

बीएआरसी
न्यूज़लेटर
BARC
NEWSLETTER

ISSUE NO. 302 | MARCH 2009

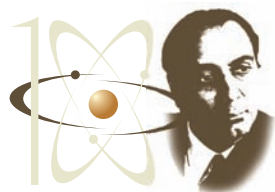


Homi Bhabha Birth Centenary Year
30 October 2008-30th October 2009

IN THIS ISSUE

**EC-SMPS HYBRID VERSION FOR
NUCLEAR INSTRUMENTATION AND CONTROL SYSTEMS**

**STRESS CORROSION CRACKING STUDIES IN
AHWR / BWR SIMULATED ENVIRONMENT**



In the Forthcoming Issue

Supercritical fluid extraction of uranium and thorium from liquid and solid matrices

Extraction and purification of actinides (uranium, thorium and plutonium) from various matrices is of crucial importance to the nuclear industry. Supercritical fluid extraction has a distinct advantage over conventional extraction techniques both in the minimization of liquid volume and in the simplification of the extraction process.

The experimental set-up of a super critical fluid extraction systems, the various optimization parameters such as pressure, temperature, nitric acid molarity, extraction time, modes of extraction and complexation, use of other co-solvents in the extraction of Uranium and Thorium, have been described in this article.

CONTENTS



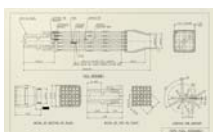
EC-SMPS Hybrid Version for
Nuclear Instrumentation and Control Systems

02



Stress Corrosion Cracking Studies in
AHWR / BWR Simulated Environment

06



Development of remotely operated tools to
dismantle and reconstitute active spent fuel of
TAPS-1&2 for post-irradiation examination

10



Graduation Function of the BARC Training School

14



HMT and BARC sign MoU for Manufacture of 8-KG
Payload Articulated Manipulators

16



Symposium on
Landscaping for Sustainable Environment (LSE)

18



2nd DAE-BRNS
International Symposium on Materials Chemistry
(ISMC-2008)

20



Sixth Supervisory Training Programme on Radioactive
Waste Management: a report

22

भा.प.अ. केंद्र के वैज्ञानिकों को सम्मान
BARC Scientists Honoured

24

URL:<http://www.barc.gov.in>



DR. HOMI BHABHA CENTENARY YEAR

EC-SMPS HYBRID VERSION FOR NUCLEAR INSTRUMENTATION AND CONTROL SYSTEMS

Shantanu Das

Reactor Control Division
and

Md. Arifuddin

Nuclear Power Instrumentation Division, ECIL

Irrespective of the types of control and instrumentation systems such as reactor protection, reactor regulation, fuel handling or boiler turbine control system; treating all of them on par enhances the overall plant safety, reliability, availability and maintainability. *The power supply to run all these systems therefore, is one of the most important components in enhancing overall plant performance.* This aspect was well realized and thus from the very beginning, the design of a rugged fault-tolerant hot-plugable power supply was aimed at and then implemented in nuclear reactor protection and control systems, in NPCIL plants. Experience suggests that outsourcing a power supply design or using a commercial off-the-shelf product is not advisable for nuclear plants. Module based power supplies offer a number of benefits that ultimately result in lower cost of maintenance. For instance, the modules are already de-bugged and every internal component behaviour is well known and thus controlled. Output power capability can be enhanced, for example 80A system can be delivered by paralleling four 20A standard modules and for redundancy a few extra can be added. This is called fault tolerant M+N configuration. With hot-plugging feature, one can have online maintenance for C&I and configure them to the various systems needed by the customer. System down time is lowered and serviceability is enhanced with lower maintenance cost and maintenance effort as the modules can be replaced online, as pluggable, without disturbing the input power switching or wiring. Prior to the development of these rugged power supplies, switched

mode systems were used as commercial off-the-shelf products which were mainly imported. These commercial products did not address certain basic issues of stability and heat engineering. This in-house developed modular power supply is robust as verified experimentally on a fairly large number of circuits. The verification was carried out in harsh climatic and seismic conditions too.

The first phase is called ECPS-I, where basic inherent load sharing was demonstrated. This product was well utilized in very large numbers, in NPCIL power plant control and instrumentation systems, from Kaiga-APP to PHWR-500 TAPP-4. A few of these were employed in the control system of the Dhruva and Apsara reactors up grade along with NAPP & MAPP upgrades. The second phase called ECPS-II had a forced share daisy chain circuit, to allow equal sharing of load current, despite wide differences in the individual voltage settings of each module.

Based on the above experience and feedback from all plant users, a third generation advancement was taken up in June 2006. This new product is now complete and is the third phase product ECPS-III, also called the EC-SMPS Hybrid version. This product is for NPCIL PHWR-700MW reactor control & instrumentation. This module is form-factor compatible with the earlier generations of this product. Therefore it can be replaced wherever ECPS-I or ECPS-II modules are being employed. In this product, only 100W models are

available as against 100W (size 20T) and 60W (size 16T) products in the earlier module. But the 100W size is reduced to 16T instead of the earlier 20T. In this product, the number of daughter boards is reduced from four to two, by using Hybrid Micro Circuit fabrication process for the alarm and control card. Digital Panel Meter is provided in the front panel of each module, to indicate the sense point voltage or

unit delivery current. The push button switch to select these display modes is also provided in the front panel. The sense voltage adjustment trim-pot is provided in the front panel as against side adjustments in the earlier versions. Detailed third party tests were carried out and following is the summary of test results as specifications of the ECPS-III models.

Specifications of EC-SMPS Hybrid version	
Input	240V AC +/-10%,50Hz single phase long term variation 240V AC, -30%, for duration of 20mS.
DC Output Model No. ECPS-SM100(05100) ECPS-SM100(12100) ECPS-SM100(15100) ECPS-SM100(24100)	5V, 20A 12V, 8.3A 15V, 6.6A 24V, 4.2A
Output Voltage Tolerance	+/-1%
Load Regulation	0.1% to 0.6% typical 1% maximum
Line Regulation	0.1% typical 0.5% maximum
Ripple + Noise	1% typical 2% max. (Measuring with 20MHz scope)
Temperature Coefficient	0.2%/°C typical 0.5%/°C maximum
Threshold Current	120% (approximate)
Short Circuit/Over Voltage Protection	Fixed & factory set at approximately 115% is reset by interrupting the input for a short duration
Drift	0.2% typical for 8 hours, 0.5% maximum
Transient Response	Less than 5mS for a step change of 50% to 100% of rated load value
Efficiency	Greater than 65%
Hold up time	10mS at 216 V AC typical, 20mS maximum
Insulation Resistance	100 M Ohm minimum at 100V DC
Power Indication	AC ON and DC ON indications by LED on front panel and power ON switch at rear panel
Fuse Protection	Provided at rear panel



DR. HOMI BHABHA CENTENARY YEAR

Input/Output connections	Through 48 pin F-EURO connector solder type socket, online hot plug in type test Jacks provided on front panel for measuring DC sense point output
Paralleling/Load Sharing	Multiple units can be paralleled for load sharing
Operating Condition	0-55°C, RH 55% to 85%
Storage Temperature	-25 to 55°C
Dielectric Strength	1.5KV for 1 minute between input terminals and ground and 500V DC between output terminal and ground
Shock & vibration	Conforms to IEEE 344 Frequency 1Hz to 33Hz Acceleration 3.5g in X, Y, Z axis
EMI Compatibility	Conforms to MIL-STD-461/462 (MIL STD-CS-01/CS-02/CS-06)
Climatic	Conforms to IS 9000 Part II & IV Dry Heat: 55°C RH 50% for 4 hours Damp Heat: 40°C(+/-2°C) at 90% RH to 25°C(+/-5°C) at 98% RH
Output Monitoring	DPM provided for Voltage/Current readout with selector switch at front panel
Voltage Adjustment	Trim-pot provided at front panel
Dimensions	3U(H)X16T(W)X220mm(D)
Mounting	Bin mounted on 19" standard 3UX84TX320mm EURO bin
Operational Features	Mother Board facilitates input/output through terminal block (screw type) provided on separate PCB, one mother board required for one SMPS unit

Following are the figures of the ECPS-III and ECPS-II during prototyping product development and testing and figure of the final product EC-SMPS Hybrid Version.



