S. Bajaj, Chairman, AERB lighting the lamp at the International workshop on New Horizons in Nuclear Reactor Thermal Hydraulics & Safety

Safety analysis provides an assessment of the capability of the plant to control or accommodate departures from normal operation or postulated malfunctions or failures. It also demonstrates that the plant does not pose unacceptable safety hazard. In addition, safety analysis serves to arrive at performance requirements for design of safety systems and helps to develop a basis for various limits and 'limiting conditions for operation' (LCOs) to be specified in the technical specifications for operation of the plant. The scope of safety analysis covers assessment of plant response to events ranging from normal operation including operational transients, anticipated operational occurrences, design basis events and severe accidents. This classification of events is done based on their frequency of occurrences. Typically Anticipated Operational Occurrences (AOOs) include events with frequencies of occurrence equal to or greater than 10^{-2} per reactor year, Design Basis Accidents (DBAs) with frequencies of occurrence between 10^{-5} to 10^{-2} per reactor year and Beyond Design Basis Accidents (BDBAs) include events with frequencies of occurrence less than 10^{-5} per reactor year. The analysis requirements and acceptance criteria for each of these categories of events differ, e.g.,

- For normal operations and operational transients, the acceptance criteria would be that the operation limits and conditions should be satisfied and reactor should survive safely without tripping.
- For infrequent anticipated operation occurrence and transients, the requirements are that the primary coolant pressure should be within the design overpressure limit of the system and there shall be no fuel damage as demonstrated from prediction of no departure from nucleate boiling and no fuel centerline melting. Also there should be minimum challenges to protection and safety systems, i.e., most of the corrective actions should take place by actuation of normal regulating and control systems.
- For accident conditions considered in design, fuel failures may occur but it should be demonstrated that the calculated radiological consequences to the environment remain within prescribed reference dose limits.

Beyond Design Basis Accidents (BDBAs) with significant core degradation are termed as severe accidents. However, the definition of beyond design basis accident conditions is superseded by Design Extension Conditions (DECs) in recent regulatory requirements. **Design Extension Conditions are not considered as Design Basis Accidents, but that are considered in the design process of the facility in accordance with best estimate methodology, and for which releases of radioactive material are kept within acceptable limits.** Design Extension Conditions could include severe accident conditions. The main technical objective of considering the design extension conditions is to provide assurance that the design of the plant is such as to prevent accident conditions not considered in design basis accident conditions, or to mitigate their consequences, as far as is reasonably practicable. This might require additional safety features for design extension conditions, or extension of the capability of safety systems to maintain the integrity of the containment. The design shall be such that design extension conditions which could lead to significant radioactive releases are practically eliminated. If not, for design extension conditions that cannot be practically eliminated, only protective measures that are of limited scope in terms of area and time shall be necessary for protection of the public, and sufficient time shall be made available to implement these measures

Safety analysis requires identification and characterization of postulated initiating events (PIEs) that are appropriate for plant design and its location. For each postulated initiating event PIE, consequent event sequences are required to be worked out, identifying the mitigating actions and systems that will cut in, either automatically or with operator intervention. Finally, for each of these event sequences, it is not only required to evaluate the consequences, primarily in terms of radioactivity release/dose to the environment, but also to work out other key parameters, e.g., margins available in reactivity (for ensuring assured shutdown), or in core thermal hydraulics, or in fuel temperatures to failure, or in pressure limit of pressure retaining components. The scenarios thus evaluated for the prescribed postulated initiating events and event sequences are stylized enveloping scenarios with the objective that the actual accident sequences, should they occur, would have consequences within those predicted. Accordingly, some of the basic rules of the safety analysis include the following;

- All input parameters are chosen at the highest or lowest end of their normal range so as to yield worst-scenario results.
- The off-site grid power supply is assumed to have failed/not available so that all power requirements are met by starting on-site emergency diesel generators (DGs).
- The mitigating safety systems are assumed to be available with their most effective single active components failed, e.g. the reactor shutdown systems availability is considered with its most effective shutoff rod not available.
- In PHWRs where two independent reactor shutdown systems are provided, the one, which is more effective, is assumed failed.
- While considering automatic trip of reactor on protective system actuation, the first trip parameter is usually ignored, for each of the two shutdown systems in PHWRs.

The methodology and purpose of safety analysis for the 'Beyond Design Basis Events' (BDBEs) differs from that for 'Design Basis Accidents' (DBAs). Here, the analysis aims for 'best-estimate' predictions rather than 'bounding-conservative' ones that one aims for in DBAs. Consideration needs to be given to the severe accident sequences using a combination of engineering judgment, deterministic and probabilistic methods, to determine those sequences for which reasonably practicable preventive or mitigation measures can be identified.

In general, analyses of postulated initiating events require use of complex computer codes which model the physics of various physical phenomenons relevant to the accident scenario, such as the thermal hydraulic of the reactor system, core neutronics, fuel and core component heat-up effects, etc. These codes have to be qualified through extensive validation usually against several sets of experimental data. Validation results should be analysed so as to bring out computer program limitations. Also, as the use of computer program is strongly interactive and dependent on users understanding of the phenomena analysed, it should be ensured that the computer program is used by the user qualified for the relevant application. The user should be familiar with various aspects of modeling which include various assumptions, discontinuities in modeling, range of application, and various numerical methods used. To ensure continuous improvement in line with research findings, safety analysis methods and assumptions need to be systematically reviewed to ensure that they are correct and meet the objectives set for the analysis. The results should be assessed against the relevant requirements, applicable experimental data, expert judgment, and comparison with similar calculations and sensitivity analyses. Techniques like supervisory review, peer review, independent verification, comparison using alternate tools and methods can help in review of the analysis, depending on the objectives of the analysis. Thus code validation, user qualification and periodical updates are important mechanisms to maintain the quality of safety analysis.

