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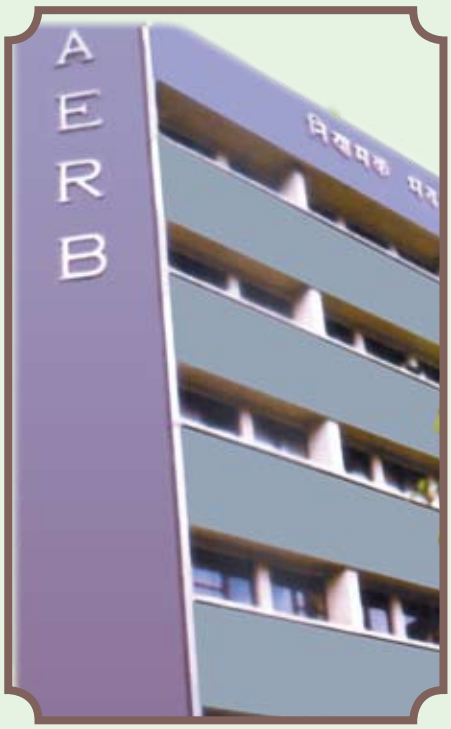
AERB Newsletter

25 Years of Safety Regulation 1983 -2008

ATOMIC ENERGY REGULATORY BOARD

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



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From the Chairman's Desk

Apart from normal regulatory work, the period between July and December 2008 had several activities organized as part of Silver Jubilee Year Celebrations of AERB, that started on 15th Nov. 2007; the date of setting up of AERB in 1983. AERB colloquia on EPR, AP1000 and VVER Reactor Designs and on Convention on Nuclear Safety (CNS) were organized. Advanced evolutionary features of Pressurized-Water Reactors with passive safety features were discussed in detail and the AERB staff were apprised of the various aspects of CNS and highlights of the presentations made by the Contracting Parties of CNS during the review meeting held in IAEA, Vienna during April 14 to April 24, 2008.

Four special lectures were organized on i) 'Indian Innovation: From Gandhi to Gandhian Engineering' by Dr. R. A. Mashelkar, CSIR Bhatnagar Fellow and former Director General of CSIR ii) 'Insights into Theories of Turbulence and Heat Transfer' by Prof. J.B. Joshi, Member, AERB and Director, UICT, Mumbai, iii) 'Early Detection and Screening for Cancers: Lessons Learnt' by Dr. K. A. Dinshaw, Member, AERB and former Director, TMC, Mumbai and iv) 'Recent Advances in Chemical Accident Modeling' by Dr. K. V. Raghavan, Member, AERB and INAE Distinguished Professor, IICT Hyderabad.

On November 15, 2008, the AERB Silver Jubilee Function was organized which was attended by a large number of former and present AERBities and several senior officers from DAE Units. A book titled "AERB: 25 Years of Safety Regulation" was released on the occasion. The book provides a historic account of the formation and growth of AERB over the past twenty-five years highlighting the aspects that were challenging to the regulator.

As a culmination of the Silver Jubilee year celebrations, that coincided with the start of the Birth Centenary Year of Dr. Homi Bhabha, an IAEA International Conference on "Topical Issues in Nuclear Installation Safety: Ensuring Safety for Sustainable Nuclear Development" was organized during November 17-21, 2008. Over 90 foreign delegates and over 200 delegates from India participated in the Conference.

This newsletter covers some details of these activities and a summary of the regulatory work done during this six months period. A feature article on "KGS-3: Safety Review during Commissioning Phase" is also presented in this issue of AERB newsletter.

(S. K. Sharma)

SAFETY REVIEW AND REGULATION

AERB Board Meeting

Ninety sixth AERB Board meeting was held on September 12, 2008 in Mumbai. The Board approved the publication of AERB Safety Code on 'Nuclear Power Plant Operation' [AERB/NPP/SC/O (Rev. 1)]. The present code is a revision of the old code and includes new chapters on operational safety experience feedback, plant life management, probabilistic safety assessment and nuclear security. The chapter on radioactive waste management has been deleted as a separate safety code on 'Management of Radioactive Waste' has since been published.

In order to solve the problem of shortage of Nuclear Medicine Technologists (NMTs) in Nuclear Medicine Centres, AERB had earlier organised short term training programme for science graduates who had 5 years or more of work experience as assistants to nuclear medicine physicians. The training was followed by an examination and the successful candidates were accredited as NMTs. These accredited NMTs have requested to allow them to appear for the examination to qualify as Radiological Safety Officers (RSOs). A number of NMT-cum-RSOs who have qualified through full term training courses represented against this stating that the accredited NMTs should not be considered at par with them for qualifying as RSOs. The Board reviewed the matter and after detailed discussion approved conducting of RSO examination for the accredited NMTs along with the next batch of NMTs who have qualified through full term training, in order to ensure uniform level of qualifying standards for the two sets of personnel.

Authorisations Issued

- Authorisation for Operation of "Boron Enrichment Exchange Distillation Facility at HWP – Talcher.
- Authorization for Siting and Construction of "130 tons/yr capacity of Tri-Butyl Phosphate Plant" at HWP – Baroda.
- Authorisation for Operation of "Boron Enrichment Plant Facility at HWP – Manuguru.
- Licence Renewal of HWP – Hazira.
- Licence Renewal of Nuclear Fuel Complex, Hyderabad under Factories Rules, 1996.
- Licence Renewal for Operation of Narora Atomic Power Station.
- Licence Renewal for Operation of Kakrapar Atomic Power Station.
- Licence Renewal for Operation of HWP – Thal.
- Clearance for starting of Commissioning of dry powder section of uranium oxide plant & for processing of slightly enriched uranium at Nuclear Fuel Complex, Hyderabad.

Regulatory Inspections

Unit	No.
Nuclear Facilities	
UCIL-Jaduguda, Narwapahar, Bhatin, Turamdih, Banduhurang, Bagjata, Mohuldih mines and Jaduguda and Turamdih mills	2 each
IREL, Udyogamandal and IREL, Chavara	1 each
NFC, Hyderabad	2
HWPs - Hazira, Thal, Manuguru	1 each
RAPS - 1&2, RAPS – 3&4, MAPS -1&2, KGS – 1&2, KGS-3&4, KAPS – 1&2, TAPS – 1&2, TAPS – 3&4, NAPP	7
Kudankulam Nuclear Project (KKNP)	2
Prototype Fast Breeder Reactor (PFBR), Kalpakkam	2
Demonstration Fuel Reprocessing Plant (DFRP), Kalpakkam	1
RAPP 5&6, KKNP, PFBR, DFRP, NFC (ZC) -Pazhayakal projects (Special monthly inspections on Industrial Safety)	26
Raja Ramanna Centre for Advanced Technology (RRCAT), Indore and Electronics Corporation of India Ltd. (ECIL), Hyderabad	1 each
Beach Sand Minerals (BSM) Facilities	5
Radiation Facilities	
Industrial Radiography Facilities	19
Industrial Gamma Irradiators	10
Nucleonic Gauges Installations	7
Medical Installations • Radiotherapy • Nuclear Medicine • Diagnostic X-rays	 2 24 28

New AERB Directive

[Issued by Chairman, AERB on March 20, 2009 under Rule 5 of the Atomic Energy (Radiation Protection) Rules, 2004]

Subject: Use of Phosphogypsum in Building & Construction Materials & in Agriculture

Rock phosphates imported in India by the fertilizer plants for production of phosphoric acid contain small concentrations of radioactive nuclides, viz., Uranium-238 and Radium-226. Phosphogypsum produced as byproduct during wet processing of imported rock phosphates contains activity concentration of U-238 typically in the range 0.1-0.2 Bq/g and Ra-226 typically in the range 0.5-1.3 Bq/g.

