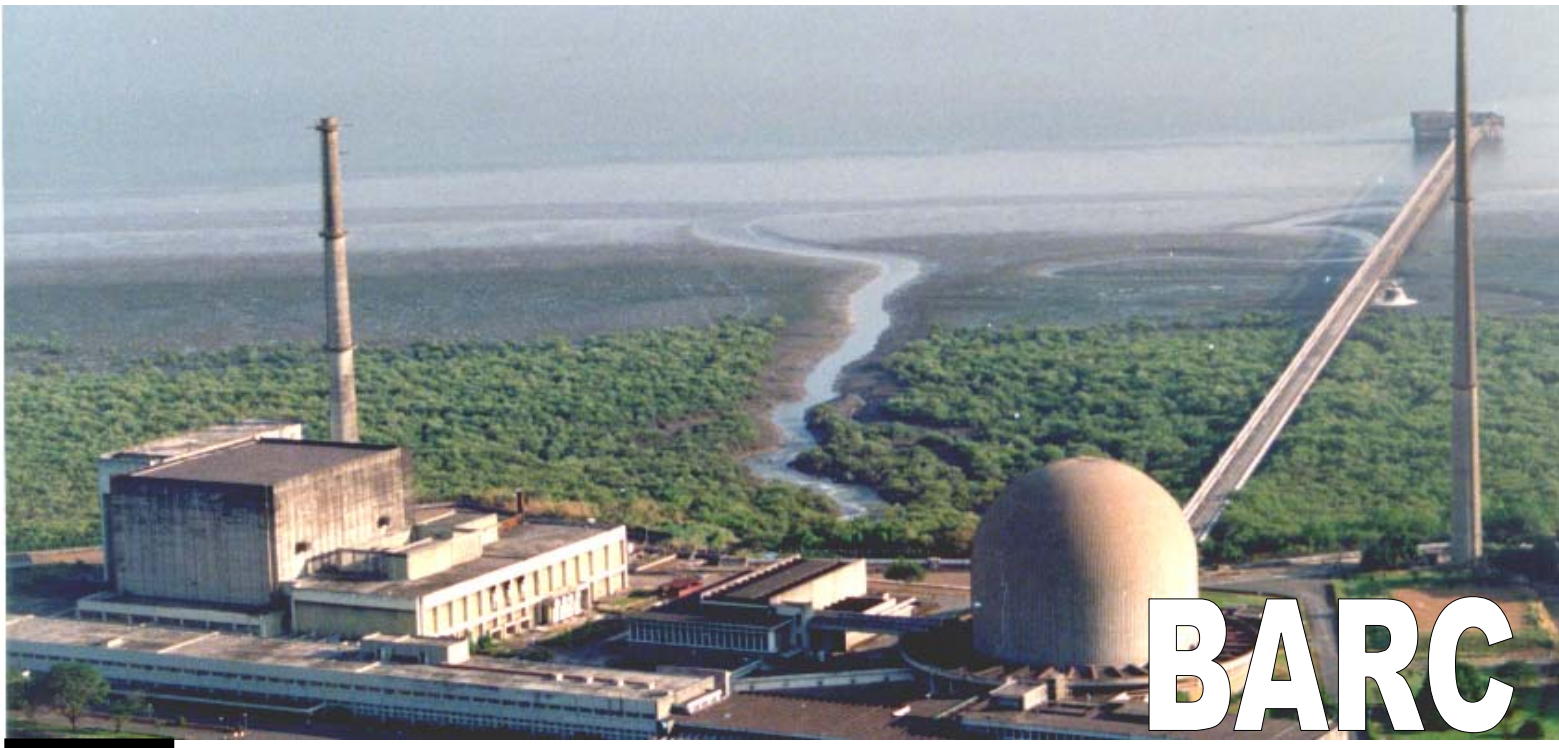

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DEVELOPMENT OF IN-SERVICE INSPECTION SYSTEM FOR EVALUATING THE CONDITION OF CIRUS CALANDRIA TUBES

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and
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Summary

Research reactor Cirus has been in operation since July 1960. Refurbishment of the reactor has been undertaken after carrying out extensive ageing related studies during which condition of various equipments and components were assessed. Assessment of the condition of reactor vessel (calandria) involved analytical evaluation of non-accessible components such as top expansion bellow, remote visual inspection of tube-sheets and calandria, etc. Radiation damage suffered by the calandria, in general, was analysed based on neutron fluence calculations supported by metallurgical evaluation of an irradiated aluminium tube sample with neutron fluence exposure similar to calandria. Assessment of condition of calandria tubes was done based on the results obtained from inspection of calandria tubes carried out by employing a specially developed in-service inspection (ISI) system. This report gives brief details of the work carried out in developing the system for conducting in-service inspection of Cirus calandria tubes.

Introduction

Research Reactor Cirus had a high availability factor of operation (~70%) till the year 1990. After the year 1990, availability factor started showing signs of gradual

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decline due to equipment ageing. A systematic study was then carried out in order to assess the ageing related degradation of various equipments and components. As a part of this ageing study, theoretical assessment of the condition of the top expansion bellow which is non-accessible part of calandria was carried out. Top tube-sheet of the reactor vessel was remote visually inspected using CCD camera and fiberscope. Radiation damage suffered by calandria was assessed based on neutron fluence calculation supplemented by metallurgical evaluation of an irradiated aluminium tube with neutron fluence exposure similar to calandria and also employing plasticine impression technique. An in-house developed system was deployed for conducting inspection of calandria tubes.

Calandria Tubes

Cirus has 199 calandria tubes rolled into the top and bottom tube sheets. Out of these 199 tubes, 186 tubes are of 2 ¼" internal diameter (ID) x 1/16" wall thickness to accommodate fuel rods, six tubes are of 2 ¼" ID x 1/16" wall thickness for accommodating shut off rods, six tubes are of 4" ID to accommodate experimental assemblies, and one 5 $^{5}/_{8}$" ID tube is provided at the center of the calandria for conducting experiments. (Fig. 1)

The calandria and calandria tubes are manufactured from aluminium alloy alcan no. 6056, which is equivalent to aluminium 1S grade having conductivity of 61% IACS (International Annealed Copper Standard). The maximum neutron fluence experienced by calandria tubes is calculated to be 1.6 x 10 ^{22}n/cm^{2}. Operating temperature of calandria is approximately 60^{o}C.

