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ON-LINE MONITORING OF TURBO-GENERATOR VIBRATION IN KAKRAPAR-1

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On-line monitoring offers immediate information about the condition of a turbo-generator. It has obvious economic advantages because, while the power is being generated, the diagnosis is also carried out at the same time. In the increasing cost conscious market, reliability of steam turbine is of fundamental importance to the power industry.

All large power steam turbines are multi-cylinder machines having several rotors successively joined. The totality of the individual cylinder rotors joined together by means of couplings is named the turbine rotor. Commonly, this term implies the generator too. Each individual rotor is normally supported by its own journal bearings, which are fastened to the turbine foundation beams. The spring properties of these supports influence the turbine vibration characteristics.

The rotor vibration largely ensues from some deviations or inaccuracy in manufacturing or assemblage of the turbine, as well as unfavourable variations of

Contents

its condition during operation (Fig.1). Such characteristics, measured and constructed for the individual bearings of the same turbine, are different, reflecting the different influences of the diverse rotors. The totality of these spectrums for all the turbine bearings forms the vibration signatures of the turbine. Signature analysis makes it possible in principle to diagnose the cause for worsening turbine vibration conditions. An online vibration monitoring system, which can offer an integrated study of turbine vibration characteristics, plays an all-important role in ensuring overall safety, reliability and economics of the plant.

With the aim to address this urgent need for on-line health monitoring of the Turbo-Generator (TG), a programme was initiated to develop and install an On-line Vibration Monitoring System in Kakrapar-1 (Fig. 2). The principal components of the system are: the front-end instrumentation consisting of transducers and signal conditioners for vibration and process parameters, a middle unit of data acquisition system and the back end data analysis and interpretation system. The main objective of the overall system is to inform the operator at any desired time about the health of the turbo-generator in the form of long term and short term trends and store all the raw data during any major transient in the plant for post processing. In addition, the system must offer diagnosis at any selected time to make corrections at the next opportunity. The main features of these three components of the system are covered below.

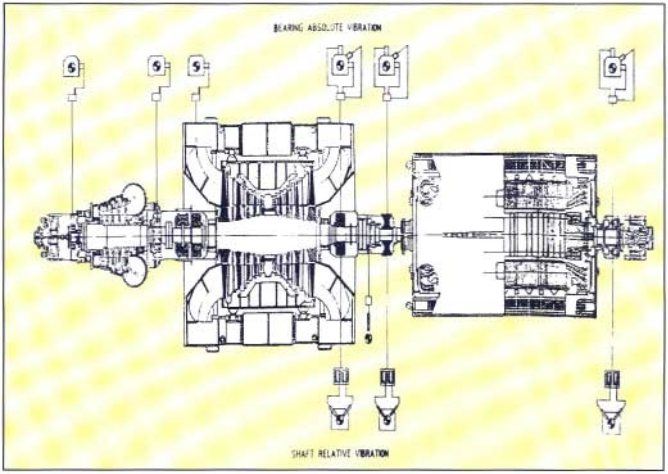

Fig 1 KAPS-1 Turbine-generator vibration measurement

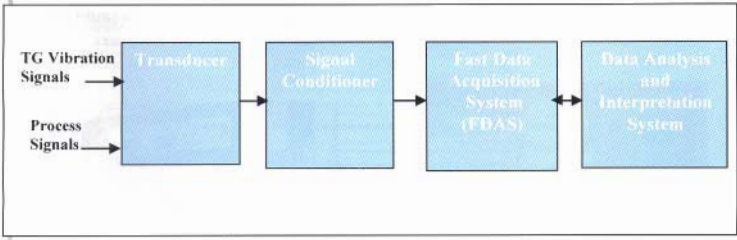

Fig. 2 On-line monitoring of turbo-generator vibration in Kakrapar-1

Front-end Instrumentation

The front-end instrumentation consists of transducers and signal conditioning electronics for measuring TG vibration and process signals. The turbo-generator in Kakrapar-1 consists of one high-pressure rotor (HP), one double flow low-pressure rotor (LP) and one generator rotor. The coupled rotor system is supported on six journal bearings instrumented with absolute velocity transducer as a standard instrumentation. The LP and generator bearings are instrumented with three velocity transducers for measuring horizontal, vertical and axial bearing vibrations. These bearing vibration signals are connected to the turbovisory panel in the plant. The signal tapping points available in the turbovisory panel are wired to the Fast Data Acquisition System (FDAS).

For monitoring shaft vibration, eddy current displacement transducers were installed on LP and generator bearings. The shaft vibration signals were directly connected to the data acquisition system.