The subject of processing of imported rock phosphates and the use of phosphogypsum so produced in commercial applications like Building and Construction Materials and in Agriculture has been examined in the Atomic Energy Regulatory Board (AERB) from the radiological safety considerations and the following directives are issued.

1. Analysis of Rock Phosphate and Phosphogypsum

All rock phosphate processing industries shall carry out analysis to determine U-238 and Ra-226 content in each imported consignment of rock phosphate as well as in the phosphogypsum produced from its processing and shall report the results to AERB on quarterly basis. This data will be reviewed in AERB for a period of about two years for deciding on the frequency of such analysis in future.

2. Sale of Phosphogypsum by Fertilizer Plants

AERB approval is not required for selling phosphogypsum for its use in building and construction materials provided the activity concentration of Ra-226 in it is less than or equal to 1 Bq/g. [If Ra-226 concentration in phosphogypsum is more than 1Bq/g, it is to be mixed with other ingredients such that the Ra-226 activity concentration in bulk material is less than or equal to 1.0 Bq/g.]

3. Manufacturing and Use of Phosphogypsum Panels and Blocks

AERB approval is not required for manufacturing and use of phosphogypsum panels or blocks provided they have Ra-226 activity less than 40 kBq/square metre area of any surface of the panels/blocks.

4. Use in Agriculture

There is no restriction for use of phosphogypsum in agricultural applications from the radiological safety considerations.

AERB SILVER JUBILEE YEAR CELEBRATIONS

(November 2007 - November 2008)

On November 15th 2008, AERB organized a function to celebrate completion of 25 years since it was established. Among others the function was attended by Prof. A. K. De and Shri S. D. Soman, former Chairmen, Shri S. V. Kumar, Shri G. R. Srinivasan, the former Vice-Chairmen of AERB, M. S. R.Sarma, former Chairman, SARCOP and Dr. Anil Kakodkar, Chairman, AEC. Also present were Dr. S. Banerjee, Director BARC, Dr. S. K. Jain, CMD, NPCIL and Shri A. L. N. Rao, CE, HWB. The function started off with a soulful rendition of a devotional song by Smt. S. Bhattacharya, former scientific officer, AERB. The Silver Jubilee History book, "AERB : 25 Years of Safety Regulation", was released by Prof. A. K. De. Chairman AEC released two monographs, prepared by AERB staff on siting and seismic safety respectively. The mood in the auditorium turned nostalgic during the addresses by former Chairmen and Vice Chairmen. Chairman AEC honoured them with a shawl, a memento and a copy of the Silver Jubilee book. Chairman AEC shared his thoughts on the important role that AERB had played and also asked AERB to gear up for the challenges in the days to come. This function was marked by a larger gathering with participation by present as well as retired members of AERB. All the retired staff members were presented a memento and a copy of Silver Jubilee book and the two monographs as token of remembrance and affection. Later, in the evening AERB staff club organized a cultural programme with in-house as well external participation.

AERB Silver Jubilee year celebrations had started in November 2007 with a small function which was attended by Chairmen AEC, past Chairmen of AERB, Directors/ Heads of Divisions of AERB, Chairmen of the various committees of AERB and AERB Staff. The new building of AERB, Niyamak Bhavan-B was inaugurated by Prof. A. K. De, the first Chairman of AERB. To treasure the memories of the day, the addresses of Chairman AEC and former Chairmen and Vice Chairmen AERB, were transcribed and included in the AERB Silver Jubilee book. The AERB Code of Ethics and a monograph on Probabilistic Safety Assessment prepared by AERB Staff were released during that function.

Many important activities were organized all through the Silver Jubilee year. During the DAE Safety and Occupational Health Professionals Meet in 2007, a monograph on 'Construction Safety' was released. A seminar on 'Challenges and Innovation in Fire Safety' was organized during the annual fire safety award distribution function. A monograph on "Fire Safety" was also released during the seminar. A two-day discussion meet on 'Emergency Exercises by NPPs-Site and Offsite: Challenges and Constraints' was organized at SRI Guesthouse, Kalpakkam.

A series of bilateral meetings were organized during the year between AERB and International Regulatory Bodies. In the month of February 2008, AERB – USNRC Safety Discussion Meet was organized under the on-going nuclear safety co-operation programme between the two regulatory bodies. A workshop on Information Exchange on Nuclear Safety between AERB and Rostaknadzor, the regulatory body of Russian Federation, was organized in March 2008. In the month of May 2008, as part of AERB – ASN (French Regulatory Body) collaboration in reactor safety, a seminar on 'Pressurized Water Reactors' was organized.

AERB organized a series of lectures by its Board Members. The first in the series was delivered by Prof. J. B. Joshi on "Insights into theories of turbulence and heat transfer". Dr. (Ms) K. A. Dinshaw delivered a lecture on "Early detection and screening of cancers: lessons learnt" and Dr. K. V. Raghavan delivered a talk on "Recent advances in chemical industries with the case study of Nagothane explosion". In addition, there was also a thought provoking lecture by Dr. R. A. Mashelkar, former Director General, CSIR on "Indian Innovation : From Gandhi to Gandhian Engineering" which emphasized on the principle of producing more from less, and for more people.

Apart from these special events planned for the Silver Jubilee year, several awareness programmes and workshops were also organized. To create awareness about consignments containing radioactive material, AERB organized a one day awareness programme on radiation safety for safe transport of radioactive material for air and sea carriers. In order to educate the operators of X-ray baggage inspection system at airports on radiation safety aspects, AERB organized a one day awareness programme on the subject and also a one day workshop for X-ray machine manufacturers/suppliers on regulatory control of diagnostic X-ray equipment and installations. A workshop for paramedical staff was organized at NFC, Hyderabad.

As a culmination of the Silver Jubilee year celebrations of AERB that coincided with the start of the birth centenary year of Dr. H. J. Bhabha, an International Conference on "Topical Issues in Nuclear Installation Safety: Ensuring Safety for Sustainable Nuclear Development" was organized in collaboration with IAEA.