As part of its safety review process, AERB carries out independent safety analysis and research on selected important areas of nuclear and radiation safety. These safety studies help in taking important regulatory decisions during licensing process of several facilities. Some of the important areas where regulatory review requires analytical support are system thermal hydraulics, reactor safety analysis, probabilistic risk assessment and radiological impact assessment. Majority of these analyses are carried out using commercial computational codes like RELAP5, ASTEC etc., while some specific studies requires development of special purpose computational tools. Using RELAP5, In-house system thermal hydraulics analysis of different Indian NPPs has been carried out to predict the response to postulated initiating events. Several system transients like LOCA, MSLB, feed water line break, Increase and decrease in Feed flow in SG, opening of pressurizing safety valve, identification of critical large break LOCA in RIH, stagnation channel break, Pump shaft seizure, Station blackout, uncontrolled withdrawal of control rods etc. have been analysed. Severe accident, containment and hydrogen related safety studies of Indian NPPs have been performed using a combination of CFD and lumped parameter based integral codes. Considering their renewed importance particularly after Fukushima these analytical capabilities are being continuously enhanced through participation in different joint international research programs like HYMERS. With induction of several types of reactors with diverse design in Indian nuclear map, it was imperative to develop in-house detailed multi-physics core modeling capability in AERB. Consistent with this objective a comprehensive 3D neutron kinetics code (TRIKIN) with a dedicated core thermal hydraulic model has been developed in AERB. Provision of triangular, hexagonal as well as square meshes in space solver renders high generality to the code, which allows its use for variety of reactors like PHWRs, VVERs, PWRs, BWRs and FBRs. Complete coupled TRIKIN model has been validated against a wide array of international benchmark problems. Several core dynamics analyses were carried out using TRIKIN to understand core behaviour in regard to various reactivity anomalies during startup of KKNPP-VVER. These studies provided valuable technical support to different review groups at AERB. A simplified multipoint kinetics model, which is condensed version of extensive 3D TRIKIN code, has been internally coupled to system code RELAP5 to analyze asymmetric reactivity transients. Probabilistic Safety Assessment (PSA) is a complimentary tool to deterministic safety

(Continued on Page 19)

Transient Critical Heat Flux Experimental Investigation

P K Baburajan and Avinash J Gaikwad, Nuclear Safety Analysis Division, AERB

Introduction

Critical heat flux (CHF) is one of the important parameters considered in the design of fuel channels in nuclear reactors. Critical heat flux is the maximum heat flux limit that is applied on the design and operation of nuclear fuel elements. Correlations and look up table to predict the CHF are derived using steady state data. In abnormal operating and accident situations fuel channels encounter transient flow and transient power conditions. Hence understanding CHF under transient conditions is crucial in the overall safety of fuel channels. During Loss of Coolant Accident (LOCA) the reactor system can experience low pressure and low flow (LPLF) conditions. Experimental investigation on CHF in horizontal channels under LPLF conditions are being conducted in collaboration with IIT Bombay. This article presents in brief the experimental set up, experimental procedures, and the findings of the experimental studies.

The schematic of the experimental setup is shown in Fig. 1. The setup mainly consists of a gear pump, stainless tube test section, 20 kW low voltage high current power supply and instrumentation to measure pressure, flow and temperature. Water from the sump tank is pumped through the test section and the flow rate is set by adjusting the speed of the pump and the opening of the valve at the upstream of the test section. Electromagnetic flow meter is connected at the upstream of the test section to monitor and acquire the flow rate continuously during the experiment through data acquisition system. Differential pressure transducers are connected across the upstream valve and the test section to monitor and acquire pressure drop across the upstream valve (as a measure of system stiffness) and the test section. The exit of the test section is connected to glass tube for the visualization of flow patterns and flow regimes during the experiment. The glass tube exit is connected to the sump which is open to atmosphere. The inlet fluid temperature is measured using thermocouple. Test section made of stainless steel (ss) tubes of different diameters (5.5mm - 9.5mm) and lengths (0.55m, 0.75m and 1.0m) are used in conducting experiments. The exit region of a test section during different stages of a CHF experiment is shown in Fig. 2. Black paint is applied on the stainless steel test section tube to measure the wall temperature using infrared thermal camera. The experimental procedure for the CHF measurement followed is described here. Initial water mass flow rate through the test section is set by adjusting the pump speed and opening position of the test section upstream valve. Power (initially about 500 W which ensures single phase flow at the test section exit) is applied to the test section wall by adjusting the voltage. After the system steady state is achieved power supply increased in steps of 250 W until the beginning of flow boiling (bubbly flow is seen in the glass section) and then onwards the power increased in steps of 100W. The heat transfer coefficient decreases towards the exit of the test section due to large amount of vapor generation and the tube wall overheating is initiated. As the overheating is progressed, appearance of red hotness is observed and the power supply is reduced to zero to prevent any damage to the test section. The heat flux initiating the overheating of the test section wall is considered as critical heat flux (CHF).