ECPS-III 100W prototyping product development & testing (2006-2007) at ECIL



ECPS-II 100W & 60W testing for Kaiga-3/4 and RAPP 5/6 systems after development (2005-2007) at RCnD



Final product (ECPS-III) EC-SMPS hybrid version for PHWR 700MWe C&I systems (September 2008)

Acknowledgement

We acknowledge the encouragement and guidance given to us by Mr. G. P. Srivastava Dir. E&I Group, BARC (Former CMD, ECIL), Mr. G. Govindarajan (Former Dir. EIG-BARC), Mr. B. B. Biswas, Head of Reactor Control Division BARC and Mr. A. K. Chandra, ED R&D, C&I NPCIL to develop this product for NPCIL PHWR-700MWe control and instrumentation systems. We would also like to thank Mr. P. Sudhakar, Sr. DGM ECIL and Dr. J. Bhattacharya, Sr. DGM ECIL for help in making HMC techniques for this product and for conducting rigorous tests on various C&I systems. Without the motivation of Mr. Krisnamoorthy Manager-ECIL, Mr. Goverdhan, TM ECIL and Mr. M. M. Maiti FM/B Reactor Control Division BARC, the product engineering would not have been completed.

Additional Reading

1. Shantanu Das, B. B. Biswas Proprietary Electronics for Reactor Safety & Controls *Int. J. Nuclear Energy Science & Technology* Vol. 3, No.4, 2007, pp. 358-369, 2008.
2. Shantanu Das, B. B. Biswas, Fault Tolerant Power Supplies for safety significant nuclear I&C, *Int.J.Nuclear Knowledge Management IJNKM-2008*, Vol. 3 ,No.1,pp.59-72 (2008).
3. Shantanu Das, B. B. Biswas, Fault Tolerant Power Supply for safety significant Nuclear I&C, *BARC Newsletter*, April 2006.
4. Shantanu Das, B. B. Biswas, Nuclear Power Plant "Safety Significant" digital instrumentation & controls design based on PSA classification, III international conference on Reliability, Safety Hazard (ICRESH-05-Invited Talk) Mumbai Dec. 2005.
5. Shantanu Das, B. B. Biswas, Care and precaution required for wire and wiring in reactor control and instrumentation systems (experience from KAPP to Kaiga), *BARC Newsletter*, April 2005.
6. Shantanu Das, M. M. Maity, B. B. Biswas, In-house development of complex integrated circuits for Nuclear Reactor Application-a step forward in import substitution, *BARC Newsletter*, September 2005.
7. Shantanu Das, M. B. Patil, D. A. Roy, B. Ganaraj, C. K. Pithawa, B. B. Biswas, Umesh Chandra, P. Sudhakar (ECIL), Microcomputer boards for safety and safety critical systems for nuclear power plants and other high reliable industrial application, *BARC Newsletter*, Nov. 2000.



DR. HOMI BHABHA CENTENARY YEAR

STRESS CORROSION CRACKING STUDIES IN AHWR / BWR SIMULATED ENVIRONMENT

Supratik Roychowdhury, Vivekanand Kain and G. K. Dey
Materials Science Division

A 30kN capacity load cell in an autoclave, (with a recirculation loop) capable of carrying out Stress Corrosion Cracking (SCC) studies in simulated Boiling Water Reactor (BWR) / Advanced Heavy Water Reactor (AHWR) environment, (aqueous phase at temperature 350°C, max and pressure 20 MPa max) and with water chemistry control, has been commissioned in the Corrosion Science Section of the Materials Science Division, BARC. It consists of a recirculation loop with an autoclave and a Slow Strain Rate Test (SSRT) facility. Cylindrical tensile, flat tensile and 0.5T-CT specimen can be tested in this system. Long term experiments like SSRT at low strain rates ($\sim 10^{-7}/s$) and crack growth studies in varying water chemistry conditions can be

done. Direct Current Potential Drop (DCPD) system is used for online crack growth monitoring, for tests carried out in high temperature, high pressure water, and using CT specimens. A Ag/AgCl reference electrode is used in the autoclave, for continuous monitoring of the reference potential. Online monitoring (and proper control) of dissolved oxygen (also when required dissolved hydrogen) and specific conductivity is done in the system. SCC susceptibility and crack growth rates in different austenitic stainless steel grades relevant to AHWR are currently being studied in this facility.

Fig. 1 shows the photograph of the test facility at the Corrosion Science Section, Materials Science Division.



Fig.1: Photograph of the recirculation loop test facility

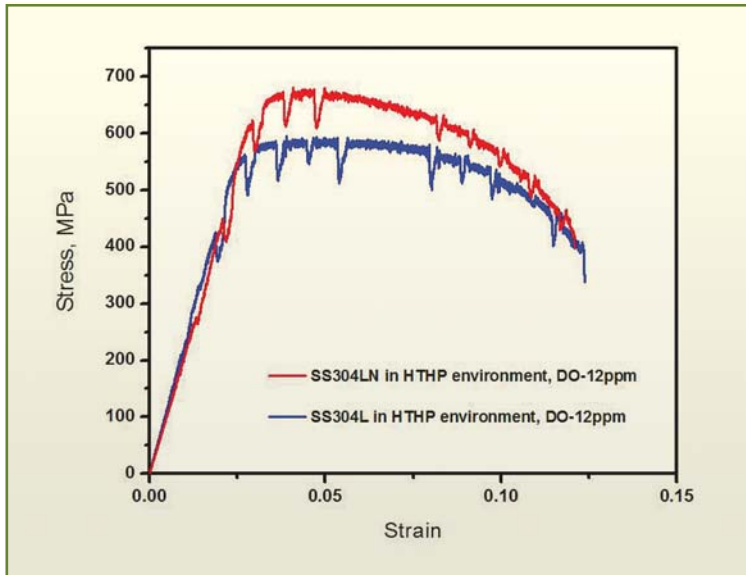


Fig. 2: SSRT results for SS304L and SS304LN in high temperature (288°C) high pressure demineralized water at a dissolved oxygen level of 12ppm

Fig. 3 shows the close control of water chemistry parameters like dissolved oxygen, conductivity over extended period of time. In this experiment, a fatigue pre-cracked 0.5"CT specimen of sensitized SS 304LN was used. Fatigue precracking in the environment was done using controlled triangular waveform and for the stress corrosion crack growth experiment, controlled trapezoidal loading was applied. The electrochemical potential of the specimen, which is the driving force for crack growth, is also continuously recorded with respect to a Ag/AgCl reference electrode. The crack length variation with time, from which the crack growth rate can be calculated