In early 1970, internal surfaces of some selected calandria tubes were visually examined using boroscope. However, after experiencing heavy water leaks in two calandria tubes (one in the year 1971 and another in the year 1994), a need for development of a reliable ISI system was felt

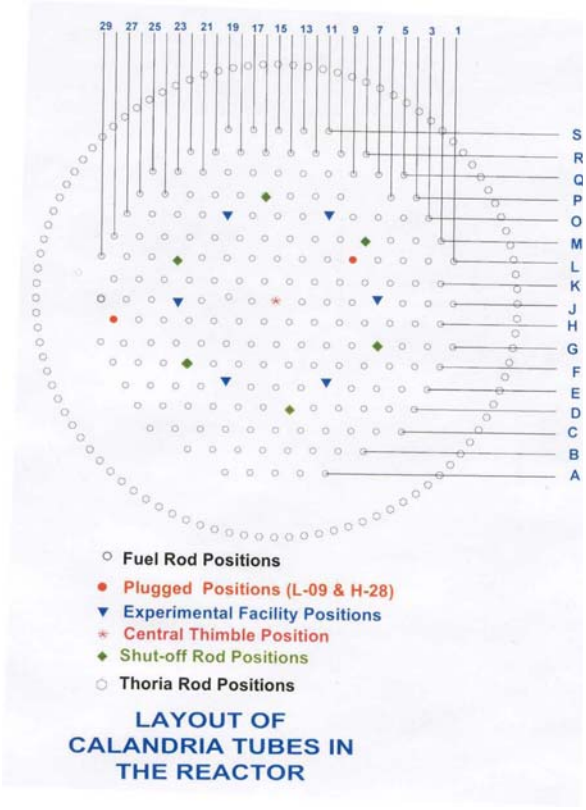

Fig.1

for the assessment of the condition of all the calandria tubes.

Eddy Current Testing method using a differential coil bobbin type probe was felt most suitable for inspection of the calandria tubes, as other nondestructive examination (N.D.E) techniques including ultrasonic testing could not be applied due to corrosion deposits on the calandria tube surface. In-Service Inspection Section of Research Reactor Services Division took up the work of development of special test probe and reference standard, and after extensive trials carried out the complete inspection of the calandria tubes in the reactor.

Development of a Differential Coil Eddy Current Probe

Development of differential coil eddy current bobbin type probe required to be specially designed due to following site constraints :

i) The top of calandria is about 17' below the operating floor from where the inspection probe could be lowered.

The probe had to negotiate the top end shields before entering the calandria tubes.

ii) The radiation level in the calandria during the ISI campaign, when reactor was in shut down state, was expected to be of the order of 10^6 R/hr.

iii) The main constraint in designing the probe was the smaller size, i.e. 2 1/8" (54 mm) diameter holes in the top steel thermal shields, through which the probe has to travel in order to inspect 2 ¼" (57 mm) diameter calandria tubes.

After a series of extensive trials, an inspection set-up based on measurement of eddy current was developed for carrying out inspection of 2 ¼" (57 mm) size calandria tubes. The inspection probe consists of spring loaded nylon fins, which get compressed while passing through smaller diameter hole of 2 1/8" size (54mm) in the top steel thermal shields (Fig. 2 & 2A.). The spring-loaded fins keep the differential coil concentric with the calandria tube and greatly reduce the wobbling signals, though the probe has low fill factor (0.85). The differential coil of the probe is connected to a dual frequency eddy current test system.

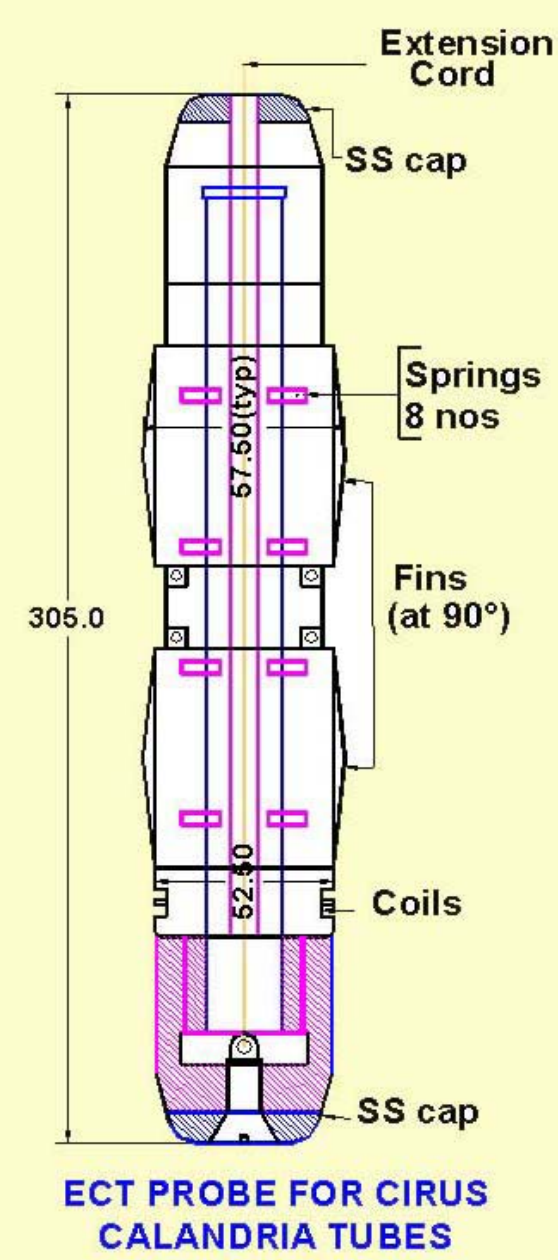

Fig. 2

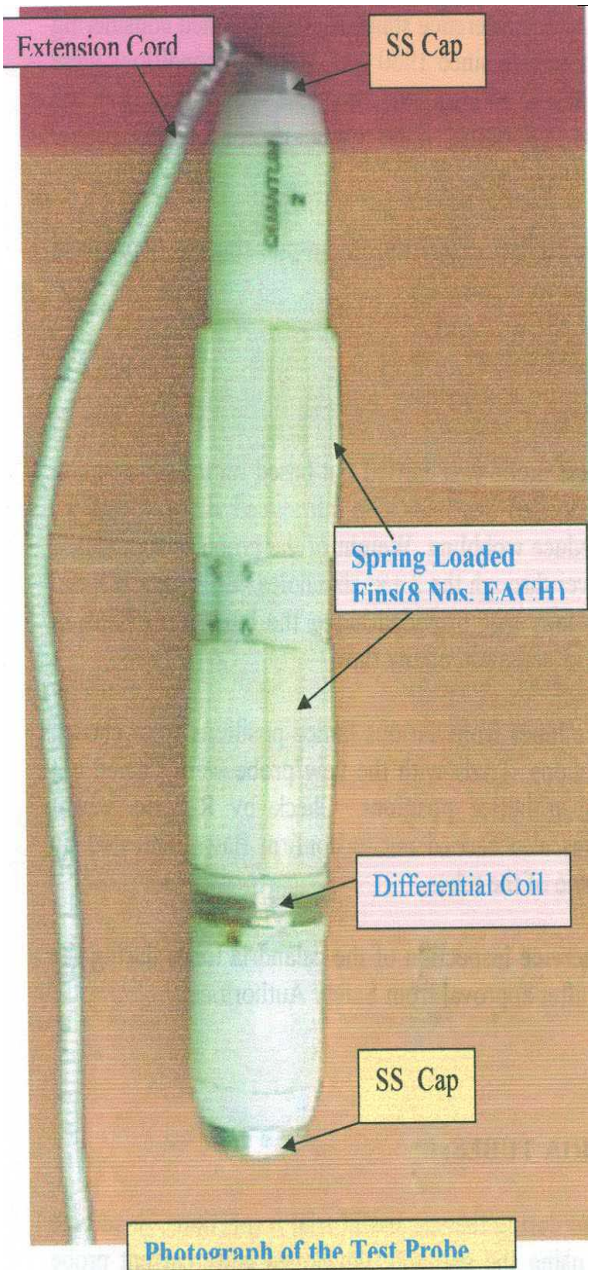

Fig. 2A

The probe can identify short discontinuities such as cracks, pits or other localized discontinuities in the calandria tube. Sensitivity of the probe is good enough to monitor a 1.5 mm size and 7% of wall thickness deep pits. Laboratory trials, out of pile and in-pile trials were conducted to freeze the dimensions and the test parameters. Approval of safety and regulatory authorities were obtained before deployment of the system for actual site work.