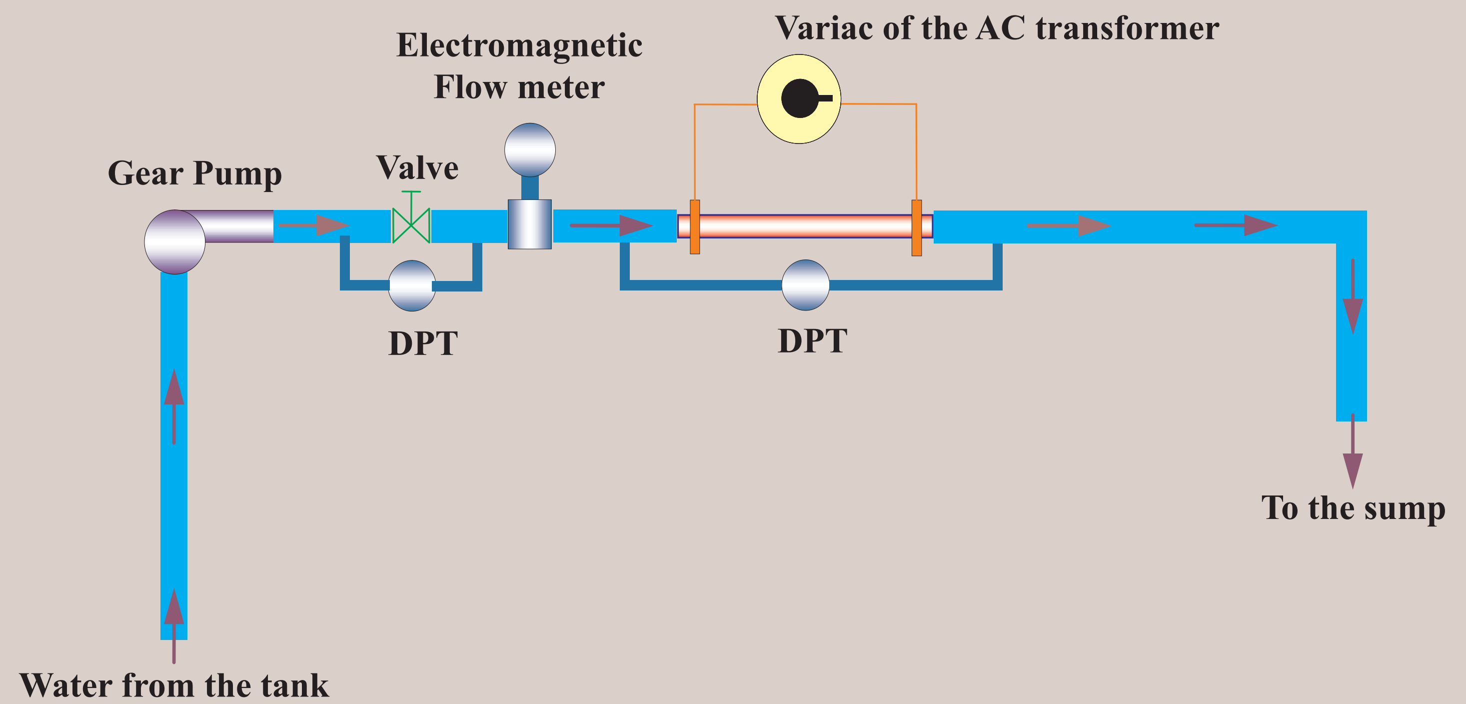


Fig. 1 Schematic of setup for the measurement of CHF Setup and experimental procedure