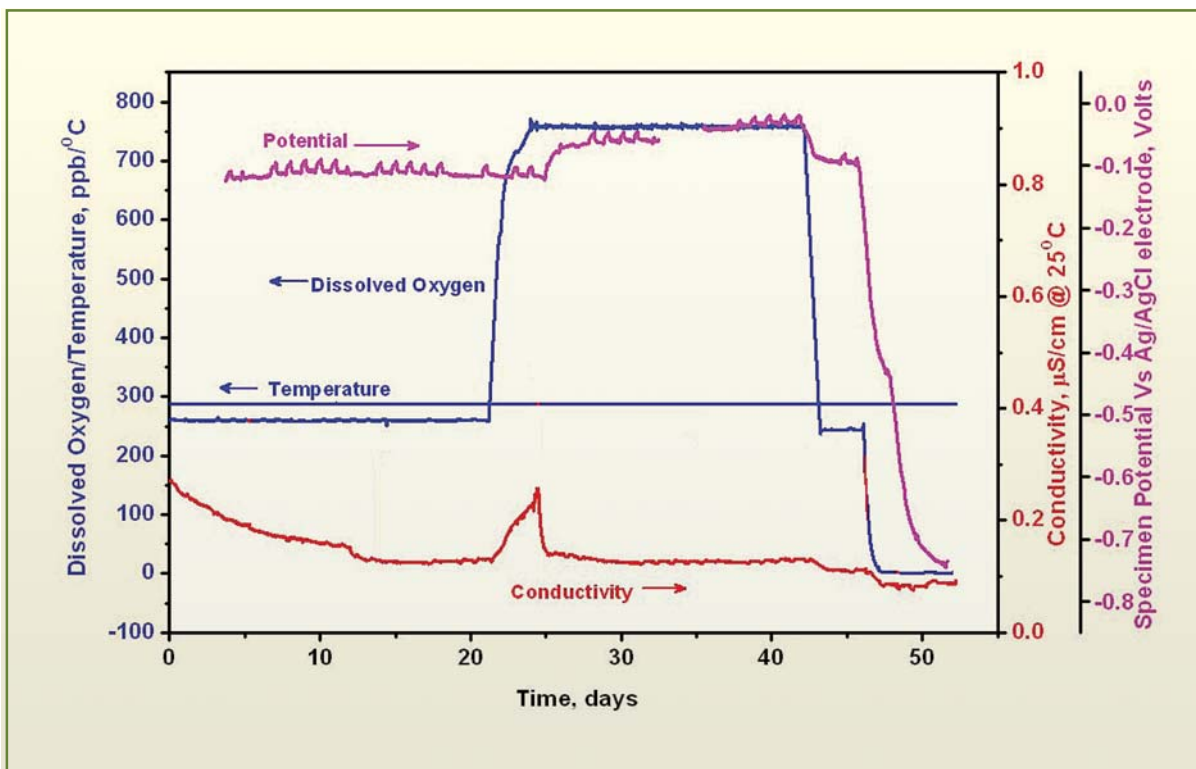


Fig. 3: Variation in the water chemistry parameters for the duration of the test

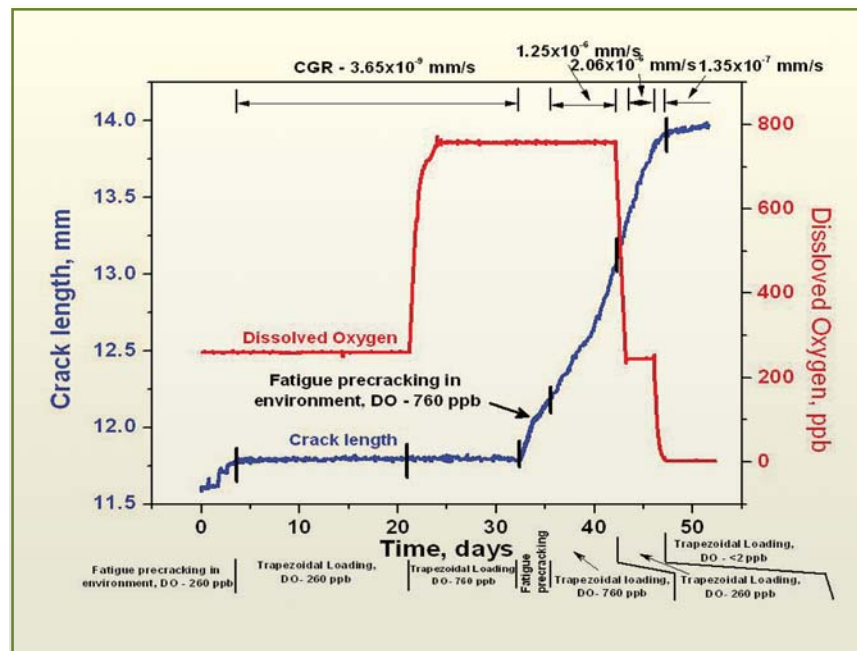


Fig. 4: Variation in the crack length and dissolved oxygen for the duration of the test

for different dissolved oxygen levels, is shown in Fig. 4. The crack growth results shown in this figure are valid in the 'K' range of 25 MPam to 33 MPam. Fig. 4 also clearly illustrates the importance of fatigue precracking in the environment. Initially there was no crack growth after fatigue precracking in the environment for 30 days but the crack subsequently started growing after proper fatigue precracking in the environment. Intergranular nature of the fracture surface can also be seen from the fractographs shown in Fig. 5. Crack growth along the grain boundaries is clearly evident from the fractograph. Fig. 6 shows the crack growth rate obtained in different dissolved oxygen levels and the range of the stress intensity factors in which the data was obtained. It can be clearly seen that improper fatigue pre-cracking leads to very low values of crack growth rate. All the SCC cracking in reactors is always intergranular. Therefore, the test facility set up in BARC has been able to simulate the degradation/SCC that occurs in nuclear reactors. The SCC growth rates measured under different levels of dissolved oxygen, match well with the measured

values reported by other researchers on the world working on operating reactors.

This test facility is now available for generating data on SCC growth rate for different materials to be used in AHWR. Such data would also help establish the susceptibility of different stainless steels to SCC under operating parameters of AHWR and in establishing its operation life. The Corrosion Science Section, Materials Science Division, BARC has rich experience in operating static autoclaves and recirculation loops, that simulate/accelerate the reactor operation conditions, SCC testing in reactor operating conditions for different materials (stainless steels, nickel-based alloys and Zr based alloys) and studies on oxidation behaviour and hydrogen pick up behaviour by different Zr-based alloys, under reactor conditions. Preliminary studies on the effect of partial boiling on oxidation and hydrogen pick up behaviour by different Zr-based alloys, have also been initiated. Other studies in this research group include, simulation of irradiation damage of austenitic stainless steels (Radiation-Induced

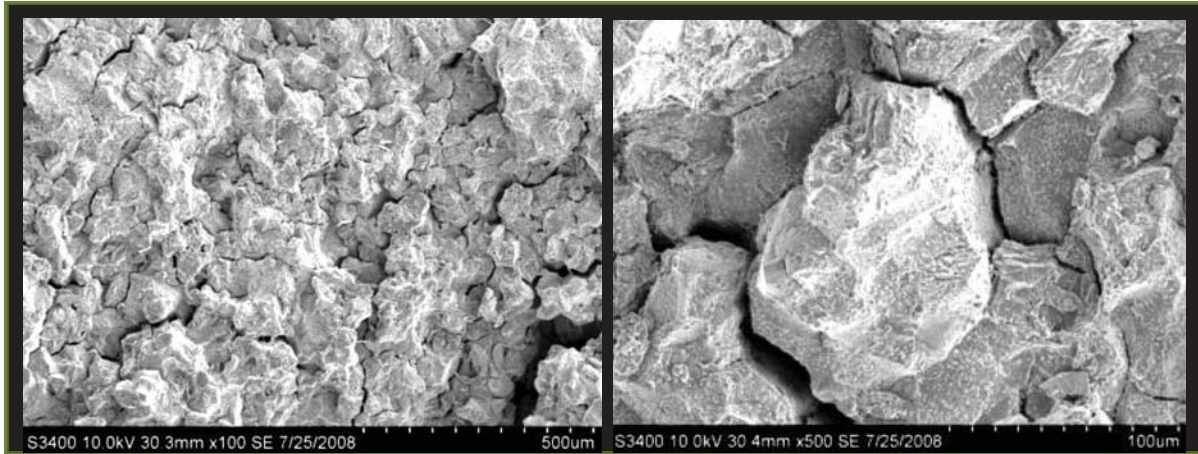


Fig. 5: Fracture surface showing complete intergranular nature of the crack in the environment a) at a lower magnification, b) higher magnification showing a single grain

Segregation) and its correlation to Irradiation-Assisted Stress Corrosion Cracking (IASCC), Low Temperature Embrittlement (LTE) studies of the welds of austenitic stainless steels and development of electrochemical techniques, that can also be used as *in-situ* and on-site techniques for early detection of embrittlement in welds in reactors, during shutdown. There are especially important for reactors with a long design life and life extension of existing reactors. SCC studies at low temperatures (ambient temperature and temperatures below 100°C) for austenitic stainless steels are being carried out.

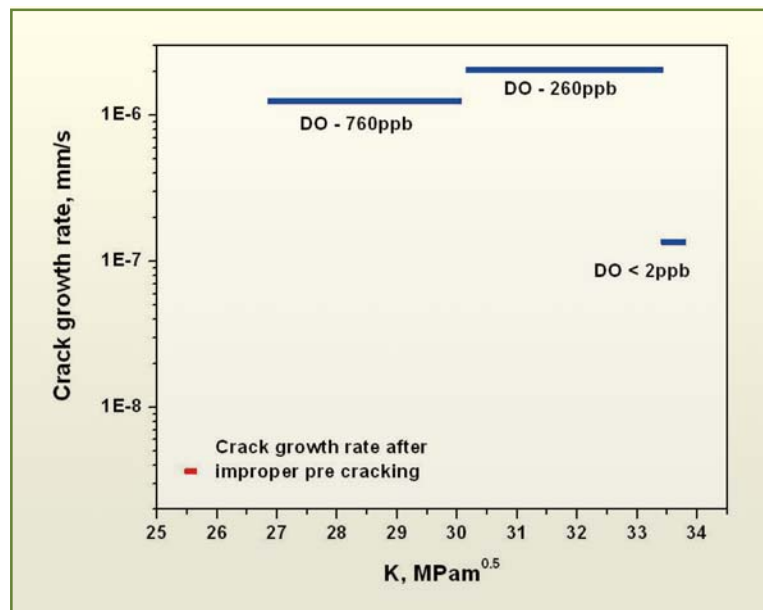


Fig. 6: Crack growth rate as a function of the stress intensity factor at different dissolved oxygen levels for SS 304L at 288°C, demineralized water.



DEVELOPMENT OF REMOTELY OPERATED TOOLS TO DISMANTLE AND RECONSTITUTE ACTIVE SPENT FUEL OF TAPS-1&2 FOR POST-IRRADIATION EXAMINATION

Chandan Dey and Manjit Singh
Division of Remote Handling & Robotics

Introduction

The two Boiling Water Reactors (2 x 160 MWe) in India are located at Tarapur and are in operation since 1969. These reactors use light enriched uranium oxide as fuel and Zircaloy-2 material as fuel clad. The fuel pins are arranged in a square matrix (6 x 6) and use differential enrichment from reactor physics design considerations. Spent fuel assemblies are stored under-water from shielding considerations. It was felt necessary to develop a set of remotely operated tools, to dismantle and reconstitute fuel assemblies, for the Purpose of Post-Irradiation Examination (PIE). This will provide information about its metallurgical and mechanical behaviour during active cycles, viz. Fuel pellet behaviour, pellet-clad interaction, clad integrity, etc.