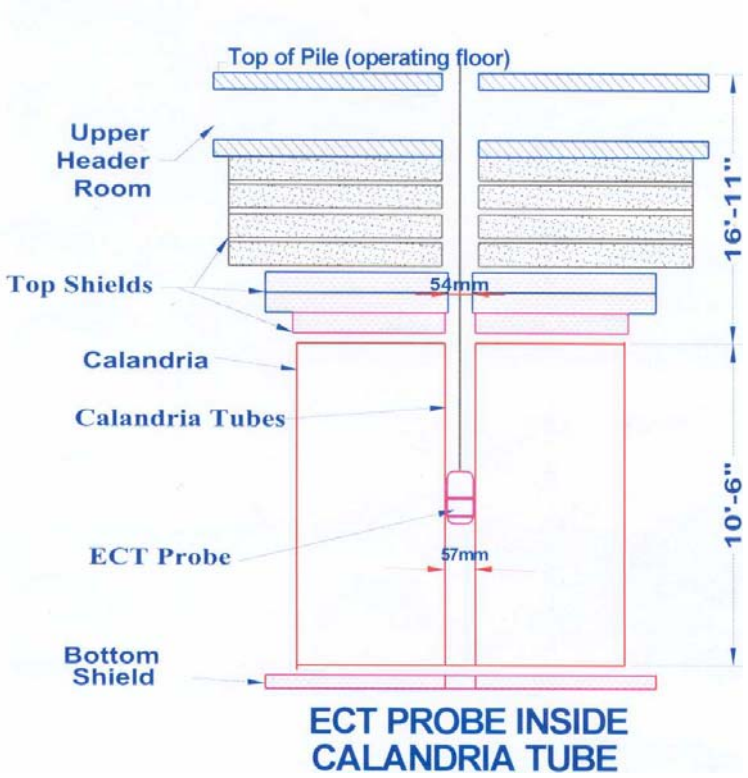

Fig. 3

Development of Reference Standard

Fabrication of dimensionally similar tube of aluminium 1S material was carried out with the help of Atomic Fuels Division as it was not readily available. Flaws of known dimensions were then machined in the tube. The flaws were machined as percentage of local wall thinning (flat bottom holes) and were calibrated for their corresponding instrument signals as lissajous curve pattern on CRT screen and strip chart. The flaw sizes of the reference standard was designed considering the fact that the reactor was in service since 1960 and operating conditions were moderate. All the local flaws below 20% of wall thickness were grouped in one category as insignificant flaws. Calibration of the test set-up for the known flaw sizes was carried out.

Once the test set-up was made ready, permission for in-pile trials was obtained from Safety Authorities.

Trial Runs

Minor design changes in the test probe was carried out based on the observation made during trial runs. Spring loaded fins had to be introduced at two locations, instead of at one location, to reduce wobbling. Weight of the probe was increased to facilitate its smooth cross over through the 2 1/8" size holes in the steel thermal shields (Fig. 3). A measuring tape was provided along the length of extension cable for convenient recording of elevation of any flaw.

A total of 13 nos. of calandria tubes from various lattice positions were chosen for conducting the trial inspections. Trials with the new probe were carried out successfully for all the thirteen lattice positions. Check by Remote Visual Inspection using boroscope was also carried out to confirm flaws indicated by ECT on the inner surface of some of the tubes.

It was decided to conduct in-service inspection of the calandria tubes during the refurbishment outage of Cirus after approval from Safety Authorities.

Inspection of Calandria Tubes

Based on the confidence gained during the successful trial inspections, in-service inspection

of calandria tubes using the specially developed eddy current probe was taken up.

The probe was connected to a dual frequency ECT set up, readily available in the Division. The observations were recorded on strip charts as well as on magnetic tapes.

During the ISI of calandria tubes, the test frequencies and other instrument settings were kept constant. Probe movement was done manually and the tubes were inspected at a speed of 1ft/sec, except for the positions near the tube sheets where the probe travel was kept at 1inch/sec. Slow speed inspection near the tube sheets was carried out as rough surfaces were noticed in these areas.

Though normal radiation field of 106 R/hr. was considered at the time of designing the probe, the present inspection campaign was carried out during refurbishing outage with the reactor core in de-fuelled condition. Hence, high radiation streaming was not encountered during the work.

During the inspection, the following difficulties were encountered :

i) ECT probe got stuck in a few lattice positions in steel thermal shield region and the probe was subsequently removed by pulling. During the inspection in one of the lattice positions, the probe got damaged and a new test probe had to be fabricated to resume the inspection.

ii) The probe had to be replaced after inspection of about 100 calandria tubes owing to normal wear and tear.

Highlights of Measurements

The flaw indications calibrated as a percentage of local tube wall thinning were segregated into four categories, viz. below 20%, above 20% but below 40%, above 40% but below 60%, and above 60% . 163 lattice positions indicated less than 20% deep flaws of minor nature.The observations made during the campaign are shown in Fig. 4.