⇧ Dignitaries on the Dias during the AERB Silver Jubilee Celebration in November, 2008

(Left to Right): Shri. S. K. Sharma, Chairman, AERB, Shri. S. D. Soman, Former Chairman, AERB; Dr. Anil Kakodkar, Chairman, AEC; Prof. A. K. De, Former Chairman, AERB and Shri. S. K. Chande, Vice-Chairman, AERB

⇧ Shri. S. K. Chande, Vice-Chairman, AERB addressing at the concluding session of AERB Silver Jubilee Celebrations in November 2008

SPECIAL LECTURES

Insights into Theories of Turbulence and Heat Transfer

(Prof. J. B. Joshi, Director, University Institute of Chemical Technology, University of Mumbai, Matunga, Mumbai-400 019 and Member, AERB Board)

⇧ Prof. J. B. Joshi: AERB Silver Jubilee Colloquium in September, 2008

Solid-fluid heat-transfer coefficients have an important role in the design of chemical processing, nuclear and energy equipment. The major resistance to heat transfer lies in a region very close to the wall, where experimental measurements are very difficult. The validity and accuracy of the models developed for the estimation of the heat and mass transfer coefficient still do not have general applicability for the entire range of Reynolds and Prandtl numbers, because of the limited knowledge of near-wall turbulence. There have been two approaches for such model development: one is an analytical approach, which considers the momentum, mass, and heat transfer to be analogous in nature and the understanding of one of these processes can be used to predict the other two; The other approach is heuristic, based on the visualization of the behavior of the coherent structures in the near-wall region. The continuous movement of fluid elements to and away from the wall (coherent structures) affects the transport phenomena. The models for the quantification of this behavior have been developed for the estimation of heat and mass transfer rates in the literature. This is possible using direct numerical simulation (DNS) and large eddy simulation (LES), which can accurately predict the near wall flow pattern. The results of attempt to exploit the ability of DNS and LES to develop insight into hitherto used models, based on analogies and/or heuristic arguments, were presented.

The methodologies and applications of various experimental fluid dynamics (EFD) techniques (namely, point measurement techniques such as hot film anemometry, laser Doppler anemometry, and planar measurement techniques such as particle image velocimetry (PIV), high speed photography, Schlieren shadowgraphy, and the recent volume measurement techniques such as holographic PIV, etc.), and the computational fluid dynamics (CFD) techniques (such as direct numerical simulation and large eddy simulations) were discussed. Also, several notable mathematical quantifiers such as quadrant technique, variable integral time average, spectral analysis, proper orthogonal decomposition, wavelet transform based method, eddy isolation methodology, velocity gradient tensor, etc were reviewed. All the three techniques (computational, experimental and mathematical) have evolved over the past 6-7 decades and have shed light on the physics behind the formation and dynamics of various flow structures.

This understanding has brought improvements in the formulations of heuristic models of mass and heat transfer, the semi-empirical correlations and in the development of turbulence theories and estimating the design parameters. The presentation provided an understanding of how far the views of earlier established theories have been able to match the recently revealed dynamics of flow structures (as uncovered by use of various techniques). Some success stories of implementation of this understanding in the chemical process industry were also presented.

The presentation also dealt with the heat transfer aspects of single phase jet loop reactor (JLR) and multiphase condensation jet reactor (CJR). To understand the science behind the interaction between flow pattern and heat transfer in these reactors, experiments using hot film anemometer (HFA) have been carried out at solid-liquid (SL) interface and vapor-liquid (VL) interface in these reactors. The analysis has been carried out using eddy isolation model (EIM) and continuous wavelet transform (CWT) based methodologies to evaluate eddy age distribution at these interfaces where distinction in distribution has been observed at SL and VL interfaces. Further, local heat transfer coefficients (HTC) have been evaluated experimentally as well as based on the eddy age and area distributions.

Further, in order to achieve the desired structure and dynamics of turbulence, an attempt has also been made to develop a protocol for suggesting optimum power consumption and also the possible geometry of the equipment. The work ends with addressing the present issues, the existing knowledge gaps and the path forward in this field.

Early Detection and Screening for Cancers: Lessons Learnt

(Dr. (Ms) K. A. Dinshaw, Former Director, Tata Memorial Centre (TMC), Mumbai and Member, AERB Board)

⇧ Dr. (Ms) K. A. Dinshaw: AERB Silver Jubilee Colloquium in October 2008

The two major components of cancer control are early detection and screening.

Early Detection: Recognizing possible warning signs of cancer and taking prompt action leads to early diagnosis. Increased awareness of possible warning signs of cancer, among physicians, nurses and other health care providers as well as among the general public, can have a great impact on the disease.

Screening: Screening refers to the use of simple tests across a healthy population in order to identify individuals who have disease, but do not yet have symptoms. Examples include breast cancer screening using breast self-examination (BSE), clinical

SPECIAL LECTURES

breast examination (CBE) and mammography and cervical cancer screening using cytology (pap smear), visual inspection with acetic acid (VIA) and human pappilloma virus (HPV) testing.

Screening programmes should be undertaken only when their effectiveness has been demonstrated, when resources (personnel, equipment, etc.) are sufficient to cover nearly all of the target group, when facilities exist for confirming diagnoses and for treatment and follow-up of those with abnormal results, and when prevalence of the disease is high enough to justify the effort and costs of screening. While advocating screening programmes, it is important for national cancer control programmes to avoid imposing the "high technology" of the developed world on countries that lack the infrastructure and resources to use the technology appropriately or to achieve adequate coverage of the population. The success of screening depends on having sufficient numbers of personnel to perform the screening tests and on the availability of facilities that can undertake subsequent diagnosis, treatment, and follow-up. Some basic factors that should be taken into account when the adoption of any screening technique are:

1. Sensitivity: The effectiveness of a test in detecting a cancer in those who have the disease;

2. Specificity: The extent to which a test gives negative results in those who are free of the disease;

3. Positive predictive value: The extent to which subjects have the disease in those that give a positive test result;

4. Negative predictive value: The extent to which subjects are free of the disease in those that give a negative test result;

5. Acceptability: The extent to which those for whom the test is designed agree to be tested.

While based on the existing evidence, mass population screening can be advocated only for breast and cervical cancer, using mammography and cytology screening, several ongoing studies are currently evaluating low cost approaches to screening that can be implemented and sustained in low-resource settings.

The TMC is evaluating the low cost techniques VIA, and CBE performed by trained primary health workers in urban slums of Mumbai (the TMCUOP) and in the rural areas of Osmanabad-Barshi and Ratnagiri-Sindudurg (the TMCROP). These studies have already demonstrated disease downstaging and should show in the coming years whether these methods and strategies have an impact on the disease incidence and mortality.

Recent Advances in Chemical Accident Modeling

(Dr. K. V. Raghavan, INAE Distinguished Professor, Former Chairman, Recruitment & Assessment Centre, DRDO, Ministry of Defence and Member, AERB Board)

The modeling of chemical release and post release events involving fires, explosions and toxic gas dispersions has enabled the safety analysts to determine their hazard consequences and risk potential. A single chemical accident can have many distinct incidents and multiple outcomes, the consequences of which can be quantified through mathematical modeling and consequence analysis. The presentation highlighted the recent advances made

⇧ Dr. K. V. Raghavan: AERB Silver Jubilee Colloquium in November 2008

in the modeling of chemical release and post release events with examples drawn from the first ever Indian effort in modeling the major gas cracker accident that took place in 1990.