Different conditions of test section during CHF experiment and findings

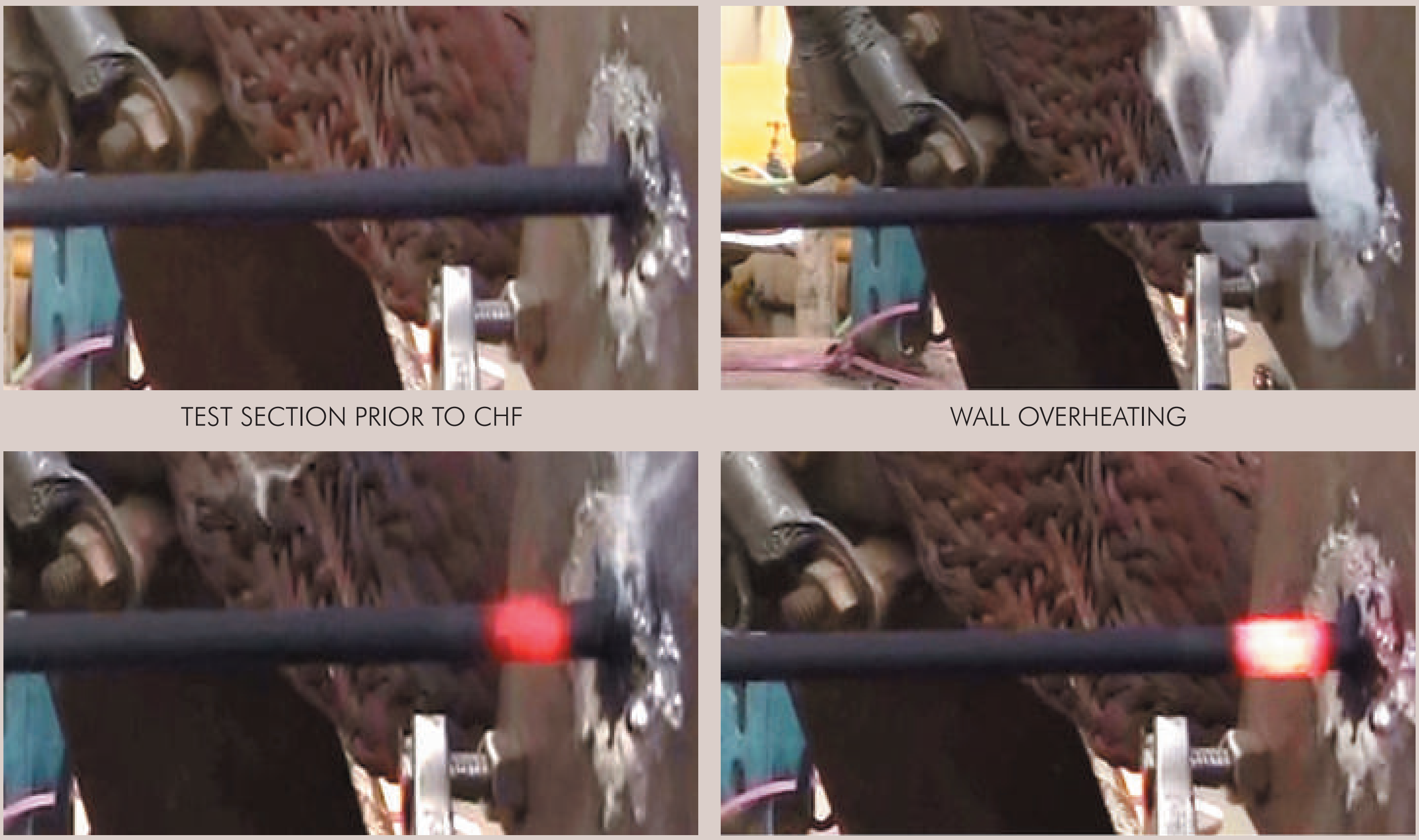
Critical heat flux measurement is carried out in horizontal tubes for steady flow and transient flow conditions. The effect of parameters covered in the steady state CHF measurement are test section length, diameter and mass flux. Experimental results show that CHF (a) increases with the increase in mass flux, (b) decreases with the increase in heated length and (c) increases with the increase in diameter. Experimental data is used to develop a correlation to predict the CHF for steady flow condition as a function of non-dimensional fluid-to-fluid parameters.

Experiment was conducted to investigate the effect of upstream flow restrictions on CHF. Classification of hydrodynamic system as soft and stiff based on parameter stiffness (ratio of upstream flow restriction pressure drop to test section pressure drop) is developed. A soft system is associated with large flow instabilities in the two phase region and a stiff system has comparatively less flow instabilities. In the present work, cases with stiffness less than 1 is classified as soft and a stiff system is identified with stiffness value greater than 1. The CHF data obtained in the soft system (upstream valve in fully open condition) show that the CHF values reduce significantly as compared to CHF at steady state conditions. Increase in CHF is observed with the increase in the stiffness of the system as a result of reduced flow instabilities.

Under abnormal operating and accident situations system undergoes transients. CHF under flow transient (flow decay and oscillatory flow) are experimentally investigated and appropriate correlations were developed for the prediction of CHF in these conditions. The data is compared with steady state CHF values. The experimental data analysis shows that half flow decay time (time required to reduce the initial flow by half) does not have major influence on CHF. A decreasing trend in the CHF value is observed with the increase in the period of oscillations and amplitude of flow oscillatory conditions.

The experimental setup was also modeled using the system code RELAP5 and CHF data was analysed. The heat transfer package of the code predicted the experimental data within 20% deviation. The numerical analysis indicates liquid film dryout as the mechanism of CHF in the present work and the flow regime during CHF occurrence is identified as annulus flow. The outcome of the experimental study shows that CHF under transient conditions is slightly less than that of steady state CHF values.

Transient critical heat flux experimental investigation



TEST SECTION PRIOR TO CHF

WALL OVERHEATING

APPEARANCE OF RED HOTNESS

PRIOR TO POWER OFF

Fig. 2. Test section during experiment

Exclusion, Exemption and Clearance in Regulatory Parlance

Soumen Sinha, Industrial Plants Safety Division, AERB

Man has always been exposed to natural radiation arising from the earth as well as from outer space, namely cosmic rays. Our own bodies contain naturally occurring radioactive elements. We also receive exposure from man-made radiation, such as X-rays, radiation used for medical diagnosis and therapy. There are certain radiation exposure situations which cannot be controlled as they are not amenable to be controlled by any reasonable means while there are situations which need not be controlled with the full system of regulatory requirements because those system are unwarranted. The former situation calls for application of 'exclusion' and the latter 'exemption' concepts respectively. These concepts are modern parallels to the ancient legal maxims, de minis non curat lex and de minis non curat praetor which pertains to regulating the situations that are considered inconsequential or infeasible to control on one hand, or unimportant or irrelevant on the other hand. These concepts can be seen as scoping the applicability of the regulatory system used to control exposure to radiation sources. This is an important matter since considerable regulatory and administrative resources could otherwise be expended if the scope is not properly defined.