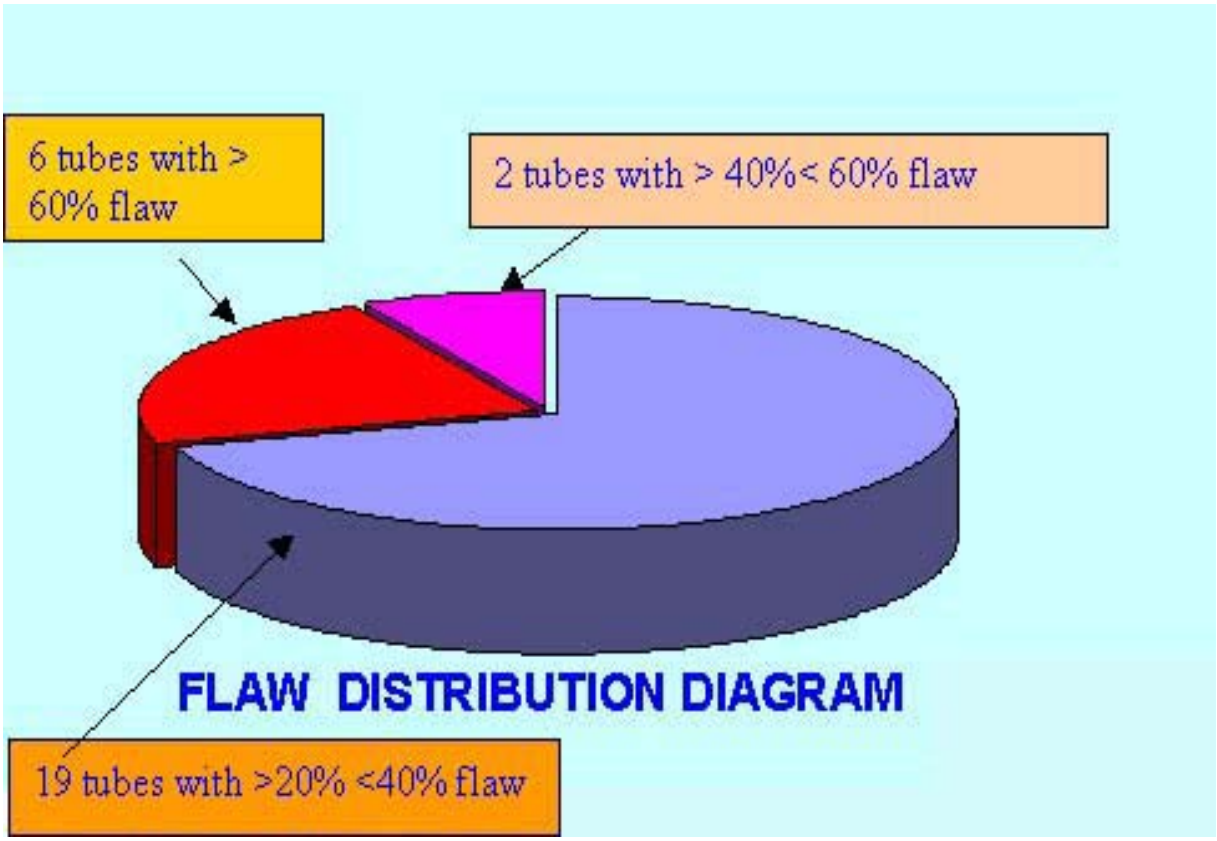

Fig. 4

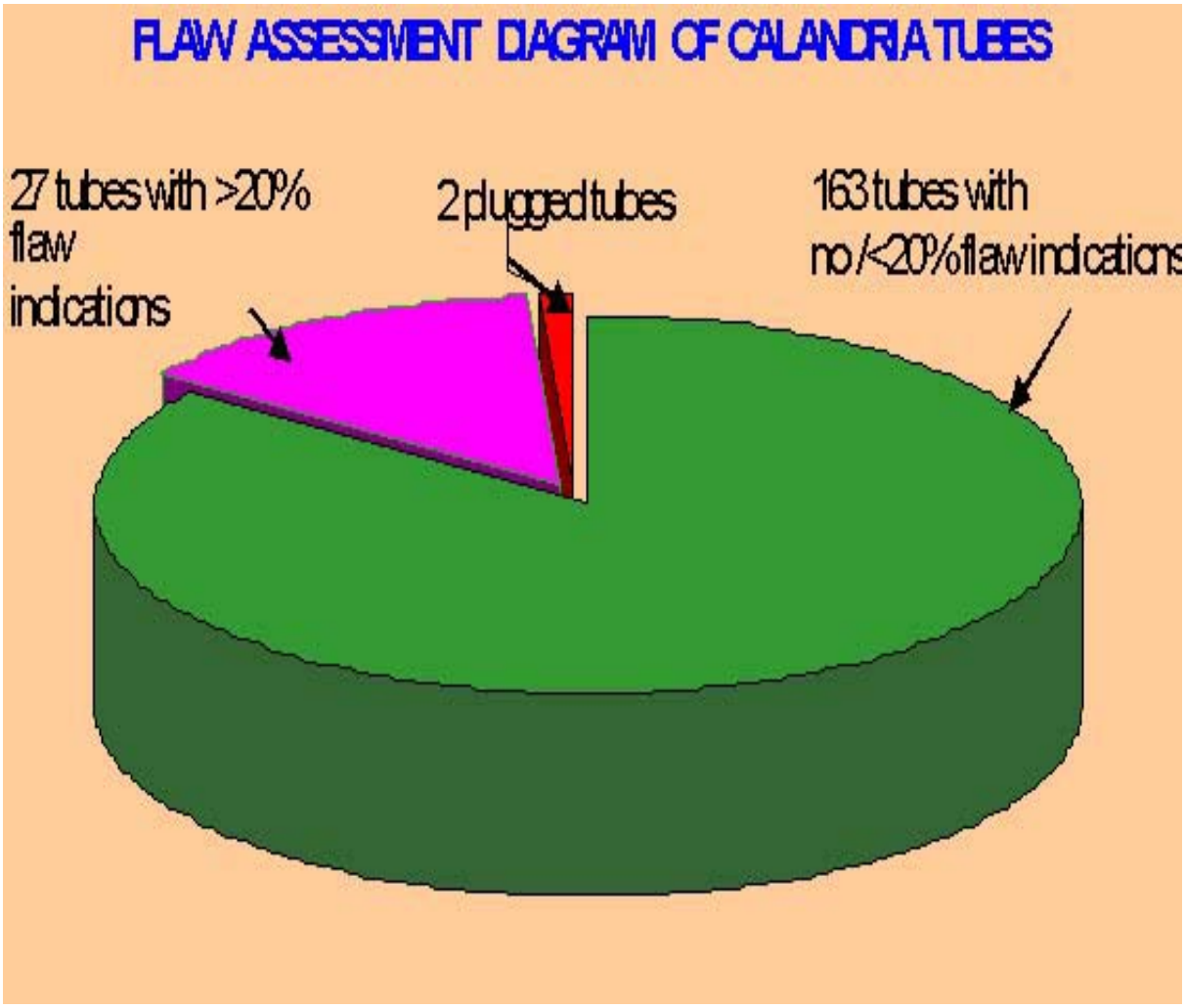

Fig. 5

Assessment

ISI of 190 out of the total 192, 2 ¼" diameter & $^{1}/_{16}$" wall thickness calandria tubes, was carried out as 2 tubes are plugged. Assessment made on the measurements is given in Fig. 5.

A few tubes with >20% flaw indications had multiple indications. It was also observed that the flaw indications were not located in a particular zone of the reactor core but were randomly distributed.

Flaw indications in the 163 tubes which were <20% deep or with no flaw were considered as insignificant flaws.

It was observed that the flaw indications, including <20%, were not of generic nature, though most of flaws were located on the ID of the tubes. It was also noticed that more ID indications were found closer to top tube-sheet.

Calendria tubes which are showing flaw indications > 20 % , with special attention to those tubes which have > 60 % indications, will be closely monitored by periodic inspection for ensuring their healthiness and continued availability.

Conclusion

The in-house developed dual frequency eddy current bobbin probe with self-centering spring loaded fins has been successfully employed in the in-service inspection of Cirus calandria tubes. It was concluded that the calandria tubes are generally in healthy condition for continued use in future.

TRAINING PROGRAMMES IN RADIATION SAFETY CONDUCTED BY RADIOLOGICAL PHYSICS & ADVISORY DIVISION

D.P. Bhatia
Radiation Dosimetry & Training Section
Radiological Physics & Advisory Division

Radiological Physics and Advisory Division (RP&AD), BARC, is responsible for providing radiation safety related advisory services to all medical, industrial, research and agricultural institutions in the country. Training and education of the radiation workers of these institutions should be so oriented as to reap maximum advantage of the modern technological developments, at the same time causing minimal harm to the occupational workers and members of the public at large. To sustain their activities using radiation, these institutions need trained manpower on a regular basis. Also, continuous technological changes make it necessary to retrain the personnel working in these institutions. To this effect, the Division conducts a number of radiation safety related Human Resource Development Programmes and also participates in many such programmes conducted by other Divisions of BARC. Most of these training programmes are mandatory as well as regulatory in nature. These programmes are briefly described below:

Diploma in Radiological Physics (Dip. R. P.)