Indian Innovation: From Gandhi to Gandhian Engineering

(Dr. R. A. Mashelkar, CSIR Bhatnagar Fellow and former Director General of CSIR, New Delhi)

What Engineering would be most crucial for the 21st century? Electrical Engineering? Aeronautical Engineering? Computer Engineering? Electronics Engineering? No. None of these. It will be 'Gandhian engineering'. Gandhian Engineering stems from two of the profound statements that Mahatma Gandhi made. "Earth provides enough to satisfy every man's need, but not every man's greed". This means getting "more from less"! In another statement, Gandhi said, "I would prize every invention of science made for the benefit for all". This means getting it for "more and more people"!

Gandhian Engineering is simply "getting more from less for more". This means the design and development of products and services with more functionality, from less material, less cost, less time, less environmental pollution and of benefit to not just a privileged few but of more and more people on this planet; in fact all 4 billion people, whose income levels are less than 2 dollars a day.

When it came to products and services, "high price – high performance" was reserved for the rich. Low price – low performance was, of course, for the resource-poor. Can we change this price-performance envelope to say that we will build "low price – high performance" for the resource poor? Yes, we can. But for this, we require Gandhian engineering.

A good example of Gandhian engineering is Tata's people's car – Nano, the most inexpensive car in the world, much lighter than comparable models, with an exceptional fuel efficiency and yet a vehicle with amazing legroom. This means 'more from less' – but that also means 'for more and more people'. The lecture provided several examples of Gandhian Engineering for different sectors, strata, scale and scope. It also described innovative approaches of organization and funding of research.

TRAINING & SAFETY RESEARCH PROGRAMME

AERB Refresher Course

As a part of AERB Training Activity, the following two Refresher Courses were conducted.

"VVER Reactors": The course organized during July 10-11, 2008 covered the following topics: 'Plant Layout & Design of Structures, System and Components', Reactor Coolant Systems & Associated Systems', 'Reactor Assembly & Core Physics', 'Engineered Safety Features', 'Instrumentation & Controls' and 'Accident Analysis'.

"Acts and Rules applicable to AERB": The course organized during August 5-6, 2008 covered the topics 'Atomic Energy Act, 1962', 'Factories Act, 1948', 'Atomic Energy (Factories) Rules', 1996', 'Water Act & Air Act and Rules', 'Environment Protection Act, 1986', 'Radiation Protection Rules, 2004', 'Safe Disposal of Radioactive Wastes Rules, 1987' and 'Control of Irradiation of Food Rules, 1996'.

AERB Colloquia

Two colloquia; 'Convention on Nuclear Safety (CNS)' and 'EPR, AP-1000 and VVER Reactor Designs' were organized on August 22, 2008 and on December 2, 2008 respectively. In the talk on 'Convention on Nuclear Safety (CNS)', the background and objective of Nuclear Safety Convention and the Review Process were highlighted. The Indian national report submitted to the fourth review meeting of the CNS, the questions raised on the report by the participating countries and our responses, and highlights of the proceedings of the meeting were presented.

In the colloquium on "EPR, AP-1000 and VVER reactor designs", the basic philosophy and salient design features of AP-1000 highlighting active and passive safety related systems like containment cooling system, core cooling system, that are not relied upon for handling Design Basis Accidents were presented. The salient design features of EPR, 1,600 MWe PWR by AREVA, France and Siemens AG, Germany and the innovative features to take care of Severe Accidents (SA), military or large commercial airplane crash and also flexibility in fuel management, redundancy in safety systems etc, were presented.

SAFETY RESEARCH PROGRAMME

AERB Committee on Safety Research Programme (CSRP) met once during the period. During the meeting, 6 Principal Investigators made presentations on the work carried out in their projects, methodology followed, results obtained and future work planned. The committee reviewed the detailed evaluation of the presentations and recommended suitable midcourse corrections in the work programme.

The CSRP considered the new project proposals for funding and after deliberations recommended for approval the following six projects. Also, the Committee approved the renewal of grant-in-aid for 3 on-going projects.

New Projects Approved by CSRP

Sr. No.	Title	Principal Investigator / Institute
1.	Hydrogeochemical Modeling of Coastal Aquifers in and around Kalpakkam - An Integrated Approach	Dr. S. Chidambaram, Annamalai University, Tamil Nadu
2.	Microbial Biofilm Formation and Corrosion of Firewater Pipelines in NPPs	Prof. S. Jayachandran, Pondicherry University, Tamil Nadu
3.	Evaluation of Tensile Properties of Zircaloy-2 and Zircaloy-4	Dr. R. Ganesh Narayanan, IIT,Guwahati
4.	Experimental Investigations on Transient Critical Heat Flux	Dr. S. V. Prabhu, IIT-Bombay, Mumbai
5.	Dispersion of Hydrogen-Steam Mixture in Containment	Dr. Kannan Iyer, IIT, Bombay, Mumbai
6.	Development of a TLD based on Borate Glass: Implication to Clinical Dosimetry	Dr. A. Nabachandra Singh, Thoubal College, Manipur

REPORTING ON ...

USNRC-AERB Meeting

The USNRC-AERB technical discussion meeting was held on 24-25 November 2008 to discuss the progress of work on the two standard problem exercises (TMI-2 accident and ISP-42, PANDA test) and to finalize the draft report. The programme started with the opening remarks by Shri.S.K.Sharma, Chairman AERB and Dr. Dale E. Klein, Chairman USNRC. This was followed by presentations on sensitivity and uncertainty analysis of TMI-2 accident scenario from AERB and USNRC experts. The results of the simulation of the experiments (Phases A-F) conducted in the PANDA test facilities were also presented. Simulation of Phases A-F using RELAP5, simulation of Phases A-C using ASTEC and RELAP5 and simulation of Phases D-F using RELAP5 were presented by experts from AERB and BARC respectively. Extensive discussions took place on all the presentations.