Exclusion: unamenability to control

Excluded exposures are those that are essentially unamenable to control, regardless of their magnitude, and include exposure to natural radioactive constituents within human body that are homostatically controlled (such as potassium-40), to cosmic rays at ground level and to unmodified concentrations of the naturally occurring radionuclides in most raw materials. These exposures are simply unavoidable and in control is unfeasible, atleast without inordinate effort. Radiological protection in such cases is considered defacto optimized.

The judgment of the legislators and regulators in determining what exposure situations are unamenable for control is not influenced by cultural or societal expectations but following the principles of justification and optimization.

Exemption: unwarranted control

Exemption concept determines what situations should not and what may be freed a priori from some or all regulatory control established by the law.

There are three principles (called exemption principles) determining whether or not a practice or a source within a practice can be a candidate for exemption.

1. Individual risks must be sufficiently low as not to warrant regulatory concern
2. Radiation protection, including the cost of regulatory control, must be optimized
3. Practice should be justified and inherently safe

Clearance: a posteriori exemption

Just as the concept of exemption is used to determine a priori whether to regulate a specific practice, the concept can also be used a posteriori to consider exemption from within the system for which the term clearance is used. In other words, clearance is nothing but removal of radioactive materials or objects within authorized practices from any further control by the regulatory authority as they do not warrant continued regulation. Clearance can be therefore seen as a process of relinquishing regulatory control. For a cleared source, any future exposure it causes is de facto excluded from the regulatory framework.

Legislative and Regulatory provisions

Atomic Energy (Radiation Protection) Rules, 2004 framed under the enabling provisions of the Atomic Energy Act, exclusively provides for exclusion and exemption. Further to this, Atomic Energy Regulatory Board (AERB), the national regulator of radiation safety has issued a Safety Directive on 'Exclusion, Exemption and Clearance of Radionuclides in Solid Materials' (No.1/2010) that specifies the exemption and clearance levels both for radionuclides of artificial as well as natural origin.

The typical practices and source which are not under regulatory control, how the radiation risk from such unregulated sources/practices is managed, and the agencies that are involved etc are elaborated in the subsequent paragraphs.

Examples

Naturally High background radiation areas of Kerala and Tamilnadu

Radiological exposures from incurred by inhabitants of natural high background radiation areas (NHBRAs) due to **presence of monazite in coastal sands of peninsular India are excluded as it is not considered 'amenable' and 'optimum' to move the inhabitants to other places in order to avoid exposure.** However, in order to study the health effects of inhabitants of NHBRAs, Government of India has set up a Low Level Radiation Dosimetry Station in one of such locations to carry out the epidemiological studies.

Mining of beach sands

Mining of beach sands by no means alter or modify the concentration of radionuclides which was pre existing in the sea shores in form of monazite. The radiological exposure incurred during mining operations is a very small increment to the natural background exposure. Further, the increment is one or two orders of magnitude below the variability of the natural background. It is neither practical to implement control scheme for such small increment nor any reasonable control measures could achieve significant reductions in individual dose. Hence, **exposure incurred during mining of beach sands has been exempted.** In such cases, even no accidental exposure or radiological risk due to discontinued practice is anticipated. AERB has communicated the same to Ministry of Mines as well as Chief Secretaries of all States in India. However, separation of constituent minerals from beach sands and disposal of relatively enriched monozite in tailings warrant radiation safety regulations.

Commercial applications of phosphogypsum

Phosphogypsum is obtained as by product during wet processing of rock phosphate and contains about 80% of the radium initially present in rock phosphate. With respect to use of phosphogypsum in commercial applications, **AERB has stipulated that if Ra-226 concentration in phosphogypsum is less than or equal to 1Bq/g, then its use is exempted from regulatory control**. If higher, AERB has recommended to mix the same with other ingredients. The Safety Directive has been communicated to Ministry of Chemicals and Fertilizers as well as to Ministry of Agriculture. To ensure that Ra-226 level are within the exempt limits, AERB has asked the fertilizer plants to submit quarterly analysis reports of each imported consignment of rockphosphate as well as in the phosphogypsum produced from its processing. In addition, for use of phosphogypsum in making panels, **AERB has stipulated a surface density of 40 Bq/m2 which is derived from the consideration to limit the exposure to 0.3mSv per annum.**

Coal based thermal power plants

Coal, like most materials found in nature, contains trace quantities of naturally occurring radionuclides. Post combustion in Thermal Power Plants, the natural radioactivity content in coal gets concentrated in the resulting waste products, namely fly ash, bottom ash and boiler slag. To assess the radiological issues involved in these plants, an Expert Committee was constituted by AERB. **This Committee did not feel that these plants warrant regulatory control from radiological safety point of view as the expected dose is less than 0.3mSv per annum.**

Oil and Gas Industries

Normally, the water in oil and gas formations contains Ra-228, Ra-226 and Ra-224 dissolved from the reservoir rock together with their decay progeny. When this water is brought to the surface with the oil and gas, changes in temperature and pressure can lead to the precipitation of radium rich sulphate and carbonate scales on the inner walls of production equipment (pipes, valves, pumps). Radiation protection considerations arise mainly from the removal of this scale and sludge during maintenance and decommissioning operations and from the subsequent disposal of such materials as waste. Of late, it has been brought to the notice of AERB about elevated radiation levels at few of drilling locations. **To carry out a detailed examination of these issues towards developing appropriate regulatory guidelines, AERB has constituted an Expert Committee. The review and assessment is in progress.**