Medical exposures continue to constitute a major source of exposure to humans due to artificial sources of ionising radiation, and their use has enabled great progress to be made in many aspects of medicine. These practices need to be carried out in optimised radiation protection conditions as recommended by the International commission on Radiological Protection. It is, therefore, necessary to ensure the protection of individuals against the hazards of ionising radiation used in medical diagnosis and treatment. It can be done by harmonising and promoting the best practices of Medical Physics in the country by making available trained and qualified Medical Physicists, expert in Radiological Physics. Towards this end, RP&AD conducts a post M.Sc. Diploma course in Radiological Physics (Dip. R.P.)

The Diploma in Radiological Physics course is a multidisciplinary course conducted by RP&AD. The objective of the course is to provide qualified Radiation Safety Officers to industries and research laboratories, and Medical Physicists to Hospitals where ionizing radiation sources are used. Candidates with M.Sc. (Physics) qualification are eligible to apply for the course. Final selection is made on the basis of performance in an interview conducted by a selection committee constituted by officers drawn from different Divisions of BARC and a representative of the Physics Department of University of Mumbai. Many participants of this course have been sponsored by leading radiotherapy centres of the country. Many students from the neighbouring countries have also attended this programme, under sponsorship of the International Atomic Energy Agency and World Health Organisation. The course is designed to cover wide areas of medical physics, radiation physics, radiation safety, and peripheral subjects. The programme consists of a formal course of about 300 lectures, 50 tutorials and 25 practicals and a number of seminars divided into 3 terms. There is a written and viva voce examination at the end of each term.

The students of this course spend a good deal of their time in practical training. They are sent to different Sections of RP&AD and other Divisions of the Health Safety & Environment Group of BARC for a period of four weeks. To integrate theory with practice in nuclear medicine, radiology and radiation therapy, a six-week outstation field training is also arranged at reputed radiotherapy centers of the country. Students, in groups of 2 to 3, are sent to these centres. Here, they assist the medical physicists of the assigned hospitals and get necessary hands-on experience in treatment planning & dosimetry of radiation therapy procedures. Finally, a 4-week training program is arranged at the Tata Memorial Hospital (TMH) and Radiation Medicine Center (RMC), Parel, where they are given intensive training, both theoretical and practical, on the role and duties of a medical physicist in the treatment of cancer.

To keep the trainees aware of the developments taking place in various fields, lectures on special topics are arranged by calling experts from various centres from time to time. Visits to various Divisions, Sections and important facilities in BARC and outside are also arranged for the benefit of the students. The trainees are also taken to hospitals and industries for familiarisation with equipment and techniques used by them. The final Diploma is given by the University of Mumbai based on a three-tier examination system. The successful candidates work as Medical Physicists /Radiation Safety Officers in leading radiotherapy centres or industrial institutions of the country. Many of them have been employed abroad in responsible positions.

Radiation Safety Aspects of Nucleonic Gauges (NG)

Nucleonic gauges find many non-destructive applications in industry for in situ determination of thickness, density and composition of materials, for measurement and control of process material in closed containers, for analysis of ores and minerals, well logging, etc. There are about 850 institutions in India, using more than 6000 gauges for different applications. It is mandatory for these institutions, particularly those which are in possession of gamma and neutron sources, to have personnel trained in radiation safety and duly approved by the competent authority. To cater to this need, RP&AD is regularly conducting training courses on Radiation Safety Aspects of Nucleonic Gauges. Candidates sponsored by nucleonic gauge user institutions with minimum qualification of a Degree in science or Diploma in engineering are eligible to attend this course. The course is of seven working days' duration. The course consists of lecture-cum-discussions on radiation physics, radiation units, biological effects of radiation, radiation hazards evaluation and control, nucleonic gauges, and concerned subjects and practical-cum- demonstrations on proper and safe use of radioisotopes. Candidates successful in the course-end examination are certified by the competent authority as Radiological Safety Officers Level-1. This course is conducted by the Division at the Centre for Training & Certification in Radiological Safety (CT&CRS), Anushaktinagar, Mumbai, and also at Electronics Corporation of India Ltd., Hyderabad, and at some of the other user institutions, like Reliance Industries, Patalganga. So far, 55 such programmes have been conducted.

Radiation Safety Aspects for High Intensity Irradiator Operators

The purpose of this mandatory course is to provide training in radiation safety to personnel involved in the operation and maintenance of high intensity irradiators. Candidates sponsored by irradiator user institutions with minimum qualification of tenth standard are eligible to attend this course. The course is of 15 working days' duration. The course consists of lecture cum discussions on radiation physics, radiation units, biological effects of radiation, radiation hazards evaluation and control, radiation detection & dosimetry, safety and design features of irradiators, radiation accidents, etc., and some practical-cum-demonstrations, and a visit to an irradiator installation. Candidates successful in

the course-end examination are certified as Operators of High Intensity Irradiators.

Radiation Safety Aspects in Applications of Radioisotopes in Research (RA)

This mandatory training programme provides training in radiation safety in the use of radioisotopes in physio-chemical, biomedical, agricultural and industrial research. Candidates sponsored by user institutions with minimum qualification of graduation in science are eligible to attend this programme. The course is of seven working days' duration. The course consists of lectures on radiation physics, radiation units, biological effects of radiation, radiation hazards evaluation and control, planning of radioisotope laboratories, disposal of radioactive wastes, production of radioisotopes and labelled compounds, etc. and practical-cum-demonstrations on proper and safe use of radioisotopes. Candidates successful in the course-end examination are eligible to be nominated as Radiological Safety Officers Level-2.

Radiography Testing & Safety Level - 1 (RT-1)

RP&AD co-ordinates in the conduct of training programme on Radiography Testing Level-1 at different accredited training centres of the country. The purpose of this mandatory training programme is to provide training in radiography and radiation safety to industrial radiographers, who handle radiography equipment. Candidates with six-month experience as trainee radiographer in an industrial radiography department and minimum qualification of Higher Secondary (10+2) with physics and mathematics are eligible to attend this training programme. The course is of 15 working days' duration. The course consists of lecture-cum-discussions on radiation physics, radiation units, X-ray and gamma ray equipment, radiography techniques, defectology, test methods, work parameters, biological effects of radiation, radiation hazards evaluation and control, etc. and practical-cum-demonstrations on radiography and proper and safe use of radioisotopes. Candidates successful in the course-end examination are licensed to work as industrial radiographers. This programme is conducted at centres like Institute of Quality Management, Mumbai, Indian Society for Non-destructive Testing, Visakhapatnam, Tiruchirapalli, etc.