AERB Hosts IAEA International Conference on Topical Issues in Nuclear Installation Safety

An International Conference on Topical Issues in Nuclear Installation Safety: Ensuring Safety for Sustainable Nuclear Development during November 17-21, 2008, Mumbai was organized by AERB. The objective of the conference was to foster the exchange of information on topical issues in nuclear safety, especially on issues that ensure safety for sustainable nuclear development. The participants in the conference represented a broad range of experts in the area of nuclear safety, including professionals from the different disciplines involved in the safety of nuclear power plants, installations in other parts of the fuel cycle and research reactors and experts from regulatory bodies as well as senior policy makers. A total of 93 delegates from 37 countries abroad and about 200 delegates from India participated in the conference. The topics covered in conference were International Harmonization of Nuclear Safety, Safety Infrastructure for Nuclear Programmes, Safety management and New Construction Experience Feedback, Relationship between Safety and Security. The President of the conference was Mr. A.-C. Lacoste, Chairman, ASN (French Nuclear Regulatory Body). The conference was inaugurated by Dr. Anil Kakodkar, Chairman, AEC and Secretary, Department of Atomic Energy. The Chiefs of Regulatory Bodies of several countries including USA, Finland, South Africa, and UK attended the conference. Participants from IAEA and other International Organizations such as World Association of Nuclear Operators (WANO), and the Organisation for Economic Co-operation and Development (OCED) / Nuclear Energy Agency (NEA) attended the conference. The Conference provided an opportunity to share experiences and expectations related to nuclear safety, as well as the challenges for sustainable and safe nuclear power development. Participants also exchanged the lessons learned and operational experience from current nuclear power programmes, along with discussion of experiences with new nuclear power plant construction. Other important subjects such as opportunities for the nuclear industry and protection of nuclear installations against malevolent acts were also discussed during the conference. The conference provided important recommendation on key issues related to nuclear installation safety.

⇧ Dr. Anil Kakodkar, Chairman, AEC addressing at the IAEA International Conference on Nov.17, 2008 at NPCIL Auditorium in Mumbai.

(Left to Right): Shri S. K. Sharma, Chairman, AERB; Dr. A. C.Lacoste, France; Dr. Taniguchi, Deputy General for Nuclear Safety & Sources, IAEA; Dr. El-Shanawany, IAEA; Dr. Om Pal Singh, AERB

25th DAE Safety & Occupational Health Professionals meet at Kalpakkam (December 18 - 20, 2008)

The 25th DAE Safety & Occupational Health Professionals Meet was jointly organized by the Bhartiya Nabhikiya Vidut Nigam Ltd., (BHAVINI), various DAE Units at Kalpakkam and Atomic Energy Regulatory Board, Mumbai at Safety Research Institute (SRI) Complex, Anupuram during December 18-20, 2008. The themes for this Silver Jubilee year's meet were "Safety Management and Safety Culture" for "Industrial Safety" and "Industrial Medicine for occupational health safety".

Dr. Baldev Raj, Director, IGCAR & Chairman, Steering Committee, 25th DAE Safety & Occupational Health Professionals Meet, welcomed the delegates. Shri R. Bhattacharya, Head, IPSD, briefed the participants about the Journey of the Safety Professionals Meet from its inception. Shri S. K. Chande, Vice Chairman, AERB distributed the prizes to the winners of Logo Competition & delivered the introductory address. Dr. Baldev Raj, released the CD containing Posters made by Shri Kailash H. Gharat, IHSS, RSSD, BARC. Dr. S.K. Jain, Chairman & Managing Director, BHAVINI & NPCIL released the booklet on Safety Management & Safety Culture. Shri S.K. Sharma, Chairman, Atomic Energy Regulatory Board, inaugurated the meet and released the proceedings and CD of the Meet. Green Site awards were presented to IREL, Manavalakurichi and Kalpakkam Site. Shri Abhijit Rajan, Chairman, & Managing Director, Gammon India, Ltd. delivered "Dr. S. S. Ramaswamy Memorial Endowment Lecture" on Safety Culture and Safety Management. Shri S.P.Sethi, Principal Advisor (Energy) Planning Commission, Government of India along with Shri S. K. Sharma, Chairman, AERB inaugurated the exhibition of safety appliances depicted by various companies.

The inaugural session was followed by two technical sessions on "Safety Management & Safety Culture" and one on "Occupational Health". Each of these technical sessions had three invited lectures from renowned experts. The invited lectures were on "Safety Management", Safety Culture" & "Behavior based

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Safety Approach" in the first session. "Safety Culture & Safety Management" in the second session. "Emerging Approaches for Occupational Health Risk Management in Industrial Medicine", "Occupational Health Practices at the Workplace" and "Behavioral Aspects of Employees in the third session".

On the second day, in Plenary Session I, seven papers were presented on "Safety Culture and Management in DAE Units". In Plenary Session II, review of Industrial Safety Performance vis-à-vis Presentations on Injury and Occupational Health Statistics were presented by AERB. Thirteen papers on "Analysis of accidents/ NMAs / SRUORs – Techniques & Lessons learnt" were presented by various DAE units. Six papers each were presented in the Parallel Sessions IA and IIA on "Health & Safety Management for Confined Space Work" and "Safety Management Models and Applications" respectively. Medical officers presented sixteen papers on "Occupational Health" in the parallel sessions IB & IIB.

On the third day, in Plenary Session III, five presentations from DAE units on "Physical Hazards (Noise, Heat, Vibration, Illumination, etc) – Control at Workplace – Methods & Strategies" were presented. In Valedictory Session, Poster presentations on "Innovations and Practical Examples on Job Safety – Case- studies" were carried out by Tradesmen / Supervisors of DAE units. This was followed by the briefing of technical papers on Safety and Occupational Health aspects presented during the Parallel Session I & II. In addition there were two presentations from exhibitors. Prizes were distributed for Poster, Cartoon, Slogan Competition among DAE Employees. There was an interactive feedback session. The meet concluded after finalizing the venue for the meet in 2010 as Dr. Raja Ramanna Centre for Advanced Technology (RRCAT), Indore. The theme of the Meet was identified as "Electrical Safety & Cryogenic Safety". The theme for "Occupational Safety" would be decided in next ACOH meeting.

Quality Management System (QMS) of AERB (July – December, 2008)

Fourth Internal audit of different Divisions of AERB was carried out during November 10-12, 2008. In 2008, new Level-II documents on procedure for consenting process of new projects and operating plants were prepared. Standard format for minutes of safety committee meeting has also been prepared. Quality manual and procedure for internal audit have been revised during this year. This was the first internal audit after issue of new and revised documents. Though no non-conformance was raised during this audit, some observations were made by the auditors suggesting improvement of the QMS of AERB. Auditors also verified actions taken on the observations and non-conformances raised during the earlier audit.

Two management review meetings were held on October 29, 2008 and on December 16, 2008 to review the results of internal audits, client feedback and process performance of the QMS. In the review meetings, decisions like framing of measurable quality objectives, analysis of data, quarterly review of pending issues of consenting process and regulatory inspection process and preparation of minutes of safety committee meetings in standard format were taken. It has also been decided that for improvement of the quality management system of AERB, a separate report will be prepared by individual Division for pending issues of regulatory inspection of different facilities at the end of the year and the same will be forwarded to the facility for necessary action.

AERB has decided that feedback on consent issued will be taken after commissioning of an NPP project as well as nuclear fuel cycle facility. Feedback on regulatory inspection will be sought on selected installations once in a year. In case of radiation installations, feedback will be sought once in a year from a few randomly selected installations. For promotion of awareness of client requirements in AERB work culture, organizing of workshop is also under consideration.