(Continued from Page 15)

assessment (DSA) and quantifies the risk. To support PSA review, AERB has also developed in-house capability for independent verification. e.g., Level-1 PSA model for internal initiating events of NAPS1&2 was implemented in Risk Spectrum software with a view to performing independent verification of utility submissions and help in optimizing plant operating guidelines. External events such as Fire and Seismic PSA studies are also being carried out. In view of Fukushima event, AERB has initiated joint R&D exercise along with IGCAR, BHAVINI and BARC on “External Flood PSA for PFBR” (EFPSA). The objective of the exercise is to evaluate the response of PFBR under different external flooding conditions, determine key contributors to core damage and spent fuel damage due to external flooding and demonstrate EFPSA methodology considering PFBR as a pilot plant. In addition, other than in-house analytical safety studies, AERB has taken up experimental studies jointly with different research and academic organizations to fill up important knowledge gaps in reactor safety.

To conclude, safety analysis has evolved continuously from elementary concepts to the best estimate methods being adapted these days. Several key challenges related to modeling complexities, computational economy, validation and verification, accuracy of data, acceptance criteria, quality assurance and code couplings have been religiously pursued by nuclear industry to upgrade the quality of safety analysis. These efforts have improved confidence in design and flexibilities in operating practices. Sustained research and development in different areas of reactor safety has significantly improved overall performance and safety of operating nuclear reactors worldwide. With enhancements in computing resources, advanced multi-physics and CFD methods are being developed, which will be extremely helpful in more improved and realistic simulation of involved systems with different physical phenomenon. Such elaborate simulation will reduce computational uncertainties significantly. Next generation reactors, with several innovative features pose significantly more safety analysis challenges in regard to neutronic decoupling, passive system performance, first of a kind and innovative systems, safety back fits, human performance, experimental validation, severe accident research and accurate quantification of fission product release. These challenges can be overcome by bringing in continuous improvements in safety analysis tools and methods through a focused R&D program. **AERB has taken many sincere initiatives towards establishment of state-of-the-art analytical capabilities for independent design verification in several key areas, which are playing a major role in quality regulatory process at AERB.**

Radiation Protection in Pediatric Radiology

Arti Kulkarni and Anuradha V, Radiological Safety Division, AERB

Introduction

The past decade has witnessed a phenomenal increase in the Medical X-ray equipment in the country. Along with this there has also been an increasing and at times excess use of high radiation dose modalities such as Computed Tomography and interventional radiology. It has thus become imperative to spread the knowledge of radiation safety amongst the medical community.

Children are biologically more vulnerable and this vulnerability is owing to their higher radio-sensitivity and their longer life expectancy. The increased radio-sensitivity in children is because of proliferation during growth periods, at cellular and sub-cellular levels. As most malignant tumours manifest many years after exposure, children, because of their longer life expectancy, have a higher chance of being alive and therefore posses a greater risk of manifestation of tumor. In short, the lifetime risks are expected to be higher in a child than in an adult.

Radiation protection principles

The fundamental principles of radiation protection are Justification, Optimization and Dose Limits.

In medicine, use of ionizing radiation is a well-justified practice, as it has proved to be life saving, both with respect to diagnosis and therapy. However, there are certain practices (ICRP-121) which come under unjustified radiation exposures, namely:

- skull radiograph in an infant or child with epilepsy;
- skull radiograph in an infant or child with headaches;
- sinus radiograph in an infant or child under 6 years of age suspected of having sinusitis;
- cervical spine radiograph in an infant or child with torticollis without trauma;
- radiographs of the opposite side for comparison in limb injury;
- scaphoid radiographs in children under 6 years of age;
- nasal bone radiographs in children under 3 years of age.
- routine daily chest examination in intensive care units
- Radiological examinations requested purely for medico-legal purposes

The second stage is the optimization of exposures. Though x-ray exposures in pediatric procedures are justified in most cases, it is far from being optimized. With just a little conscious application, it is possible to optimize the exposures very effectively. The various optimization techniques to be followed in each modality are described in the article.

Medical exposures (usually patient) have no "dose limits". The dose limits, prescribed by competent authority are applicable for the radiation workers and public. For patients, as a good practice there exists what are called "Diagnostic Reference levels (DRLs). As on date in India such DRL's are in the process of getting established.

Methods of Optimisation

By being wary of "unfavorable conditions"

a) Through proper choice of equipment
b) Through proper operational procedures for different modalities

a) Unfavorable conditions:

i) Using unsuitable Automatic Exposure systems; in imported equipment, which are not customized to Indian demography before use.
ii) Following adult exposure protocols for children.
iii) Using sub-standard equipment, which has not been design approved (AERB Type Approved) and not subjecting the equipment to periodic quality control tests.
iv) Not using all dose-minimising features that the machine provides.
v) Radiographs taken by unqualified personnel, who do not fully appreciate the implication of their actions.
vi) Not considering other means of diagnosis (MRI, USG etc).
vii) Not asking for previous x-ray records, for same ailment.
viii) Expecting best quality images, even if there is no additional gain in terms of diagnosis.
ix) Unnecessary referrals.

b) Proper choice of equipment:

- Do not buy refurbished equipment from un-authorized suppliers:
  Such equipments are not design approved by AERB.
- Adhere to design specifications:
  - equipment shall be AERB Type approved
  - High frequency and high power (kW) equipment, i.e. higher mA (> 300 mA) stations should be preferred (facilitates to use shorter exposure times and reduced retakes)
  - small focal spot of about 0.5mm-0.8 mm
  - removable anti scatter grid
  - AEC (Automatic Exposure Control) provision with proper calibration of paediatric protocols
  - carbon fiber couch
  - patient dose recording option is recommended for continual monitoring and optimization.
- Use with caution pre-owned equipment:
  When second-hand equipment is considered, it needs to maintain the original manufacturer's specifications and meet the local minimum criteria for acceptability and proof obtained.

c) Proper operation procedures:

During regulatory inspections, AERB officers have advised users on many occasions on adherence to safe operating procedures such as

- AVOID "Babygrams". Expose only areas of interest
- Replace faulty collimator bulb immediately. Not having a light beam as a guide could result in the complete opening of collimator an infant and cause whole body exposure.

In particular, AERB officers have observed that infants are exposed as shown below.

i) Optimisation in Radiography and Dental

a. Use shielding and immobilization devices: These devices help towards correct collimation, and proper positioning of shielding devices, to protect radiosensitive organs such as gonads, breast, eyelens and thyroid.
b. Judiciously use Anti-scatter grid: Anti-scatter grid is used for reducing scatter radiation, thereby improving the image quality. The flipside of using these grids is the need for higher exposure parameters. For children dose is increased 3-5 times without any concomitant improvement in image quality.
c. Identify "child-friendly" parameters of exposure: High kV, shortest exposure time and high mA (for required mAs), more focal to film distance and use of additional filters are important.

ii) Fluoroscopy and Interventional Radiology:

IR procedures can cause deterministic injuries. Hence, paediatric interventional procedures may be performed by experienced paediatric interventionists and assisted by qualified and trained technologists in radiological protection.

- **Use "Child- suitable" IR equipment:**
  Use where ever possible, small-sized detectors (eg 10") for paediatric IR procedures. Alternatively, conscious use of collimators is a must.
- **Use "Child-sized" protocols:**
  Use lowest dose protocol possible for patient size, frame rate (3.5-7.5 pulses/s for pulsed fluoroscopy) and length of run (in cine mode). Image acquisition runs should only be performed if necessary,
- **Use design features:**
  - "last image hold" option
  - Tube to patient distance should be maximized and patient to detector should be minimized.
  - Fields need to be tightly aligned to area of interest using light beam diaphragm
  - Minimize electronic magnification; digital zoom needs to be used whenever possible.
  - Position image intensifier and/or receptor positioned over the area of interest before fluoroscopy is commenced rather than during fluoroscopy.
  - fluoroscopy timing alerts

iii) Computed Tomography:

a) **A high quality of image is not always necessary.** Higher Image quality (at the cost of higher exposure parameters) is opted for, more out of habit, than as a requirement for confident diagnosis. Noise reduction means high doses; noise is acceptable if the scan is giving the diagnostic information.

b) **Watch out for these pitfalls:**

- Scan only the required lengths and minimize the scanning of identical areas.
- Do not give same exposure factors for pelvic (high contrast region) as for abdomen (low contrast region)
- Use spiral scan with a pitch greater than 1 (e.g.1.5), provided this does not automatically increase the mA.
- Thicker collimation with overlapping reconstruction needs to be used when thin slices are not needed.
- Avoid major overlap when scanning adjacent areas with different protocol.
- Use reconstruction wherever possible, for different slice thicknesses.
- Single phase scans are often adequate. Pre- and post-contrast or delayed scans rarely give additional information in children but can double or triple the dose
- Avoid increasing volume covered in a particular examination (Z axis over-beaming) causing extra rotations and effect of penumbra.

AERB's Regulatory Actions

- AERB is in the process of revising the AERB/SC/Med-2, 2001, "Safety Code on Medical Diagnostic X-ray equipment and installations," which includes the safety requirements in pediatric radiology.
- During Regulatory Inspections, AERB verifies whether the equipment is suitable to pediatric radiology and whether the hospital is equipped with child friendly features and proper immobilization and shielding devices.
- AERB is also carrying out various public awareness programs especially amongst the medical community.

Conclusion

In pediatric radiology, the medical practitioners play a major role in justifying and optimizing the radiation exposures to the children. It is expected that they should consider the radiation risk as an integral part of his decision making. At the time of commissioning of diagnostic radiology equipment, the radiologist's knowledge of optimization aspects is extremely important in setting of the patient protocols with the application specialist.

Official Language Implementation

Dignitaries on the Dias (L to R): Dr. A. Ramakrishna, Chairman, OLIC, AERB; Shri A.K. Sinha, Chief Engineer, NPCIL and Shri P. Mohan Babu, CAO, AERB

Official Language implementation is one of the priorities and AERB Hindi section ensured the same through its activities conducted during January to June, 2014.'

1. World Hindi Day' celebrations were held on January 31, 2014 in AERB under the auspices of the Joint Official Language Co-ordination Committee (JOLCC) of the five DAE units situated in Anushaktinagar viz. AERB, DPS, DCSEM, HWB and BRIT. Bharatnatyam rendition of Tulsidas Ramayana was presented by the artists of Kanakasabha Kala Kendra, Chembur, Mumbai.