Radiography Testing & Safety Level - 2 (RT-2)

RP&AD co-ordinates with Isotope Applications Division, BARC, in the conduct of training programme on Radiography Testing Level-2 at different centres in the country. The purpose of this mandatory training programme is to provide training in radiography and radiation safety to users of industrial radiography equipment. Candidates with two years' experience in an industrial radiography department and minimum qualification of B.Sc. (physics and mathematics) or Diploma in engineering are eligible to attend this programme. Candidates with lower qualification, if they have passed Radiography Testing Level-1, are also eligible to attend the programme. The course is of 20 working days' duration. Candidates successful in the course-end examination are licensed to work as site incharge of industrial radiography installations. This programme is conducted at centres like Regional Testing Centre, Mumbai & Kolkatta, and at Hindustan Shipyard, Visakhapatnam.

Radiation Safety for Radiation Therapy Technologists

This training course is meant for up-dating the knowledge of radiation therapy technologists in the field of radiological safety. Successful completion of this course is a desirable qualification for radiotherapy technologists as per stipulations of the Atomic Energy Regulatory Board. This need-based training programme of 7 days' duration is arranged by RP&AD at the Centre for Training & Certification in Radiological Physics or at some radiotherapy centres in the country. Course curriculum consists of 18

lectures and discussions on different topics related to radiation safety and practical demonstrations at a full-fledged local radiotherapy centre. The minimum qualification for this course is Higher Secondary (10+2) in science subjects with at least 2 years' experience in a Radiation therapy department.

Radiation Safety Aspects in the Servicing of Radiotherapy Equipment

This is a mandatory training programme for engineers, who are engaged in the servicing of radiotherapy equipment. This 7-day training course is meant for creating awareness about radiation safety among service engineers. A sponsored candidate with Degree/Diploma in engineering is eligible for admission to this training course. The course curriculum consists of 16 lectures on topics related to radiation safety, discussions and practical demonstration at a full-fledged local radiotherapy centre. Successful completion of this training programme is a mandatory requirement to obtain license to carry out the servicing of radiotherapy equipment.

Accreditation of Nuclear Medicine Technologist in Radiation Safety

Diploma in Medical Radioisotope Techniques (DMRIT) is the qualification required for a technologist to work as Radiation Safety Officer (RSO), Level-II in a nuclear medicine department. However, technologists without DMRIT qualification but already employed in a nuclear medicine department for more than 5 years, may also be recognised as RSOs by the competent authority, provided they are graduates and their proficiency in the field of radiation safety is certified by RP&AD. For the accreditation of technologists of the latter category to function as RSOs in their departments, RP&AD conducts a training programme of 3 weeks' duration on radiation safety in a nuclear medicine department. Candidates successful in the course-end examination are qualified to apply to the competent authority for being recognised as RSO (Level II) in their department. The first training programme for this purpose was conducted during January 14 - February 1, 2002 at CT&CRS. The programme consists of lectures and demonstrations on topics like basic radiation physics, radiation dosimetry & monitoring, planning of nuclear medicine installations, operational limits, radioactive waste disposal, Quality Assurance (QA) procedures in nuclear medicine, etc. 25 technologists from various nuclear medicine centres all over the country participated in the first training programme.

Training in Radiation Safety for M.Sc. Students

RP&AD conducts a two-week visit-cum-training programme for M.Sc. (Medical Physics) students of Anna University, Chennai, and M.Sc. (Radiation Physics) students of Mangalore University, Mangalore. These students are trained in radiation hazard evaluation and control and associated topics. This programme is mandatory for being eligible to be certified as Radiological Safety Officers (Level-III) and to work in radiation oncology centres of the country.

Familiarisation Programmes on Radiation Safety

Instances of theft of radioactive sources and equipment and illicit trafficking of radioactive materials have been brought to the notice of concerned authorities in India and abroad. These could result in various health hazards to the public and entail expensive and elaborate

Table 1: Training Programmes conducted/co-ordinated by RP&AD

Programme	Minimum Qualification	Duration	Programmes Conducted/ Candidates Trained	Remarks
Diploma in Radiological Physics (Dip. R.P.)	M.Sc. (Phys.)	One Year	40 / 621	Qualify as RSO (III)
Radiography Testing Level-1 (RT-1)	XII (Phys. Math)	15 days	29 / 846	Mandatory
*Radiography Testing Level-2 (RT-2)	Dip. Eng./ B.Sc.	20 days	26 / 765	Mandatory
Radiation Safety Aspects of Nucleonic Gauges (NG)	Dip. Eng./ B.Sc.	7 days	55 / 1617	Mandatory
Radiation Safety for Industrial Irradiator Operators (IRAD)	X Pass	15 days	4 / 61	Mandatory
Radiation Safety in Research Applications (RA)	B.Sc.	7 days	22 / 493	Mandatory
Radiation Safety for Radiation Therapy Technicians (RTT)	10+2 in Science	7 days	23 / 368	Mandatory
Acreditation of Nuclear Medicine Technologists	B.Sc.	3 weeks	1 / 25	Qualify as RSO (II)
Radiation Safety in Servicing of Radiotherapy Equipment	B. Engineering	7 days	5 / 84	Mandatory
#Radiation Safety for Food Irradiation Plants	B.Sc.	30 days	2 / 39	Mandatory
Certification Course for Industrial Radio-graphers	X Pass	10 days	64 / 2147	Replaced by RT-1 course
Radiation Safety in Industrial Applications of Radioisotopes	Dip. Eng./B.Sc.	4 weeks	45 / 1006	Replaced by NG & RA course
*Industrial Radiography & Safety (IRG-1)	Dip. Eng./ B.Sc.	6 weeks	48 / 1447	Replaced by RT-2 course
Familiarisation Programmes	--	2-3 days	30 / 703	Awareness/ Refresher Programme
M.Sc. (Med.Phys.) Anna/Mangalore University	B.Sc. (Phys.)	10 days	19 / 191	Qualify as RSO (III)
Foreign Trainees	--	1-3 months	39	

* Conducted by Isotope Applications Division, BARC
# Conducted by Food Technology Division, BARC

procedures to mitigate the consequences. The problem has been recognised internationally. Towards this end, RP&AD arranges a number of awareness programmes for personnel like customs officers, security staff, cargo handlers and staff of port authorities in collabo-ration with National Academy of Customs, Excise and Narcotics (NACEAN), to ensure safety of radiation sources and security of radioactive materials and to make various organisations aware of their role in preventing accidents/incidents, which affect the safety and security of radiation sources.

RP&AD also conducts two/three day need-based familiarisation programmes on radiation safety for radiologists, medical X-ray technologists and defence personnel.

Foreign Trainees

The International Atomic Energy Agency and World Health Organisation refer a number of persons to BARC, from neighbouring countries, who are engaged in use of radiation in various fields. RP&AD provides and co-ordinates training in the field of radiation safety to these WHO / IAEA fellowship holders from other countries.

Conclusion

As illustrated in Table 1, a trained manpower of about 10,500 persons has been generated through these HRD programmes in the field of radiation safety. This trained manpower is responsible for ensuring radiation safety in about 3000 institutions involved in non-nuclear fuel cycle applications of radiation. These HRD programmes have resulted in:

- Improvement in work practices and working environment.
- Decrease in average individual dose to radiation workers.
- Increase in the confidence level in handling emergencies.
- Downward trend in the number of incidents / emergencies in these institutions.