- M. K. Pathak, IPSD and P. C. Basu, C&SED

Monograph on "Seismic Safety of Nuclear Power Plants"

A monograph on Seismic Safety of Nuclear Power Plants was brought out by staff of AERB in November 2008. This monograph presents the general profile of earthquake engineering, philosophy and methodology adopted for seismic safety of new and existing Indian nuclear power plants. The monograph is divided into eight chapters. First three chapters of this monograph deal with the basic concepts of earthquake, aseismic design philosophy for general structures other than nuclear power plants, basic structural dynamics, soil-structure and fluid-structure interactions during an earthquake. Chapter four introduces the reader to the basic concepts of seismic engineering for a nuclear power plant. Different levels of earthquakes considered in NPP design, the asesimic design approach of a NPP vis-à-vis the approach for general structures other than NPP is described over this chapter. The remaining Chapters of this monograph deal with the intricacies of seismic engineering for a NPP. The topics covered in these chapters include the methodology for derivation of ground motion parameters, seismic design and qualification of new NPPs, seismic re-evaluation of old NPPs and seismic instrumentation.

- Ajai S. Pisharady, C&SED

Monograph on "Siting of Nuclear Power Plants"

A monograph on "Siting of Nuclear Power Plants" was brought out by staff of AERB in November 2008.This monograph introduces readers to various criteria followed by AERB to evaluate the site of nuclear power plant. First chapter gives an overall idea about siting of NPPs. Second chapter deals with basic requirements. Details of impact of external events on plant are described in third chapter. In the fourth chapter, impact of plant on site, environment and public are described. Fifth and sixth chapters describe emergency preparedness and other considerations, such as geotechnical safety and loss of ultimate heat sink. The quality assurance aspects are covered in the final chapter.

- Roshan A.D, C&SED

Library & Information Services in AERB

Library & Information Services of any organization play an important role in providing knowledge input to various activities of the organization to achieve its objectives and goals. AERB library is having a collection of around 10000 documents related

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AERB Library

to Nuclear Safety, Radiation Safety, Industrial Safety, Fire Safety, Health & Occupational Safety, Electrical Safety, etc. comprising Scientific and Technical Books, Conference Proceedings, Technical Reports, Codes, Standards, Guides, Manuals, Hindi Books, Power Project Documents, CD-ROMs, Video Cassettes, Bound Volumes of Journals.

AERB has developed and published more than 140 safety codes, safety standards, safety guides and safety manuals etc. In the preparation of AERB publications various other National and International Codes, Standards, Guides and Reports are used as reference materials. AERB Library acquires these publications, which form its main collection.

Some of the most useful international publications available in the AERB Library are from the International Atomic Energy Agency (IAEA), International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, the American Society of Mechanical Engineers, the Nuclear Energy Agency of the Organization for Economic Co-operation and Development (OECD/NEA) and U.S. Nuclear Regulatory Commission. Also, AERB Library has a good collection of other National and International Standards of Organizations such as BIS, BS, ANSI, ASTM, IEEE, IEC, ISO, Canadian Standards etc. relevant to its interest.

AERB library is providing a variety of library and information services to its users in addition to book borrowing and reading facilities. Some of the key services are as follows:

On-Line Public Access Catalogue (OPAC): OPAC is online catalogue of library collection. Users can search library collection by entering keywords in search box. Web-OPAC is also available to see the OPAC using intranet.

Current Awareness Services (CAS): CAS is provided to all users by regularly sending lists of New Additions to the Library, Table of Contents of Journals etc. by e-mail.

Nuclear News Services like NucNet, World Nuclear News, Nuclear Engineering News etc. are regularly sent to users by e-mail.

CD-ROM Databases: AERB library subscribes to International Nuclear Information System (INIS) database on CD-ROM published by IAEA. INIS is the world's biggest bibliographic database on nuclear literature source, which currently contains over 3 million abstracted and indexed records and a comprehensive collection of over 850,000 full texts.

Online Journals: Elsevier's Science Direct (http://www.sciencedirect.com), world's largest electronic collection of science, technology and medicine, full text and bibliographic information is made available through DAE consortium.

Digital Inter Library Loan (DILL): DILL service is used for requesting a paper or article in digital or electronic format not available in the AERB library from the other libraries of DAE Units.

- Kavi Upreti, SADD

Official Language Implementation

AERB continued its efforts to ensure effective implementation of official language policy and enhancing the use of Hindi in official work. An Inspection Team constituted by Official Language Implementation Committee (OLIC) carried out inspection to check the progress in use of Hindi in official work. Efforts were continued to prepare scientific and technical literature in Hindi and make the same available to DAE Units, other institutions and to the public. So far, 35 AERB safety documents have been translated and published in Hindi. AERB Safety Guide on "Radiation Protection during Operation of Nuclear Power Plants" (AERB/SG/O-5) and Technical Manual on "Methods for the Measurement of Radon Thoron and their Progeny in Dwellings" (AERB/TM/RM-1) were published in Hindi during July-December-2008.

Inauguration of AERB Hindi Day Function

Dignitaries on the Dias (L to R): Shri. S. P. Agarwal, Head, RSD and Shri. S. K. Chande, Vice-Chairman, AERB

To encourage the use of Hindi by the officers and staff in AERB, Hindi competitions such as Story writing, Essay Writing, Scientific and Technical Translation, Noting and Drafting, Extempore Speech, Cross-words and Slogan, etc., were organized in February 2008 and prizes were distributed to the winners in December, 2008. Hindi Quiz competition was also organized in September 2008. On the occasion of "Hindi Diwas", messages of Hon. Union Home Minister and Chairman, AEC were read and a lecture on "Right to Information Act-2005" was organized by Joint Committee for Implementation of Official Language in DAE Units.

Cultural activities at the AERB Hindi Day Function

FEATURE ARTICLE

KGS -3 : Safety Review during Commissioning Phase

Fredric Lall and D. Bhattacharya
Nuclear Projects Safety Division, AERB

1.0 Introduction

Kaiga Generating Station (KGS) is a cluster of four Pressurised Heavy Water Reactor (PHWR) based nuclear power plants located at Kaiga in the state of Karnataka. The capacity of each of the units is 220 MWe. KGS -1&2 are in operation since the year 2000. KGS-3 was synchronized to the grid in 2007. KGS-4 is under commissioning.

The regulatory review of KGS-3 was conducted by AERB as per the established methodology of three tier review for Nuclear Power Plants. These tiers are- 'Project Design Safety Committee' (PDSC), 'Advisory Committee for Project Safety Review' (ACPSR-PHWRs) and 'Board of AERB'. Since KGS-3&4 are the repeat design of KGS-1&2, so the safety review methodology adopted for KGS-3&4 was essentially to review the design differences of KGS-3&4 with respect to KGS-1&2, generic design issues carried forward from KGS-1&2 and feed back reports from the operating plants of similar design. PDSC constituted Working Groups (WGs) and Task Forces (TFs) to carry out in depth review of certain safety significant topics.