The Division of Remote Handling and Robotics (DRHR), BARC, has developed a set of remotely operated tools for handling, inspection, dismantle and reconstitution of fuel assemblies for TAPS -1 & 2.

Fuel Assembly

The fuel assembly of TAPS -1 & 2 consists of 36 fuel rods arranged in a 6 x 6 square matrix with different grades of enrichment. All the fuel rods in an assembly are dimensionally identical, however, their end cap details vary from one position to the other. Out of the 36 fuel rods, eight fuel rods have threaded joint at both the ends. The length of the fuel assembly is about 3.5 meters and it is fastened at both the ends with

a tie plate. There are seven spacers, placed equidistant from each other which are used to maintain the gap and integrity of the fuel pins in the matrix. Spacers are supported by one of the fuel rods named as 'Spacer Capture Rod'.

The fuel bundle assembly consists of the following parts:

- Twenty seven basic fuel rods
- Eight tie rod fuel rods
- One segmented fuel rod (Spacer capture rod)
- One top tie plate
- One bottom tie plate
- Seven spacers along the length of the fuel assembly
- Thirty six expansion springs
- Four locking tab washers
- Four hexagonal nuts of size 5/16"
- Four hexagonal nuts of size 1/4"

A typical fuel assembly is shown in Fig. 1.

Development of remote handling tools: Design Challenges

As the spent fuel is highly radioactive, it is required to be handled under-water, at a minimum depth of about three meters. from shielding considerations. Since the handling operation is carried out inside the water pool, design of a remote operated tool must ensure, that any of its components or that of the fuel assembly should not fall into the pool. This necessitates firm gripping of loose parts by the tools. Construction of the fuel assembly is quite compact and complex,

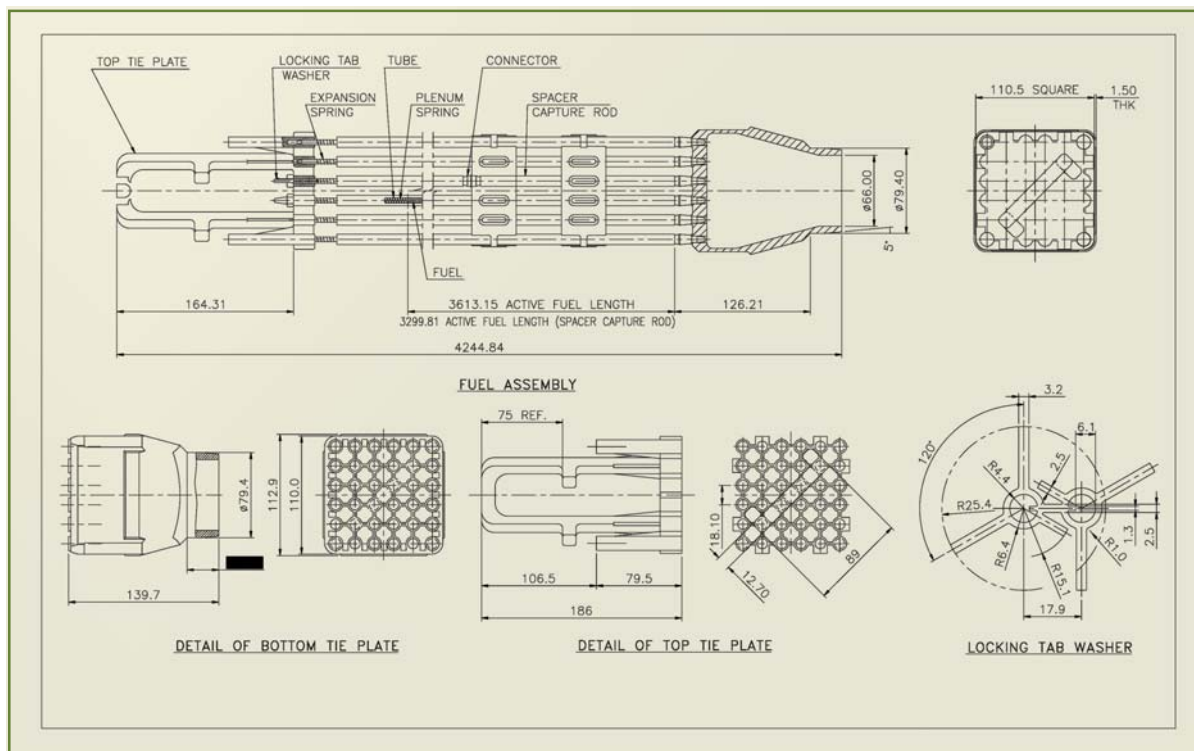


Fig. 1: TAPS Fuel Assembly

which includes lock tab washer, hexagonal nut, expansion springs and top tie plate. Being a compact assembly, handling of any of these components poses additional problem of similar components in close proximity. In other words, space constraints form a major design challenge in this development work. Additionally, while handling the components, ensuring firm gripping, the design should also ensure that components do not get damaged (like excessive gripping of the components - expansion spring, fuel pin, etc.).

Dismantling of Fuel Assembly; Sequence of Operations

- Fuel assembly (vertical) under testing, is shifted onto the carriage (using a grapples operated with the help of electrically operated overhead crane). Carriage location inside the pool is fixed.
- Carriage (electrically-operated) is lifted upward,

so that the fuel assembly top is lifted to a water depth of about three meters., which is required for shielding purposes.

- Locking tab washer is flattened (Tool-1 and 1-A).
- Hexagonal nut is unscrewed (Tool-2).
- Locking tab washer is removed (Tool-3).
- Top tie plate is removed (Tool-4).
- Individual fuel rod expansion spring is removed (Tool-5).
- Fuel rods (27) are removed (Tool-5), except 8 tie rods and one spacer capture rod.

During reconstitution of the fuel assembly the same set of operations are carried out in the reverse order.

It may be noted that during fuel dismantling, loose parts like tab washer, hexagonal nut, top tie plate, expansion spring, etc. are stored under-water.



Description of Remotely Operated Tools

As mentioned above, the desired fuel assembly is lifted upward, using the carriage, providing three meters water depth from the top of the fuel assembly. This requires a tool length of more than three mtrs. Taking that into consideration, the length of all the tools is kept approximately four meters, so that these tools can be operated with ease.

Aluminium pipes are used as extensions for all the tools. Total weight of each tool is restricted to a maximum of 8 kgs. for ease of handling. The various tools used for carrying out the various operations are described below:

Locking tab washer flattening tool (Tool-1 and 1-A)

There are a total of four locking tab washers (Fig. 1) in the TAPS-1&2 fuel assembly. Washer is used to prevent unscrewing of fasteners and also to prevent rotation of fuel rods during flow induced vibration. The washer is flattened to access the hexagonal nut on the tie rods, before unscrewing the fasteners. There are three spring-loaded jaws mounted at the tip of the tool. Two concentric extension pipes (Aluminium) are used, to operate this tool. Normally these jaws remain in closed condition. When the inner pipe is pushed inside, all the three jaws open, subsequently the lock tab washer gets flattened. It is to be ensured that the three jaws are aligned with the tab washer faces. In case of any mismatch, the tool is slightly twisted to rectify this situation. After the tab washer faces are flared, these are flattened using another tool (Tool-1A), having a conical end with a hole of about 4 mm diameter.

Hexagonal nut removing tool (Tool-2)

The fuel assembly has eight hexagonal nuts (four of 5/16" UNC-4 and four of 1/4" UNC-4). These are unscrewed using this tool. The tip of this tool has a matching hexagonal socket, with leaf spring loaded balls on three of its faces. This arrangement holds the

nut in position (in the hexagonal socket of the tool), so that it does not fall, after it is completely unscrewed. Due to space constraints, it was a real design challenge to accommodate spring-loaded balls in the socket. The hexagonal nut is taken out of the socket gripper, by pushing a plunger into it. Loose fasteners are stored under-water. This operation consists of two sets of tools with different hexagonal sockets to suit different screw sizes.

Locking tab washer gripper (Tool-3)

The lock tab washer (Fig. 1) is removed from the assembly before handling of 'top tie plate'. Standard nose plier is used, for gripping the tab washer. Plier is fixed to one end of the pipe at an angle of 90°. Torsion spring is used to keep both the jaws open. Wire rope and screw nut arrangement is used, to actuate the plier from the top end of the extension pipe. This arrangement ensures firm gripping of the washer. The loose parts are stored under-water.