2. As part of the JOLCC five DAE units in Anushaktinagar, AERB participated in two Hindi workshops held in February and June, 2014. OLIC, AERB conducted two Hindi talks. Shri A.K. Sinha, Chief Engineer, NPCIL delivered a talk on "Ideal Parenting" on March 21, 2014. The second talk on "Bring out the leader in you" was delivered on June 30, 2014 by Mrs. Deepshikha Singh, Managing Director, Literati Training Pvt. Ltd., Mumbai. Both the talks attracted audiences in large numbers who found that the talks to be highly enriching.

3. Internal Hindi inspection of NPSD was carried out on May 16, 2014 by a team of OLIC. The inspection team suggested actions for effective implementation of Official Language and to work out a strategy to enhance the Hindi output in the day to day work of the Division.

4. Eight regulatory documents were published in Hindi during January-June, 2014. Now total number of AERB regulatory documents available in Hindi is 86. Another twelve documents are expected to be ready by the end of September 2014.

National Science Seminar conducted at VECC by Hindi Vigyan Sahitya Parishad, BARC

Shri S.S. Bajaj, Chairman, AERB, was invited as the Chief Guest for the National Science Seminar conducted at VECC, Kolkata during 7-8 January 2014 under the auspices of Hindi Vigyan Sahitya Parishad, BARC. Addressing the august gathering, Shri Bajaj appreciated the commendable efforts of Parishad in promoting the cause of Hindi especially in scientific realms. He stated that such seminars provide an excellent forum for technical writing in Hindi which still has a long way to go in our country.

Shri S.S. Bajaj, Chairman, AERB, inaugurating National Science Seminar of Hindi Vigyan Sahitya Parishad organised at VECC, Kolkata

NOTICE

FOR USERS OF RADIOACTIVE SOURCES & RADIATION GENERATING EQUIPMENT

IT IS AN OFFENCE TO POSSESS OR USE RADIOACTIVE SOURCES* OR RADIATION GENERATING EQUIPMENT# WITHOUT A VALID CONSENT, ISSUED BY ATOMIC ENERGY REGULATORY BOARD (AERB), UNDER THE PROVISIONS OF ATOMIC ENERGY ACT, 1962 AND ATOMIC ENRGY (RADIATION PROTECTION) RULES, 2004.

Statutory requirements to possess or use radioactive source or radiation generating equipment are:

- Must have a valid consent (licence) from AERB
- Install only type-approved equipment
- Ensure safety and security of radiation sources at all time
- Follow radiation protection requirement
- Ensure periodic Quality Assurance checks as applicable
- Send periodic safety report to AERB
- Ensure safe disposal of sources not in use with due approval from AERB

*Radioactive Sources include, radioisotopes used in:

- Radiation Processing Plants
- Radiotherapy
- Gamma Chamber
- Industrial Radiography
- Nucleonic Gauge
- Well Logging
- Nuclear Medicine
- Research Applications etc.

#Radiation Generating Equipment includes, all accelerators and X-ray devices used in:

- Radiotherapy
- Medical Cyclotron
- Industrial & Research Accelerator
- Diagnostic Radiology - CT/ Cath Lab/ X-ray machines
- Industrial Radiography
- X-ray Baggage Scanner etc

For detailed information, relevant application forms and accessing eLORA system, visit AERB website www.aerb.gov.in

NOTICE FOR X-RAY EQUIPMENT USERS

IT IS AN OFFENCE TO USE MEDICAL X-RAY EQUIPMENT WITHOUT A VALID LICENCE, ISSUED BY ATOMIC ENERGY REGULATORY BOARD (AERB), UNDER THE PROVISIONS OF ATOMIC ENERGY ACT 1962 AND ATOMIC ENRGY (RADIATION PROTECTION) RULES 2004.

Users of the following Medical X-ray equipment such as

- Computed Tomography unit
- Interventional Radiology unit
- X-ray Radiography unit
- Fluoroscopy X-ray unit
- Mammography X-ray unit
- Orthopantomography unit
- Dental X-ray unit
- Bone Densitometer unit
- X-ray unit for Veterinary applications must approach AERB to obtain regulatory consent (licence/registration).

Obtaining Licence for medical X-ray equipment is now online through AERB's web application

e-LORA (e-Licensing of Radiation Applications) System

For more information and obtaining Licence, visit AERB website www.aerb.gov.in and click on eLORA

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Home Page

Personnel Joined During the Period January - June 2014

Sr. No.	Name	Designation	Date of Appointment
1.	Smt. Pammy Goswami	SO/D - On transfer	07/02/2014
2.	Shri Sachin G. Todkar	SA/B	19/05/2014

Shri K. Zahir Hussain being felicitated by Dr. A. Ramakrishna, OLIC Chairman and members

Personnel Retired/Transferred During the Period January - June 2014

Sr. No.	Name	Designation	Date of retirement/ Transfer
1.	Shri S. A. Khan	SO/G - VRS	23/01/2014
2.	Smt. Y.V.S. Swaroopa Lakshmi	SO/D - Transferred to NFC, Hyderabad	31/01/2014
3.	Shri Parshi Satish Kumar	SO/D – Transferred to NFC, Hyderabad	31/01/2014
4.	Shri K. Zahir Hussain	AD(OL) - Transferred to IGCAR, Kalpakkam	02/06/2014
5.	Smt. Sandhya S. Kalmadi	UDC - Transferred to DAE, Mumbai	27/06/2014

Shri S.S. Bajaj, Chairman AERB inaugurating the exhibition during Fire Safety Week at AERB

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