Based on the satisfactory safety review, AERB granted clearances for 'Excavation' in June 11, 2001, 'First pour of Concrete' in March 22, 2002 and 'Erection of Major Equipment' in August 8, 2003 for KGS -3&4.

2.0 Regulatory Review during Commissioning of KGS Unit-3

Safety review during commissioning phase was carried out as per the AERB Safety guide on "Consenting Process for Nuclear Power Plants and Research Reactors" (AERB/SG/G-1). As per established procedure, even for repeat design projects, safety review during commissioning phase is carried out separately in detail for each unit. Applications for various stages of commissioning and test results of the previous stage were scrutinized thoroughly. Important commissioning tests like containment Proof Test and Integrated Leakage Rate Test, Emergency Core Cooling System (ECCS) Integrated Test, Experiment/ tests to measure core-physics parameters, etc. were witnessed by AERB representatives.

Subsequent paragraphs describe in–brief sub-stages of commissioning of PHWRs and some of the salient tests/ safety significant jobs carried out at each sub-stage:

2.1 Proof Test and Integrated Leakage Rate Test of Containment

The Proof Test is carried out to ensure structural integrity and elastic behaviour at design pressure of primary containment and Integrated Leakage Rate Test is carried out to ensure leakage rate of air from primary containment is within the design specification at the peak pressure estimated to be attained during an accidental condition. The procedures of both the tests were reviewed by AERB committees and the tests were carried out in line with the procedures. Proof test results established the structural integrity and elastic behaviour of primary containment. Result of ILRT confirmed that the leakage rate was within the specified limit.

2.2 Hot Conditioning of Primary Heat Transport System (PHTS) and Light Water Commissioning

Hot Conditioning (HC) of PHTS is carried out to form an adherent layer of magnetite on the inner surfaces of Primary Heat Transport System piping. Clearance for hot conditioning and light water commissioning was granted by AERB after satisfactory review of the required documents. Water temperature of PHTS was raised to 250°C by primary circulating pumps' operation and chemistry parameters were properly controlled. Uniform magnetite layer of 0.43 microns was formed on the inner surface of piping. Light water commissioning tests of PHTS including transient tests and tests of Emergency Core Cooling System were carried out subsequent to HC. Commissioning tests of Primary Shut-down System (PSS), Secondary Shut-down System (SSS), Adjuster Rods (AR), Control Rods (CR), etc were carried out with light water in Moderator system. Commissioning results were found satisfactory and AERB granted permissions to drain light water from PHT and Moderator system.

2.3 Initial Fuel Loading in the Reactor Core

Initial fuel loading pattern was reviewed in the light of core physics requirements. The fuel loading involved natural uranium, depleted uranium and deeply depleted uranium fuel bundles in reactor core. Important activities namely draining, drying, pre-service inspection of coolant channels, inspection of fuel, establishment of physical separation between KGS-3 and KGS-4 (then under construction), enforcement of radiation zoning and nuclear security etc. were ensured to be completed prior to issue of authorization for the initial fuel loading.

2.4 Flushing and Filling of Moderator System and PHTS with Heavy Water

Prior to addition of 20 Te of heavy water in the moderator system for flushing, the start-up Boron coated counters were installed in the central thimble and connected to startup instrumentation dolly. Ion chambers of reactor regulating and protection systems were source checked, installed and connected to their respective systems. Instrument calibration, proper connectivity and response checks of instruments, alarm settings and associated test results were reviewed. Filling of PHTS with heavy water was completed successfully.

2.5 Bulk Heavy Water Addition to Moderator System and First Approach to Criticality

NPCIL's combined application seeking authorization for bulk heavy water addition to moderator system, First Approach to Criticality and Phase-B experiments was reviewed. Prior to the bulk heavy water addition, results of flushing of moderator system and 20 Te Heavy water addition were reviewed. Document on "Technical Specifications for Operation" of KGS-3&4 was reviewed and approved by AERB and process of licensing of manpower for operation of KGS Unit-3 was completed. All the radiation protection measures were implemented from this stage onwards. Adequate concentration of neutron poison (Boron) was maintained to ensure reactor sub-criticality during filling of heavy water.

Integrated tests of Reactor Regulating System (RRS) and Reactor Protection System (RPS) were completed prior to First Approach to Criticality. Important operations related to reactor protection and reactor core cooling were carried out from supplementary control room. The test results were reviewed and found to be meeting safety requirements. AERB granted authorization for First Approach to Criticality of KGS -3 after confirming completion of the safety related prerequisites including that of nuclear security. First Criticality of KGS Unit-3 was attained on February 26, 2007 within 5 years of starting of construction. Neutron and gamma radiation surveys were carried out at first criticality and were repeated subsequently for each step of significant raising of reactor power.

2.6 Low Power Physics Experiments

Reactor trip logics of all the channels were checked and static and dynamic worth of absorber rods (individual & group) of Primary Shutdown System (PSS) were measured. In KGS-3, for the first time in 220 MWe Indian PHWR, on-line clutch release test of PSS was successfully carried out while the reactor was operating. Worth of Secondary Shutdown System (SSS) was measured and operations of

FEATURE ARTICLE

Automatic Liquid Poison Addition System (ALPAS) at different modes were checked. Temperature coefficient of coolant and moderator were measured. The reactor power was limited to less than 0.2% FP during these tests.

2.7 Synchronization of TG set and operation of Plant up to 90% FP

After successful completion of low power physics experiments, power of reactor was raised in steps and important tests including transient tests were carried out to ensure behaviour of RRS, RPS, Moderator System, PHTS, Secondary System, Electrical System, Auxiliary System and shielding requirements are as per design. Important parameters of the above mentioned systems were also measured and found to be within acceptable limits. Reactor power would be raised to 100 % FP after completion of all the commissioning tests at 90% FP and ensuring that the test results are satisfactory.

3.0 Experience of Commissioning of KGS-3

Some of the safety significant issues which emerged during review of commissioning of KGS-3 are described in brief in subsequent paragraphs;

3.1 Non-Termination of H_2O Injection in ECCS

During a loss of coolant accident, ECCS is designed to supply cooling water to reactor core in three stages namely high pressure heavy water injection from accumulator, intermediate pressure light water injection from accumulators and low pressure recirculation of light water by ECCS pumps. Sequence of injection of water, termination of water injection and isolation of accumulators at proper parameters (low level and low pressure) and sequence and timing of valve operations are checked in ECCS integrated test as a part of LWC tests.

During the ECCS integrated test in KGS-3, termination of intermediate pressure light water injection did not take place as low level conditions in light water accumulators were not satisfied. Water entered to light water accumulators from the discharge of ECCS pumps due to passing of the isolating valves and prevented drop in level of water to low level. ECCS pumps started working in long term recirculation mode. Subsequently, termination of light water injection on low level and low pressure was demonstrated by tripping ECCS pumps. Core cooling by ECCS was demonstrated successfully. To overcome this problem, commissioning procedures for the ECCS integrated test for other three units were modified.