Top tie plate gripper (Tool-4)

After removing all the tab washers, the top tie plate is removed. The top tie plate is shown in Fig. 1. It has a reverse 'U' shaped handle and square cross section. This feature was utilized while designing the tool, the tool has two fixed jaws and a vertical slot is provided on either side. The top tie plate handle is inserted through the slots of gripper jaws and it is held by the gripper.

After holding, the top plate is locked with the gripper before removing it from the fuel assembly. Concentric pipes are used for locking the top tie plate. It ensures that the top tie plate does not fall in the pool while handling by the gripper. After taking it to the desired location, the gripper is unlocked and the top tie plate is stored under water.

Fuel rod / Expansion spring gripper (Tool-5)

After removing the top tie plate, the expansion spring

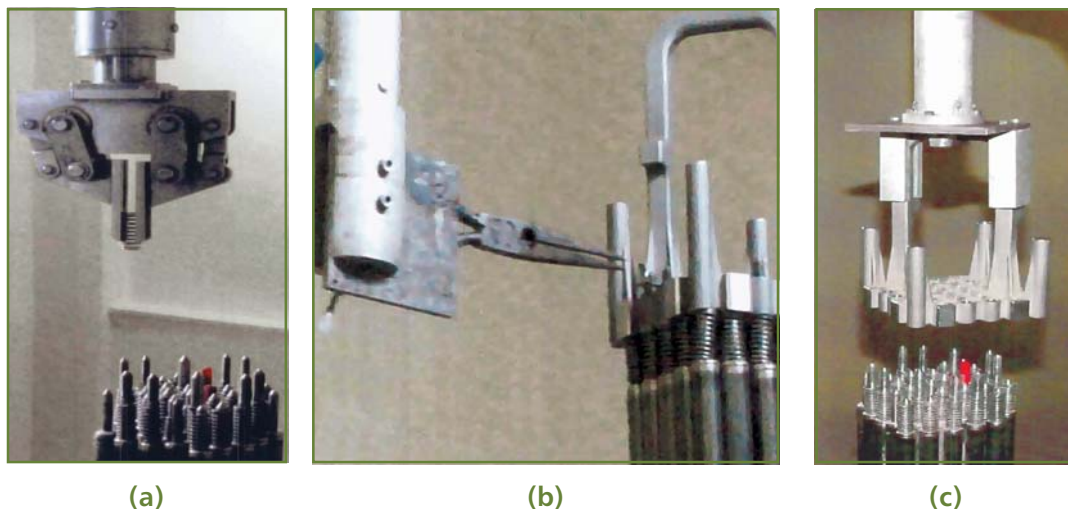


Fig. 2: (a) Expansion Spring Gripper (b) Lock Tab Washer Gripper (c) Top Tie Plate Gripper

and the fuel rod at desired location are required to be removed. In case of requirement of dismantling of the entire fuel assembly, springs at all the locations (27 locations) are removed using this tool.

This tool is designed with 'V' jaws, to grip the expansion spring as well as fuel rod, since both the objects are cylindrical. V-jaw design provides four point contacts, requiring less gripping force. Compact jaw is designed to operate within the available space (gap between two springs is about 3 mm) without interfering with the adjacent components. Tool jaws are moved using four bar mechanism through links, rack and pinion and the screw and nut arrangement. This design provides self-locking feature.

Testing Trials

It is emphasized here that the tool design has evolved through successive testing trials. A full-scale dry mock-up facility was erected, using an inactive fuel assembly at BARC. Functioning of all the tools was successfully demonstrated. These are now, ready for final testing trials at site.

Conclusion

Successful testing of the tools using dry mock-up facility, has established the purpose of this development work. After dismantling of the fuel assembly, the fuel rod could be subjected to post-irradiation examination inside the hot cell. It is envisaged that this experience of design of remote-operated tools could also be extended to advanced upcoming reactors in India, like the Advanced Heavy Water Reactor (AHWR).

Acknowledgements

The authors are thankful to Head, PIED, BARC and engineers from PIED, BARC & NPCIL, for various technical discussions and continued support.

Additional Reading

1. Fuel Design Data, *Nuclear Engineering International*, Sept. 2004, P26-35.
2. C. Ganguly, "Manufacturing of Fuels for Water-Cooled Nuclear Power Reactors at NFC", *Nu-Power (An International Journal of Nuclear Power)*, Vol. 14, No. 4 (2000), P12-16.



DR. HOMI BHABHA CENTENARY YEAR

GRADUATION FUNCTION OF THE BARC TRAINING SCHOOL

Scientists & Engineers (127) of the Orientation Course for Engineering Graduates & Science Post-Graduates (OCES) and Fellows (15) of the Orientation Course for DAE Graduate Fellowship Scheme (DGFS) entered the main stream of the atomic energy programme in the country, after undergoing orientation courses and successfully graduating from the BARC Training School. The 51st Graduation Function to confer the Homi Bhabha Medals to the toppers and distribute the graduation certificates was held on August 25, 2008 at Central Complex Auditorium, BARC, Trombay, Mumbai.

The Chief Guest for this function was Dr. R.K. Pachauri, Chairman, Intergovernmental Panel on Climate Change & Director General, The Energy and Resources Institute. He gave away Homi Bhabha Medals to the toppers of

the respective disciplines. In his address to the gathering of students and eminent scientists, he mentioned the role that BARC has played in the technological progress made by the country and stated that nuclear energy has assumed great importance in the energy scenario, in view of its clean energy status. He congratulated the graduates for having been provided the foundation for an illuminating career ahead of them. Emphasising the importance of retaining the spirit of learning, he said "Scholarship and the acquisition of knowledge have to be accompanied by a certain level of humility, because it is in the nature of knowledge that its acquisition can only go to those who are humble. The moment you believe that you have acquired high level of knowledge, learning stops". He went on to make a lucid presentation on "Climate Change and the role of



At the Inauguration function (from left to right) : Dr. R.R. Puri, Head, HRDD; Dr. Vijai Kumar, Associate Director, KMG & Head, SIRD; Dr. Anil Kakodkar, Chairman AEC; Dr. R.K. Pachauri, the Chief Guest; Dr. Srikumar Banerjee, Director BARC and Dr. R.B. Grover, Director, KMG.

Nuclear Energy". Warning about global warming and its impact on the climate system, he called for adopting strong measures to mitigate these changes and preserve the planet for future generations. He opined that there is a need to give fair chance to nuclear energy also to help in meeting these objectives.

Dr. Anil Kakodkar, Chairman, AEC in his Presidential Address to the graduating officers said that world over, people have recognized our capability for designing and building nuclear power reactors, conforming to international standards entirely from indigenous inputs. He added that India being amongst the first few countries in the world to have gained competence in fast reactor technology was a matter of pride and that this technology would place the country in an advantageous position in thorium utilization, which would be a larger energy source as compared to uranium in times to come.

Dr. S. Banerjee, Director, BARC said that the Training School is a unique teaching academy and the knowledge gained during the year helps the young graduates all through their careers. He further added that the purpose of training was to gain a wide perspective of the programmes of the Department and master key areas in one's own discipline.

Welcoming the gathering, Dr. R.B. Grover, Director, Knowledge Management Group said that the Training School was set up to meet the increasing demands of



Dr. R.K. Pachauri speaking at the inaugural function

manpower, required to man the programmes of the Department of Atomic Energy. The setting up of the Homi Bhabha National Institute (HBNI), a Deemed-to-be University, provided an opportunity to the Scientific Officers not only to improve their academic qualifications but also enhance research and technology output for the Department.

Dr. R.R. Puri, Head, Human Resource Development Division said that the new batch of Training School Graduates would strive to implement the mandate of DAE, which is, to use nuclear energy in all its aspects for the economic upliftment and security of the country.

Dr. Vijai Kumar, Associate Director, Knowledge Management Group and Head, Scientific Information Resource Division proposed the vote of thanks.



DR. HOMI BHABHA CENTENARY YEAR

HMT AND BARC SIGN MoU FOR MANUFACTURE OF 8-KG PAYLOAD ARTICULATED MANIPULATORS

In a small ceremony in BARC on October 10, 2008, Dr. Srikumar Banerjee, Director BARC and Mr. A.V. Kamat, Chairman HMT Limited, signed a Memorandum of Understanding for the manufacture of 60 arms of 8-Kg Payload Articulated Manipulators. Under the terms of this MoU, such manipulators will be manufactured in HMT's machine tool factory at Bengaluru, over the next 18 months, for installation in Laboratory Hot Cells of Reprocessing, Waste Management and other Radiochemical Facilities. Based on a prototype jointly developed by BARC and HMT, the manipulator is equipped with the most advanced features for remote-handling in its category. With light weight ergonomic construction, extended reach and

perfect balance in all positions and with no electrical indexing, the manipulator will be very useful and friendly to the operators.