Fifteen relevant TG process parameters were identified and were connected to the data acquisition system. The most important ones of these are generator power, turbine speed, condenser vacuum and shaft/casing differential expansion.

Fast Data Acquisition System (FDAS)

FDAS acquires and stores TG vibration data and the associated process parameters (Fig. 3 & 4). Twenty vibration signals and 15 process signals are connected to FDAS. The data acquisition is triggered whenever an event of any vibration signal crossing its set threshold level occurs. The data acquisition unit simultaneously acquires 20 vibration signals at a rate of 5000 samples/sec and 15 process signals at a rate of 100 samples/sec. For all the vibration channels, 250 msec pre-event and 750 msec post-event data are acquired.

The data acquisition unit uses two Intel-8086 based microcomputer systems. Suitable hardware for signal conditioning and for evaluating RMS value of vibration signals is also provided. 8th Order antialiasing low-pass filters with cutoff frequency of 1 kHz have been employed for each vibration signal. The two microcomputers are connected to a PC through a high speed LAN for transferring the acquired data to the hard disk for storage and analysis. The PC provides operator interface to the

system and facility to view the acquired data both in time and frequency domain.

Fig. 3 Commissioning of FDAS

Each vibration channel can be set with its own RMS threshold level depending on the actual level of vibration. Whenever the vibration level in any of the 20 vibration channels exceeds its threshold level, 250 msec pre-event and 750 msec post-event data of all the 20 vibration channels are transferred to the PC through LAN and the event time is recorded. In the case of 15 process signals, 39,250-sec pre-event data and 750 msec post-event data are transferred. The information pertaining to that vibration channel which had crossed its threshold level is also transmitted to the PC. Whenever the event of threshold-level crossing occurs, the threshold level of the concerned signal is increased automatically by 10% to avoid flooding of data to PC. Threshold levels of all vibration channels can be viewed by the operator and changed, if needed, under password control. It is also possible for the operator to demand the current vibration and process data at any time of the day (Fig. 5).

For on-line vibration diagnosis by Expert System, FDAS acquires 1 second vibration data and 40 sec process data every hour and transfers these data to Expert System PC. These hourly data transferred to the Expert System are treated as base data.

Fig. 4 Rear view of FDAS panel

Data Analysis and Interpretation System (Expert System)

The functions of data analysis, data interpretation and diagnosis are performed by a PC-based Expert System, which is directly connected to FDAS through high speed LAN. The Expert System is an on-line software which analyses baseline vibration data in time and frequency domain. The Expert System consists of two software modules: On-line Expert System (OLES), and Operator Support and Backup Data Display (OSBUDD). OLES reads the acquired signals and analyses them using the knowledge base databank built on Sohre's distress chart. OLES then lists five most probable causes for