PM INAUGURATES WASTE IMMOBILIZATION PLANT, TROMBAY

Mr Atal Behari Vajpayee, Hon'ble Prime Minister of India, formally inaugurated the Waste Immobilization Plant, Trombay, on October 31, 2002.

Mr Atal Behari Vajpayee, Hon'ble Prime Minister of India, inaugurates the Waste Immobilization Plant, Trombay

His Excellency Mohammed Fazal, Governor of Maharashtra, Hon. (Ms) Vasundhara Raje, Minister of State, Department of Atomic Energy, Dr Anil Kakodkar, Chairman, Atomic Energy Commission and Secretary, Department of Atomic Energy, Mr B. Bhattacharjee, Director, BARC and Mr V.P.Kansra, Director, Nuclear Recycle Group, BARC, were also present on the occasion.

Mr N.K.Bansal, Head, Waste Management Division, BARC, explaining the working of WIP, Trombay, to the Prime Minister

WIP, Trombay, built at a cost of about Rs. 500 million, is the first integrated plant in the country to manage all categories of liquid waste, viz., LLW, ILW and HLW. The plant has started

vitrification of high level waste received from Plutonium Plant, Trombay.

A specially formulated lead borosilicate glass composition is used at WIP to immobilize the constituents of HLW. The vitrification facility consists of evaporator for concentration, three induction heated metallic melters for vitrification at 1050°C and elaborate off-gas cleaning system.

In view of the high radiation field, all operations are carried out in hot cells made of 1.5 m thick concrete walls. The cells are equipped with intricate remote handling gadgets and sophisticated viewing aids.

Waste Immobilization Plant, Trombay

The plant has facilities for treatment of low level waste by reverse osmosis process and cementation of concentrates. An ion exchange facility is planned to treat alkaline intermediate level waste. This facility will have provision for recovery of kilocuries of ^{137}Cs for use as a radiation source. A Joule Heated Ceramic Melter is also planned to enhance the processing capacity for HLW.

PUBLIC AWARENESS PROGRAMME ON NUCLEAR ENERGY

Waste Management Division (WMD) and Health Physics Division (HPD) of BARC participated in the two-day workshop on "Economics and Risks of Nuclear Power in North India" organised by National Union of Journalism & Communications in association with Public Awareness Division of DAE. The workshop was arranged at Institute of Electronics and Telecom Engineers, Chandigarh, during April 20-21, 2002. About fifty delegates consisting of editors/journalists of newspapers of Hindi, Punjabi and English languages, electronic media and NGOs participated in the workshop. Mr Surender Kumar, Head, Technical Services Section, WMD, BARC, spoke on the management of radioactive waste arising during power generation, isotope utilisation, reprocessing of spent fuel, etc. The basic concepts of waste minimization, segregation, treatment and disposal were explained to the audience. Recovery/recycling of useful materials like cesium, plutonium, uranium, americium, etc in minimizing the waste was emphasized. The philosophy behind storage/dosposal of solid waste was communicated in simple language to the delegates. The apprehensions in the minds of delegates about radioactive waste were removed by explaining the various steps taken and the technology employed by nuclear industry.

Mr R.M. Sharma, Head, HPD, BARC, delivered a talk on the radiation safety aspects in nuclear power plants. The audience was explained the necessity for emphasis on safety and regulatory aspects being observed in the Indian programme. He further mentioned that Health Physics Division provides the support in control of occupational radiation exposures, the monitoring and surveillance of the environment and assessment of the radiological impact on the public around the nuclear facilities, besides advising Nuclear Power Corporation of India Ltd. on various aspects of radiation protection.

Mr S.K. Malhotra, Head, Public Awareness Programme, DAE, presented the overview of Nuclear Energy in India. Mr A.B. Ghare and Mr A.K. Nema from NPCIL delivered talks on "Nuclear Power Programme - Economics of Nuclear Power".

The journalists presented their views on nuclear power generation in India. A close interaction with the journalists provided an opportunity to understand their views on Nuclear Power in general, and waste management and safety aspects, in particular. The workshop and the views expressed by BARC scientists were covered extensively in the local newspapers.

हिंदी विज्ञान साहित्य परिषद की वैज्ञानिक मोनोग्राफ प्रकाशन योजना

हिंदी विज्ञान साहित्य परिषद दिसम्बर 1967 से प्रगत वैज्ञानिक विषयों को राजभाषा हिंदी के माध्यम से जनसामान्य एवं वैज्ञानिक समुदाय तक पहुंचाने के लिये एक त्रैमासिक पत्रिका "वैज्ञानिक" का प्रकाशन, वैज्ञानिक शब्दावली निर्माण, अखिल भारतीय डा. होमी भाभा विज्ञान लेख प्रतियोगिता, स्कूली छात्रों के लिये प्रश्नमंच, राजभाषा वार्तायें, विशेष कार्यशालायें व संगोष्ठियां आदि का आयोजन करती आ रही है ।

परिषद ने अब हिन्दी में वैज्ञानिक मोनोग्राफ प्रकाशन योजना पर कार्य प्रारंभ किया है । मोनोग्राफ वैज्ञानिक उप विषयों तथा आइसोटोप, लेसर, रेडियो धर्मिता, अतिचालकता, नाभिकीय ऊर्जा के शांतिमय उपयोग, यूरेनियम, प्लूटोनियम, ईंधन पुर्नसंसाधन आदि पर तैयार किये जायेंगे । मोनोग्राफ लेखन के लिये मानदेय देने की भी व्यवस्था की जा रही है । अन्य सूचनाओं के लिये संपर्क करें : रमेश चन्द्र पंत, सचिव, हिंदी विज्ञान साहित्य परिषद, ध्रुव रिएक्टर, भाभा परमाणु अनुसंधान केंद्र ।

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RADIO-TRACER LABORATORY ESTABLISHED AT RAU

Under an MOU between Rajasthan Agricultural University (RAU), and BARC & BRNS on "Establishment of Radio-tracer Laboratory and Multi-location Testing at Rajasthan Agricultural

Dr (Ms) A.M. Samuel, the then Director, Biomedical Group, BARC, inaugurating the Radio-tracer Laboratory at Rajasthan Agricultural University (RAU)

University, Bikaner" signed on July 13, 2000, a Radio-tracer Laboratory has been established at RAU, Bikaner, for carrying out collaborative research program for the use of radiation and radioisotopes for development in the field of agriculture sciences. The Radio-tracer Laboratory was inaugurated by Dr (Ms) A.M. Samuel, the then Director, Biomedical Group, BARC, in the presence of Prof. C.P.S. Yadava, Hon'ble Vice-Chancellor, RAU, at Bikaner on August 2, 2002. The laboratory is planned to be equipped with equipment such as deep freezer, scintillation counter, gamma counter, fume hoods, radiation monitors and radiopharmaceuticals, and is expected to supply information regarding both basic and applied aspects of the problems in mutually agreed projects between RAU and BARC.