Senior officials from HMT and BARC attended the ceremony in the office of Director BARC. Welcoming the guests on the occasion, Mr. R.K. Gupta, Head, HCD&ES described the phases of development, manufacture and extensive testing of the manipulator prototype. Mr. Gupta also made a brief audio-visual presentation depicting the various functional capabilities of the manipulator. Director BARC, in his address, praised the efforts of BARC and HMT engineers and laid emphasis on enhancing the scope of such



At the exchange of MoU documents from (L-R) Mr. N.K. Sharma, Mr. Hemchandra Babu, Mr. R. Venkatesh, Mr. A.V. Kamat, Chairman HMT, Mr. N. Kale, Mr. A.K. Mudaiya and Dr. Srikumar Banerjee, Director, BARC



From (L-R) Mr. Ravikantha, Mr. Hemchandra Babu, M.D. HMT Ltd., Mr. A.V. Kamat, Chairman HMT and Dr. Srikumar Banerjee, Director, BARC addressing the gathering

developmental efforts. The Director also requested HMT to take up collaborative ventures in newer areas, for greater involvement in future. Speaking on the occasion, Mr. A.V. Kamat, Chairman, HMT Limited, narrated the various works HMT has taken up and completed for BARC in the last 10-12 years. Expressing his gratitude to Director BARC, Mr. Kamat reiterated his company's willingness for continued collaboration in future.

HMT officials present on the occasion were Mr. V. Hemachandra Babu, Managing Director, Mr. S.C. Gupta, General Manager Marketing, Mr. Ravikant, Factory General Manager, Mr. N.K. Sharma Divisional Manager Sales and Mr. R. Venkatesan, Divisional Manager Marketing.

Senior officers from BARC included Mr. G.P. Shrivastava, Director, E&I Group, Dr. Manjeet Singh, Associate Director DMAG, Dr. L.M. Gantayet Associate Director BTMG, Mr. Sekhar Basu, Associate Director NRG, Mr. A. Ramaiah, IFA, BARC, Mr. Kanwar Raj, Head WMD, Dr. G. Singh, Head IAD, Mr. S. Anantharaman, Head PIED, Mr. K.N.S. Nair CDE (ME-S), NRG Mr. S.D. Dhodapkar, E&I Group, Mr. K.K. Abdulla, AFD and Mr. V.A. Sathyaranjan, IAD. Other officers from Nuclear Recycle Group, present on the occasion were Mr. K. Banerjee, Mr. R.G. Yeotikar, Mr. K.M. Singh, Mr. A.K. Mudaiya, Mr. S.B. Patil and Ms. Jyoti Jha. The ceremony concluded with a vote of thanks proposed by Mr. R.K. Gupta and presentation of mementoes to HMT officials by Mr. Sekhar Basu, Associate Director, NRG.



DR. HOMI BHABHA CENTENARY YEAR

SYMPOSIUM ON LANDSCAPING FOR SUSTAINABLE ENVIRONMENT (LSE)

With full financial support of DAE /BRNS, the Homi Bhabha Centenary National Symposium on Landscaping for Sustainable Environment, was organized for the first time by the Landscape & Cosmetic Maintenance Section, BARC, in association with the Bougainvillea Society of India, Indian Agricultural Research Institute, New Delhi, at the Multipurpose Hall, Training School Hostel, Anushaktinagar, Mumbai, on 20 and 21 November, 2008.

The Chief guest Dr. Rakesh Tuli, Director, National Botanical Research Institute, Lucknow inaugurated the symposium. He recalled the contribution of Dr. Salim Ali in creating awareness about preserving the environment and biodiversity.

He referred to the landscape in Anushaktinagar, the residential colony of BARC, as an oasis. This vast expanse is dotted with a large number of trees which are oxygen generators and the lungs of our society.

He spoke about the development of landscapes. He said that for sustainable environment about 30 percent of the area should have forest cover and the choice of trees to be planted should be based on scientific study, involving water and nutrient utilization. Thus knowledge-based landscaping should be carried out conserving biodiversity.

He referred to the contribution of the National Botanical Research Institute, in developing the landscape in Kanpur, the leather belt, where plants are used for reducing heavy metals from water bodies.

Earlier Dr. V. K. Verma, Deputy Director General (Horticulture), CPWD and Acting President, Bougainvillea Society of India, New Delhi, highlighted the need to utilize waste land by planting ornamental plants for picturesque views. He added that bougainvillea bedecks the environment like a bride twice in a year when it blossoms.

Welcoming the audience, Mr. N. D. Sharma, Controller, BARC informed that 2,000 acres of space was created by Dr. H. J. Bhabha, a great lover of flora and fauna. Dr. Bhabha's love for nature was evident from the fact that in 1958, he set up a garden committee to develop and preserve the biodiversity of the region. Due to



Inaugural address by the Chief Guest Dr. Rakesh Tuli, Director, National Botanical Research Institute, Lucknow

the forest cover on BARC hills, the temperature drops leading to lesser energy requirements for air conditioners. Presently BARC has 100 acres of landscaped gardens.

Finally, Mr. T.S. Verma, Head, Landscape and Cosmetic Maintenance Section, BARC and Convener, Organizing committee, gave the vote of thanks. Mr. Verma presented the work of landscaping and afforestation carried out in BARC, since the inception of the section including development of polyhouses for roses and



Vote of thanks by Mr. T.S. Verma, Head, Landscape and Cosmetic Maintenance Section, BARC



Mr. N. D. Sharma, Controller, BARC, welcoming the audience

gerbera plants for cut flowers, through a slide show to the delegates of the symposium.

Dr. S. Banerjee, Director, BARC, graced the symposium in the afternoon session on 20.11.08 despite his busy schedule in the morning, which shows his affinity and love for nature like Dr. Homi .J. Bhabha and the proposal for organizing the landscaping symposium was also approved by him. Dr. Banerjee spoke in the symposium about landscape gardens designed and developed by terracing the topography of the land into terraces from Engineering Halls to the RLG side.

The symposium was attended by 118 delegates from various horticultural/ landscape institutes/ organizations. The role of different categories of landscaping in creating pleasing, functional and sustainable total living environment was emphasized, including the role of housekeeping in offices /houses and other establishments.

The symposium provided for the first time, the best forum of landscape and horticultural professionals from all over India and they all benefited mutually discussing various topics on landscaping. The delegates were highly pleased to behold the natural and man-made landscapes of BARC campus and Dhruva reactor. They also appreciated the steps taken by L&CM section, BARC, for organizing the 1st National Symposium on Landscaping and arrangements provided to them during the period of the symposium. Mr. N.D. Sharma, Controller, BARC, gave away the certificates for oral and poster presentations and also for participation to the delegates during concluding session held in the CC briefing room of the Central Complex on the 21st of Nov. 2008.

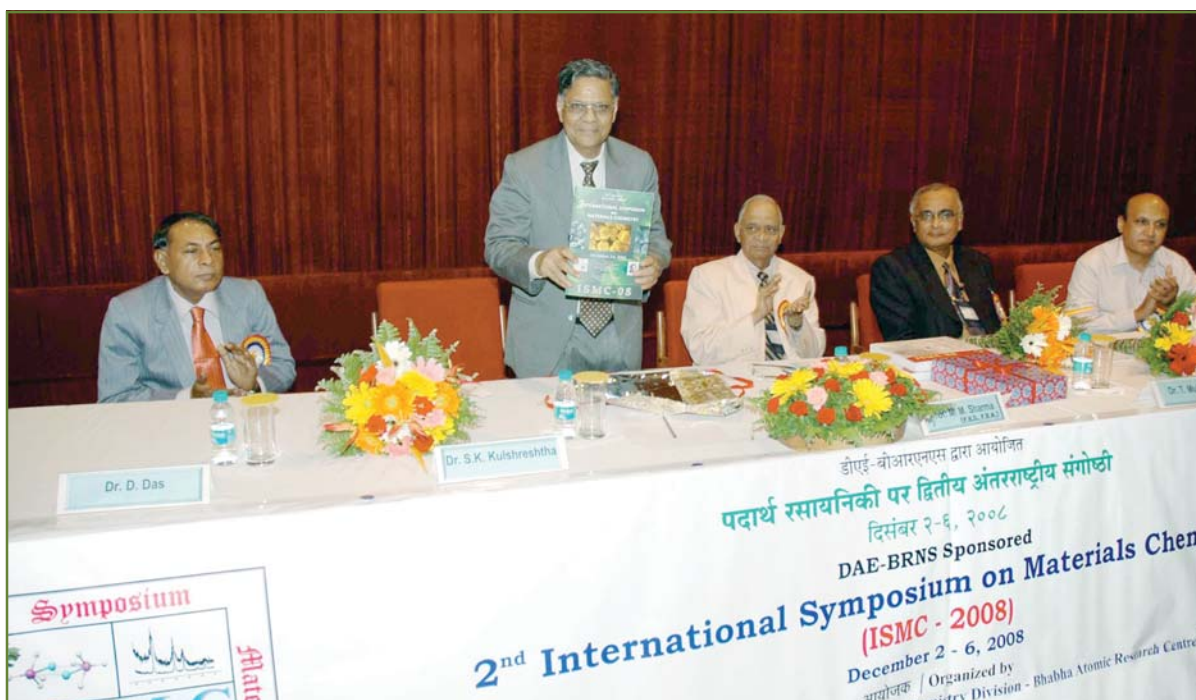


DR. HOMI BHABHA CENTENARY YEAR

2ND DAE-BRNS INTERNATIONAL SYMPOSIUM ON MATERIALS CHEMISTRY (ISMIC-2008)