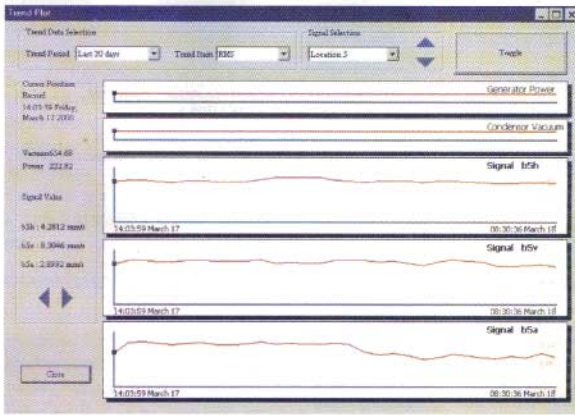

Fig. 5 Trend plots of vibration and process signals

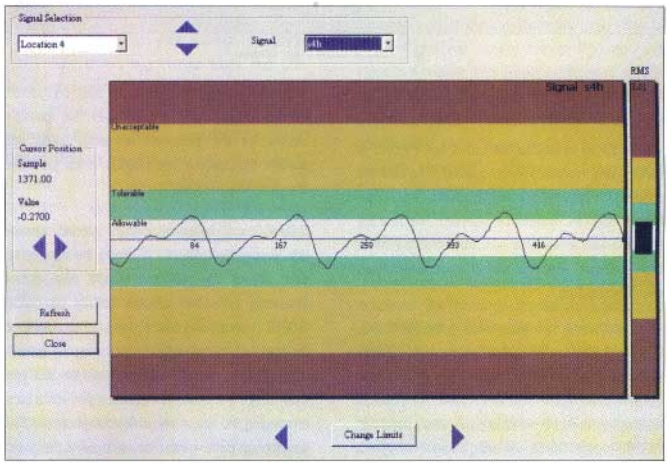

Fig. 6 Time signal display from Expert System

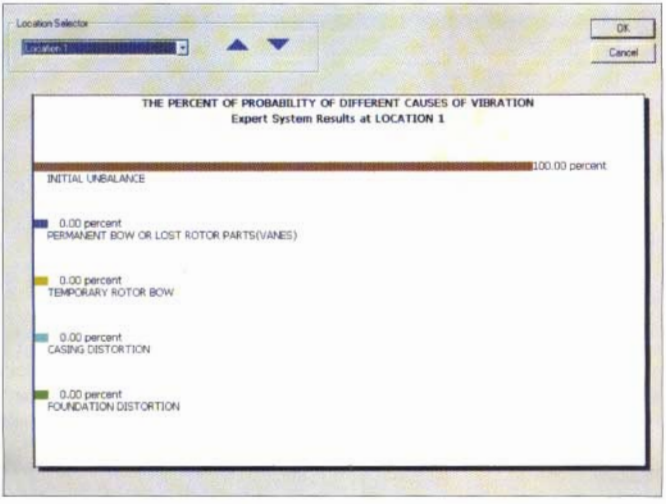

Fig. 7 Probable causes of high vibration

excessive vibration. It also trends all vibration and process data for continuous monitoring (Fig. 6).

OLES has an in-built function to check if FDAS is sending any fresh data for processing. The data are checked for acceptable quality by performing signal-to-noise ratio and coherence analysis. The data are stamped with arrival time and are converted into a binary format, which is stored in a well-defined directory structure.

After performing FFT and updating the trend plot, OLES contacts the knowledge base which compares the current FFT signals with healthy FFT compiled over a period of more than two years of monitoring. When amplitude of any particular frequency component crosses the corresponding healthy value, the details of the cross over is referred to the knowledge base built on Sohre's distress chart. OLES then gives five possible causes for the excessive vibration, taking into account the direction and location of the excessive vibration measurement (Fig. 7).

OSBUDD is a dedicated operator interface module that supplements OLES. It allows the operator to view any of the past and current data without interfering with the analysis activity of OLES. OSBUDD shows the raw signal in time domain in the backdrop of colour bands indicating the severity of vibration according to ISO standard for 3000 rpm machinery. It also shows frequency plot with a band enveloping the major frequency components. The enveloping band gives the safe level for each frequency component evolved over a long period of

monitoring. OSBUDD shows trend plots of RMS values of vibration signals and amplitudes of major frequency components. The trend can be seen for the past 24 hrs, 7 days, 1 month or 1 year. The trend of a selected process parameter is also shown along with the trend of vibration signals. For shaft vibration diagnosis, OSBUDD additionally shows orbit plots. All the processed data, trends, orbit plots and time signal can be stored in hard disk or copied on a CD. There is a provision to take hard copies of these plots.

System Commissioning at Kakrapar-1

The individual components of the monitoring system were commissioned in a phased manner. Wiring for the front-end instrumentation was completed during one of the plant shut down periods. Shaft sensors were installed and wired. Fully tested FDAS was then installed, wired and commissioned in August 1997.

TG vibration and process data acquired regularly by FDAS were stored in cartridge tapes and CDs. These tapes and CDs were routinely sent to IIT, Delhi, for development of the Expert System software. Different stages of development of Expert System software were routinely reviewed. Several software modules not originally included for development were added to make the package operator friendly. The fully tested Expert System was integrated with FDAS in March 2000. All the components of the monitoring system are performing satisfactorily at Kakrapar-1. The plant engineers and operators have been given adequate training for effectively using the system and to attend to any maintenance work.

Acknowledgement

The authors would like to acknowledge the support and cooperation received from a large team of engineers and staff of KAPS Kakrapar, NPCIL Mumbai, IIT Delhi, Reactor Control Division (RCnD) and Reactor Engineering Division (RED), BARC.

DIRECTOR, BARC FELICITATED

Dr Anil Kakodkar, Director, BARC, was conferred the Golden Jubilee Award by the Shriram Scientific and Industrial Research Foundation at a simple ceremony held at India International Centre, New Delhi on August 11, 2000. While conferring the award, Dr Kakodkar was lauded for his endeavour in the field of reactor technology, new reactor concepts, national security through Pokhran-I and Pokhran-II nuclear tests and applications of nuclear energy in various sectors. In the citation of the award, a special mention was made about his contributions to the repair technology and aging research on existing Pressurized Heavy Water Reactors (PHWRs) and his innovative design of new reactor systems like Advanced Heavy Water Reactors (AHWRs).