3.2 Modification of Excitation System of Diesel Generators (DG)

During commissioning of DGs, it was observed that on starting of Primary Pressurizing Pump (PPP) motor (highest load on DG) voltage generated by DG set collapsed and PPP motor could not be started. Starting of PPP motor caused dipping of DG terminal voltage, which in turn caused voltage dip on excitation transformer (whose primary side is fed from DG terminals) which reduced excitation and a consequent further dip of the DG terminal voltage resulted a cascaded collapse of DG terminal voltage.

Detailed design review was carried out by safety committees and manufacturer. As an interim measure, an inverter of 1.0 KVA with a battery bank was installed to feed the excitation circuit. Finally, the exciter transformer was modified to supply the required voltage to the exciter in case of the starting of the highest load. After modification, the problem has been solved.

3.3 Modification of Diesel Generator (DG) Crank Case Exhaust System

In KGS-3, DG Sets were provided with electric motor driven Crank Case Exhaust (CCE) fan. During commissioning of DG sets it was found that unavailability of CCE fan can cause unavailability of DG sets. CCE fan should be running as a starting permissive of diesel engine. In case if CCE fan trip, DG would also trip. Thus, the DG sets would become inoperable due to unavailability of just a CCE fan.

The issue was reviewed by safety committees and also by the DG supplier. As a result, design modifications were carried out. CCE fan was deleted, instead, an ejector based passive system has been incorporated to maintain sub-atmospheric pressure in the crank-case after detailed review and shop testing. Thus, the safety issue got resolved by design modification.

3.4 Light Water Leakage from a tri-junction weld of an End Shield

Annulus Gas Monitoring System (AGMS) has been provided to detect heavy water leakage from pressure tube or calandria tube rolled joints or light water leakage from end shields by measuring the inlet and out let dew point of circulating carbon-di-oxide gas. During power operation of KGS-3, a leakage was indicated by AGMS. Investigation revealed that light water ingress from lattice position O-10 was taking place in the coolant channel annulus. The channel was de-fuelled, isolated from AGMS and end fitting was taken out. Subsequent investigation revealed the presence of a minor defect in the tri-junction weld joint of south end shield. The defect location was in high radiation field zone and congested with feeders and end fittings of other coolant channels. Considering this, AERB recommended mock up operation at each stage of investigation and repair jobs. Varieties of mock ups, as required, were carried out at work shops and in-situ. Finally, the repair of the defect in the welding was successfully carriet out without any damage to any of the reactor components or nearby feeder/end fitting. This is a first of a kind high precision repair work carried out in any of the operating PHWRs. This has also called for additional tests/ checks on welds of End-Shields of future projects.

3.5 Independent Verification and Validation of Software Based Systems

Many computer based systems are used for different safety and safety related systems at KGS 3&4 and RAPP 5&6. The major computer based systems include Programmable Digital Comparator system (PDCS) for Primary Shutdown System (PSS), Reactor Regulating System (RRS), Process Control System (PCS) and Channel Temperature Monitoring System, Duel Computer Hot Standby (DCHS) System for RRS and PCS etc. As the systems use software for its operation, it is necessary that the software used should be of high quality having adequate safety, integrity and reliability. For ensuring these, the software development life cycle has to follow a properly documented and good engineering procedure. The product from every stage of the life cycle is verified and validated by an independent agency so that faults can be eliminated as early as possible in the life cycle and ultimately good quality software can be produced. Concerned WG conducted safety audit of the procedures and important design documents for verifying the safety and integrity of the produced software.

4.0 Conclusion

Regulatory review during commissioning phase of PHWR follows a structured and well established methodology. The review experience gathered during commissioning of earlier 14 PHWRs were well utilized during the review of safety related commissioning activities and test results of KGS-3. The review by AERB during commissioning phase of nuclear power plants ensures that the plant is made operational in a systematic, informative and safe manner. The review also verifies that the performance criteria, design intent and QA requirements are satisfied and the plant can be operated safely in line with the established practices.

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Staff Club Activities

During the year 2008, sports tournaments were successfully conducted for Table Tennis, Badminton, Chess and Carroms. The AERB Day Programme was celebrated on November 15, 2008 at AERB premises. Around three hundred and fifty persons that included AERB staff and their family members, graced the occasion. Shri Vaibhav P. Gholap, Secretary, AERB Staff Club welcomed all the guests and gave an account of various activities conducted by the Staff Club in the year 2008. The family members of AERB staff presented a good cultural programme consisting of dances, songs, music etc. Smt. Manisha Inamdar anchored the cultural programme in an excellent manner. This was followed by prize distribution to the winners of various sports tournaments conducted by Staff Club in the year 2008. The highlight of the evening was the musical programme arranged by reality show professional artists like Smt. Sangeeta Chitale and Shri Mutalik and was well received by AERB Staff. The artistes of the programme were presented with mementos in appreciation of their talent and splendid performance.

⇧ Classical Dance by Staff Members at the AERB Day Function on Nov 15, 2008

Personnel Joined

Sl.No.	Name	Date of appointment
1.	Smt. Reeta Rani Malhotra, SO(F)	14/07/2008
2.	Shri Krishnan Chandran, SO(C)	01/08/2008
3.	Shri S.V. Chavan, APO	08/08/2008
4.	Shri Rahul Porwal, SO(C)	18/08/2008
5.	Shri Susheel Kumar, SO(C)	01/09/2008
6.	Shri Soumyajyoti Kar, SO(C)	01/09/2008
7.	Shri Harpal Singh, SO(C)	01/09/2008
8.	Shri Manoranjan Dash, SO(C)	01/09/2008
9.	Shri Vivek Gupta, SO(C)	01/09/2008
10.	Shri Pranav Paliwal, SO(C)	01/09/2008
11.	Shri Sudhanshu Shekar Singh, SO(C)	01/09/2008
12.	Shri S.M. Gaikwad, DCA	01/12/2008
13.	Smt. Neeta Deshpande, UDC	16/12/2008

Personnel Retired

Sl. No.	Name	Date of retirement
1.	Shri V. P. Kuriakose, AO-II	31/07/2008
2.	Shri J. Vincent S. Kumar, DCA	30/11/2008

AWARDS & HONOURS

⇧ Shri. Obaidurrehman, SO/D, ITSD received the Homi Bhabha Gold Medal at the 50th graduation function of BARC training school on 31 August, 2007 from the Prime minister for securing the first rank among all OCDF-2006 Batch Trainees. OCDF is orientation course of BARC training school for those engineers who join DAE from different IITs after M. Tech degree.

- Dr. R. M. Nehru, SO/F, ITSD has been awarded the Prof.Rathinasabapathi Endowment Oration and a Citation for the year 2008 for his contribution in the field of Medical Physics at the Annual Conference of the Association of Medical Physicists of India (Tamil Nadu & Puducherry-Chapter) held at Puducherry, Tamil Nadu on December 20, 2008.

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