The 2nd DAE-BRNS sponsored International Symposium on Materials Chemistry (ISMIC-2008) organized by the Society for Materials Chemistry and Chemistry Division was held at BARC during 2-6 December, 2008. There has been an overwhelming response from participants, both from India and abroad, despite disruption in normal life in Mumbai by terrorists. There were 36 invited talks and more than 350 contributed papers covering frontline research in diverse areas of Materials Science. The symposium covered topics such as Nuclear Materials, Fuel Cell Materials, Thin

film devices and Sensors, Hydrogen storage materials, Magnetic materials, Catalysts, Polymers and Nano materials. The deliberations were focused on materials research programmes for harnessing power from nuclear fission, fossil fuels, hydrogen and other sources. The development of new technologies based on nanomaterials for the above applications were discussed at large. Eminent Scientist Prof. M. M. Sharma (Padma Bhushan), in his inaugural address, highlighted the importance of Materials Science in emerging technologies to improve the quality of life



On the dais from left to right: Dr. D. Das, Head, Chemistry Division, BARC, Dr. S.K. Kulshreshtha, Chairman, AEES, Prof. M. M. Sharma (Padma Bhushan) Eminent Scientist, Dr. T. Mukherjee, Director, Chemistry Group, BARC, Dr. V.K. Jain, Head, Synthesis and Pure Materials Section, Chemistry Division, BARC

in developing countries. Dr. R. Chidambaram, Principal Scientific Advisor to the Government of India emphasized the need for directed basic research and innovations in R&D sector for the upliftment of common man. Dr. S. Banerjee, Director BARC delivered a special lecture on phase transformations in alloy systems relevant to nuclear technologies. Dr. T. Mukherjee, Director, Chemistry Group, in his welcome address, highlighted the various R&D activities being undertaken by the Chemistry Division, BARC. Prof. D. Guyomard from the University of de Nantes, CNRS, France discussed the recent developments in improving the storage capacity of Lithium ion batteries. Prof. D. Bahadur of IIT Mumbai focused on the developments in new layered magnetic materials for drug delivery applications. Prof. W. Kaim of University of Stuttgart, Germany discussed about nonlinear optical materials, based on boron containing molecules. Prof. S. D. Mahanti from Michigan State University, USA discussed his recent research on novel thermoelectric materials. Several other scientists from countries like USA, Russia, Sweden, France, Germany and Canada presented their papers in the 5-day long deliberations. About 300 posters were presented during the conference on four consecutive days. On an average, 75 posters were presented from 2nd to 5th December, 2008 and for each day six Best Poster awards were given. Valedictory session on 6th December, 2008 was presided over by Dr. T. Mukherjee, Director, Chemistry Group. Prof. V.I. Bregadze from Russian Academy of Science, Russia conferred the Best Poster Awards to the winners. Many students, invited speakers and other delegates gave their feedback about the event.

NEW PUBLICATION

ADVANCED TECHNIQUES FOR MATERIALS CHARACTERIZATION

Edited by A.K. Tyagi, Mainak Roy, S.K. Kulshreshtha and S. Banerjee. Stafa-Zuerich, Trans tech Publications Ltd, 2009. ISBN 0-87849-379-4

Properties of materials are being investigated by Physicists, Chemists, Biologists and Engineers to solve analytical research problems. For this purpose, the use of appropriate and powerful characterization techniques becomes essential, especially in advanced applications.

The present book is a compilation of various diffraction, spectroscopic and microscopic techniques, spread across twenty chapters. It also covers techniques for compositional characterization and synchrotron radiation. Each chapter deals with a particular technique and is based on the practical experiences of dedicated researchers, who have extensively worked on that technique.

This compilation will be useful both to the student community as well as the researchers.



DR. HOMI BHABHA CENTENARY YEAR

SIXTH SUPERVISORY TRAINING PROGRAMME ON RADIOACTIVE WASTE MANAGEMENT: A REPORT

The supervisory training programme on Radioactive Waste Management is designed and formulated for supervisors, who are associated with waste generation and engaged in waste management and who have either not received any informal training or have not received any training for more than 10 years. In the past, four such training programmes were conducted at BARC, Tarapur. The Fifth Supervisory Training Programme in this series was conducted at the Centralized Waste Management Facility (CWMF), Kalpakkam in 2007. In continuation of this series, the "Sixth Supervisory Training Programme on Radioactive Waste Management" was conducted at BARC, Trombay during Sept. 15-26, 2008. This training programme covered various aspects of radioactive waste management, radiation protection and industrial and fire safety.

A total of 65 participants attended this supervisory training programme belonging to waste management plants/facilities/projects from Trombay, Tarapur and Kalpakkam. Few supervisors from reprocessing plants such as PP, Trombay; KARP, Kalpakkam and PREFRE, Tarapur also attended the course. Apart from these, supervisors from other Divisions of BARC, Trombay, such as ROD, RCD, AFD, ROD, etc. and from NFC, Hyderabad and NPCIL, Rawatbhata associated with radioactive waste management, also attended this course.

During the inaugural programme, on September 15, 2008,

Mr. H. N. Mishra, Training & Qualification Cell, NRG, welcomed the gathering. Mr. R.G. Yeotikar, Officer-in-Charge, Training and organizer of this programme, introduced the syllabus of the programme and explained the importance of the selected subjects. Mr. Mahesh Chander, Plant Superintendent, WMF, Trombay, Mr. R. K. Gupta, Head, Hot Cell Development & Engineering Section, Mr. Kanwar Raj, Head, Waste Management Division, Mr. P.K. Dey, Head, Fuel Reprocessing Division and Mr. S. Basu, Associate Director, Projects, NRG, addressed the trainees and emphasized the importance of training and its usefulness in updating knowledge in various aspects of radioactive waste management. Mr. S. Basu, indicated that we should revise our thinking about waste by treating this as a resourceful material. Vote of thanks was given by Mr. Prahlad Patange, Training & Qualification Cell, NRG.



Mr. R.G.Yeotikar, Officer-in-Charge, Training, NRG, responding to the feedback on the occasion of the valedictory function. Others on the dais from (L-R) are Mr. R. K. Gupta, Head, HCD&ES, Mr. Kanwar Raj, Head, WMD, Mr. S. Basu, Associate Director Projects, NRG and Mr. Mahesh Chander, PS, WMF, Trombay (P-1)

Mr. Kanwar Raj, in his invited talk, presented the philosophy of radioactive waste management. He explained that waste management practices followed in India are safe and reduce the impact on environment and on future generations. He also appealed to the participants to follow simple methods and practices (i) to minimize wastes, (ii) to segregate wastes and (iii) to reuse and recycle waste so that they help waste managers directly or indirectly in reducing the volume of waste and for the safety of environment.

The training programme was carried out by way of classroom lectures, demonstrations and visits to various plant / facilities at Trombay such as Plutonium Plant, Waste Immobilization Plant, RSMS, ETP and Dhruva. The training programme was designed, organized and conducted by Mr. R. G. Yeotikar, Officer-in-Charge, Training, NRG and coordinated by Mr. H. N. Mishra, Training & Qualification Cell, NRG.

Faculty members were invited from all three sites of NRG and from AFD, ROD, IHSS, Hospital, Fire Station, etc. to deliver the lectures. The topics covered were radioactive waste management of different types of waste, matrices for immobilization and their quality assurance, near surface disposal systems, deep

geological disposal – aspects of requirement, concept and status, industrial and fire safety, radiation monitoring, health physics, first aid, ventilation aspects, off-gas cleaning, aspects of remote handling, waste management database - generation, storage and utilization, future projects, instrumentation, plant process flow-sheets of various waste management plants, minimization of waste, etc. Few more subjects such as waste assaying, waste compaction, various remote gadgets, special techniques for generating wealth from waste, cold crucible technology, etc. were also covered.