Speaking on the occasion, Dr Samuel expressed happiness at the setting up of the laboratory and appreciated the work being carried out under the project. She emphasized that the MOU should act only as a general guideline and more linkages between RAU and BARC should be established

specially in areas such as use of radio-pharmaceuticals in veterinary sciences and testing of BARC-developed varieties of mustard and groundnut varieties at many locations in Rajasthan. Hon'ble Vice-Chancellor, Prof. Yadava, in his concluding remarks, thanked the DAE for the help in setting up of the laboratory and assured effective implementation of all the programs enlisted under the MOU as well as help in carrying out the Breeder Seed multiplication programme.

भा.प.अ. केंद्र के वैज्ञानिकों को सम्मान

BARC SCIENTISTS HONOURED

• डॉ.जे.पी.मित्तल, अध्यक्ष, रासायन तथा आइसोटोप वर्ग भा.प.अ.केंद्र को हमबोल्ट अनुसंधान पुरस्कार के लिये नामित किया गया है। यूरो 50,000 की राशि का यह पुरस्कार उन्हें अनुसंधान तथा शिक्षण के क्षेत्र में उत्कृष्ट योगदान के लिये प्रदान किया गया। इस पुरस्कार से उन्हें जर्मनी में लम्बे समय के लिये अनुसंधान के अवसर प्राप्त होंगे तथा दोनों देशों में परस्पर वैज्ञानिक उन्नति बढ़ाने में भी सहायता मिलेगी ।

Dr J.P. Mittal, Director, Chemistry and Isotope Group, BARC, has been elected to receive the Humboldt Research Award representing an amount of Eur 50,000/-. This award has been granted to Dr Mittal in recognition of his past accomplishments in research and teaching. This gives him the opportunity to undertake research in Germany for prolonged periods and contribute to the promotion of scientific cooperation between research institutions in both countries.

• श्री. आर.के. सिन्हा, सह निदेशक, रियक्टर अभिकल्पन एवं विकास वर्ग, श्री बी.बी.रुपानी, प्रधान, रियक्टर कूलन्ट

R.K. Sinha

Mr. B.B. Rupani

B.S.V.G. Sharma

चेनल, रिएक्टर इंजीनियरिंग प्रभाग तथा श्री बी. एस. वी. जी. शर्मा, ग्रुप लीडर, इलेक्ट्रिकल डिवाइसिज, तथा आटोमेशन ग्रुप, रियक्टर इन्जीनियरिंग प्रभाग (RED), को संयुक्त वासविक (विविधलाक्षी औद्योगिक संशोधन विकास केंद्र) की ओर से वर्ष 2000 के लिए मेकेनिकल तथा स्ट्रक्चरल विज्ञान तथा प्रौद्योगिकी के लिए पुरस्कृत किया गया। 50,000/- रूपये की राशि तथा प्रशस्ति पत्र का यह पुरस्कार संयुक्त गणराज्य के आदरणीय उप-प्रधान मंत्री जोन पुस्कोट द्वारा सितम्बर 20, 2002 को, वासविक संगठन द्वारा मुंबई में आयोजित एक अवसर पर दिया गया।

यह पुरस्कार दाबित भारी पानी रिएक्टरों (PHWRs) की विविध प्रणाली, निरीक्षण, पुर्नवास तथा जीवन व्यवस्था के विकास के लिये निर्धारित किया गया था। इस शिल्प-विज्ञान से भारत के दाबित भारी पानी रिएक्टरों के निरन्तर सुरक्षित प्रचालन के द्वारा विदेशी मुद्रा के कई सौ क्रोडो रुपयों के लाभ के अतिरिक्त भारत को विकास क्षेत्र में भी मान्यता प्राप्त हो गई है।

वर्ष 1974 में स्थापित किया हुआ वासविक संस्थान का यह पुरस्कार प्रतिवर्ष नौ विभिन्न क्षेत्रों के उन वैज्ञानिकों तथा इंजीनियरों को मान्यता देने के लिये दिया जाता है जिन्होंने राष्ट्रीय स्तर पर भारतीय अर्थ व्यवस्था, उत्पादन, अविष्कार, अनुसंधान में प्रमुख योगदान दिया है। यह पुरस्कार रॉयल सोसाइटी आफ लंडन में दिया जाने वाला मारकोनी पुरस्कार के स्तर का माना जाता है ।

श्री.आर.के. सिन्हा, श्री.बी.बी. रुपानी तथा श्री.बी.एस.वी.जी. शर्मा दाबित भारी पानी रिएक्टर के जीवन शिल्प विज्ञान के क्षेत्र में कार्यरत है। वे तकनीकी योगदान तथा स्वदेशी विकास की मुख्य तकनीकों को सरल

बनाने में मुख्य भूमिका निभा रहे हैं । यह भारत के दाबित भारी पानी रिएक्टरों की प्रौद्योगिकी विकास की कार्यविधि के लिये उपयोगी है।

Mr R.K. Sinha, Associate Director, Reactor Design & Development Group, BARC, Mr B.B. Rupani, Head, Reactor Coolant Channel Section of RED, and Mr B.S.V.G. Sharma, Group Leader, Electrical Devices & Automation Group of RED were jointly awarded the prestigious VASVIK (Vividhlaxi Audyogic Samshodhan Vikas Kendra) award for the year 2000 in the field of Mechanical & Structural Sciences & Technology. The award carries a prize of Rs 50,000/- and citation. The award was given away by Rt. Hon'ble John Prescott, Dy. Prime Minister of U.K. in a function organised by VASVIK organisation on September 20, 2002 at Mumbai.

The award was given for the development of various systems for inspection, rehabilitation and life management of Pressure Tubes of Pressurised Heavy Water Reactors (PHWRs). These technologies have not only enabled continued safe operation of Indian PHWRs, saving several hundred crores of rupees in foreign exchange, but also brought an international recognition of the capability developed by India in this field.

The VASVIK award instituted by VASVIK organisation (established in year 1974) is given annually in nine different subjects/areas of Science & Technology to recognise the outstanding scientists and engineers from all over the country, who have engaged in research

Award (at a different level) given by the Royal Society of London.

Mr R.K. Sinha, Mr B.B. Rupani and Mr B.S.V.G. Sharma are engaged in work related to PHWR life management technology development. They are providing direct technical contributions as well as leadership to facilitate indigenous development of analytical methodologies and several technologies required for an integrated approach of life management of Pressure Tubes of Indian PHWRs.

• श्री. एस. गौतम, खाद्य तकनीकी प्रभाग, को सौराष्ट्र विश्वविद्यालय, राजकोट में अक्टूबर 17-18, 2002, को उत्तम मौखिक प्रस्तुतिकरण के लिये "युवा वैज्ञानिक पुरस्कार" से सम्मानित किया गया है । इस प्रस्तुति के लेखक श्री एस. गौतम और श्री अरूण शर्मा हैं तथा इसका शीर्षक "Xanthomonas Programmed Cell Death has Similarities with Eukaryotic Apoptosis" है ।

Mr S. Gautam of Food Technology Division, BARC, has been honoured with the "Young Scientist Award" for the best oral presentation during the National Conference on Environmental Biology, held at Saurashtra University, Rajkot, during October 17-18, 2002. The work presented was entitled "Xanthomonas Programmed Cell Death has Similarities with Eukaryotic Apoptosis" and was authored by S. Gautam and Arun Sharma.

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prosperity by increasing production, improving efficiency towards economic growth of the country. It is somewhat on the lines of Marconi