The Valedictory Function of this training programme was held on September 26, 2008 and was presided over by Mr. S. Basu, Associate Director, Projects, NRG. The other guests of honour were Mr. Kanwar Raj, Head, WMD, Mr. R. K. Gupta, Head, Hot Cell Development & Engineering Section and Mr. Mahesh Chander, Plant Superintendent, WMF, Trombay. During this valedictory function a feed back session was arranged for participants from all the sites. Mr. R. G. Yeotikar, Officer-in-Charge, Training, answered and responded to this feedback. Thereafter certificates were awarded to all the participants.



Participants and dignitaries on the occasion of the Valedictory Function. The dignitaries Mr. Kanwar Raj, Head, WMD, Mr. S. Basu, Associate Director Projects, NRG and Mr. R.G. Yeotikar, Officer-in-Charge, Training, NRG can also be seen.



DR. HOMI BHABHA CENTENARY YEAR

भा.प.अ. केंद्र के वैज्ञानिकों को सम्मान BARC SCIENTISTS HONOURED



Y.V. Nancharaiah

बायोफाउलिंग एवं बायोफिल्म प्रोसेस अनुभाग, जल एवं वाष्प रासायनिकी प्रभाग, रासायनिकी वर्ग, भापअ केंद्र के श्री वाई. वी. नंचारैया का अमेरिकन सोसाइटी फॉर माइक्रोबायोलॉजी (एएसएम) द्वारा सूक्ष्मजैविकी में अंतरराष्ट्रीय प्रोफेसरशिप प्रोग्राम (2009) के अंतर्गत प्रतिष्ठित भारत-यूएस प्रोफेसरशिप (विजिटिंग प्रोफेसर) हेतु चयन किया गया। श्री नंचारैया, भापअ केंद्र प्रशिक्षण विद्यालय के 38 वें बैच से भापअ केंद्र में (जैविकी एवं विकिरण जैविकी विषय) नियुक्त हुए। पृष्ठ संबद्धता एवं ग्रैनुलर बायोफिल्म्स तथा बायोफिल्म आधारित जैवप्रौद्योगिकी अनुप्रयोग उनकी अभिरुचि के क्षेत्र हैं। एएसएम कार्यक्रम के अंतर्गत, वे अटन, न्यूयॉर्क में ब्रूकहैवेन नेशनल लैबोरेटरी में डॉ. ए.जे. फ्रान्सिस के साथ धातुओं/रेडियोन्यूक्लाइडों पर सूक्ष्मजीवी जैवपरिवर्तन पर कार्य करेंगे।

Mr. Y. V. Nancharaiah of Biofouling and Biofilm Processes Section, Water and Steam Chemistry Division, Chemistry Group, BARC was selected by the American Society for Microbiology (ASM) for the prestigious Indo-US Professorship (Visiting Professor) in Microbiology under the International Professorship Programme (2009). Mr. Nancharaiah joined BARC through the 38th Batch of BARC Training School (Biology and Radiobiology stream). His fields of interest are surface-associated and granular biofilms and biofilm-based biotechnological applications. Under the ASM programme, he will work on microbial biotransformation of metals / radionuclides with Dr. A. J. Francis at the Brookhaven National Laboratory in Upton, New York.



Dr. Dimple Dutta

डॉ. डिंपल दत्ता को, उनके रसायन विज्ञान में दिए गए महत्वपूर्ण योगदान के लिए महाराष्ट्र विज्ञान अकादमी के युवा-पदाधिकारी के रूप में चयनित किया गया है। वे प्रशिक्षण विद्यालय के 39वें बैच से हैं तथा उन्होंने आईआईटी कानपुर से एमएससी की उपाधि प्राप्त करने के पश्चात रासायनिकी प्रभाग भापअ केंद्र में कार्यभार ग्रहण किया है। उनकी वर्तमान अनुसंधानिक गतिविधियों का केंद्र चुंबकीय एवं प्रकाशीय अनुप्रयोगों वाले नैनोपदार्थ है। वर्तमान में, वे नवीन ध्वनिक रासायनिक माध्यमों का प्रयोग करके नैनोपदार्थों का संश्लेषण कर रही हैं।

Dr. Dimple Dutta has been elected as a "Young Associate of the Maharashtra Academy of Sciences" for her significant contributions to Chemical Sciences. She is from the 39th Batch of Training School and joined Chemistry Division, BARC after obtaining her M.Sc. from IIT Kanpur. Her present research activities focus on nano materials having magnetic and optical applications. Of late, she has been synthesizing nanomaterials using a novel sonochemical route.



S.K. Saxena

रेडियोभेषज प्रभाग में वैज्ञानिक अधिकारी के पद पर कार्यरत श्री संजय कुमार सक्सेना को राजभाषा कार्यों में किए गए उत्कृष्ट कार्य के प्रदर्शन के मान्यता स्वरूप उन्हें वर्ष 2007-08 के राजभाषा गौरव पुरस्कार -(हिंदी भाषा वर्ग) से सम्मानित किया गया। यह पुरस्कार उन्हें 25 सितंबर, 2008 को हिंदी

दिवस के उपलक्ष्य में आयोजित किए गए एक विशेष समारोह के अवसर पर केंद्र के निदेशक माननीय डॉ. श्रीकुमार बॅनर्जी के कर कमलों द्वारा प्रदान किया गया । श्री सक्सेना ने केंद्र की राजभाषा कार्यान्वयन समिति के सदस्य, रेडियोभेषज प्रभाग के सहायक प्रभागीय राजभाषा अधिकारी, केंद्रीय सचिवालय हिंदी परिषद के सहसचिव तथा केंद्र द्वारा प्रकाशित की जाने वाली पत्रिका संस्कृति के संपादन मंडल के सदस्य की भूमिकाओं को निभाकर केंद्र में चलाए जा रहे राजभाषा कार्यों के प्रति अपने समर्पण एवं निष्ठा का परिचय दिया है ।

Mr. S.K. Saxena of Radiopharmaceuticals Division, has been awarded the Rajbhasha Gaurav Puraskar for the year 2007-2008. This award was presented to him by Dr. S. Banerjee, Director, BARC, on the 25th September 2008, for his dedication and commitment to the promotion of the Official Language. Mr. Saxena is the Joint Secretary of the Kendriya Sachivalaya Hindi Parishad (KSHP), member of the Official Language Implementation Committee and the Assistant Divisional Officer of the official language in his Division. He is also on the Editorial Board of the magazine "Sanskriti" published by KSHP.

संक्षारण विज्ञान अनुभाग, पदार्थ-विज्ञान प्रभाग को सार्वजनिक क्षेत्र में सर्वोत्तम प्रयोगशाला हेतु संक्षारण इंजीनियरों की राष्ट्रीय संस्था (NACE) अंतरराष्ट्रीय गेटवे इंडिया सेक्शन (NIGIS) का "संक्षारण जागरूकता पुरस्कार 2007-08" प्रदान किया गया है । यह पुरस्कार पऊवि की इकाइयों को संक्षारण अनुसंधान, मूल्यांकन/जाँच, पदार्थ चयन एवं विफलता विश्लेषण तथा संक्षारण जागरूकता का प्रचार करने हेतु दिया गया । यह पुरस्कार संक्षारण मूल्यांकन एवं निवारण -2008 पर अंतरराष्ट्रीय कार्यशाला के दौरान शस्त्र प्रौद्योगिकी रक्षा संस्था (DIAT), पुणे में दिनांक 7 नवंबर, 2008 को प्रदान किया गया ।

The Corrosion Science Section, Materials Science Division has been awarded the National Association of Corrosion Engineers (NACE) International Gateway India Section (NIGIS) "Corrosion Awareness Award 2007-08" for the best laboratory in the Public Sector. This award was given in recognition of their meritorious contribution to corrosion research, evaluation / testing, material selection and failure analysis for DAE units and for spreading corrosion awareness. The award was presented on November 7, 2008 at the Defense Institute of Armament Technology (DIAT), Pune, during the International Workshop on Corrosion Evaluation and Mitigation – 2008.



Corrosion Awareness Award 2007-08 for Corrosion Science Section, MSD, BARC



Portrait sketched by Dr. Homi J. Bhabha

Edited & Published by:

Dr. Vijai Kumar, Associate Director,
Knowledge Management Group &

Head, Scientific Information Resource Division,

Bhabha Atomic Research Centre, Trombay, Mumbai 400 085, India.

Editorial Management : Dr. (Ms.) S. C. Deokathey,

Computer Graphics & Layout : N. Kanagaraj, SIRD, BARC

BARC Newsletter is also available at

URL : <http://www.barc.gov.in>