Dr Kakodkar, while delivering the golden jubilee lecture of the research foundation, emphasized upon the positive contributions of atomic energy in various sectors like agriculture, food preservation, health care and industry. He lauded research foundations like Shriram Foundation which facilitated the DAE to pass on the benefits of nuclear energy for wealth generation and improvement in the quality of life of the masses.

A FACILITY TO MEASURE CRITICAL CURRENT OF SUPERCONDUCTING WIRES

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Technical Physics & Prototype Engineering Division

For the upcoming Superconducting Cyclotron programme at VECC, Calcutta, one requires multi-filamentary Nb-Ti/Cu composite superconducting wires capable of carrying 1030 amperes at 4.2 K under a field of 5.5 Tesla. The fabrication of these conductors requires a careful fine-tuning of the metallurgical processing conditions of the superconducting wires. For this purpose, a careful Voltage (V) vs Current (I) characterization of the developed conductors by the way of identifying resistive transition is essential.

Fig. 1 Experimental set-up to measure critical current of superconducting wires.

A facility to measure the V *vs* I characteristics on short samples (approximately 1 metre) of the developed wires, with the field perpendicular to the current direction, was set up. The set-up (Fig. 1) uses the usual four probe method. The facility is equipped with a 30 litre liquid helium dewar and a home-made superconducting magnet (of length 200 mm and a bore diameter of 55 mm) capable of providing a magnetic field of 7.4 Tesla. This bore is adequate to accommodate a sample insert, which carries a 45 mm diameter tube for mounting the short sample of the superconducting wire, The current in the superconducting magnet is controlled with the help of a PC to achieve a steady field, covering the range from 0 to 7.4 Tesla.

To generate accurate V *vs* I data, two pairs of voltage leads are soldered on a helically wound superconducting wire immersed in liquid helium. A nano-voltmeter is used to monitor the voltage drop across the sample. Sample current is transported by suitably designed vapour-cooled leads to take maximum advantage of the evaporated helium gas.

An indigenously built constant current power supply, capable of delivering a maximum current of 1200 amperes, is used to pass a variable current through the sample. To obtain the sample current accurately, a 1 mΩ water-cooled standard resistor is kept in series with the superconducting sample and the voltage V_I (proportional to I) across the standard resistor (proportional to the sample current I) is measured. The voltage drop V across the sample and V_I are fed to a PC using a GPIB interface to obtain V *vs* I curves.

In Fig. 2, the V-I transition curves are shown which were obtained on a Vacuumschmelze (Germany)

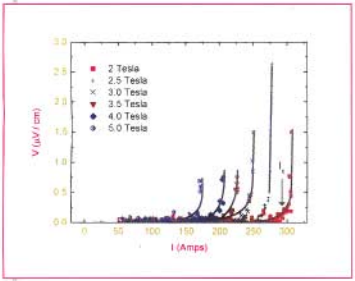

Fig.2 V-I curves of the 0.5 mm diameter Vacuumschmelze wire at different magnetic fields.

wire of 0.5 mm diameter and copper to superconductor ratio of 1.9:1 (45 filaments of Nb-Ti), whose critical current vs field values are known from earlier measurements. The critical current (I_c) obtained using a voltage criterion of 0.2 μV/cm matches very accurately with the available data on this sample.

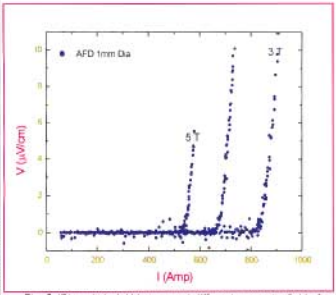

Fig. 3 (Blue circles) V-I curves at different magnetic fields for 1 mm diameter Nb-Ti/Cu wire developed by AFD earlier.

In Fig. 3, V-I curves obtained at different magnetic fields on a 1 mm diameter Nb-Ti/Cu wire with a copper to superconductor ratio 1.937:1 (45 filaments of Nb-Ti), fabricated earlier by AFD, BARC, are shown. The field dependent critical current density for these two (Vacuumschmelze and AFD) superconductors is plotted in Fig. 4 for comparison.

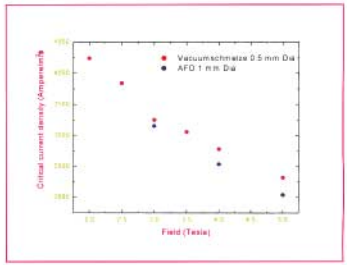

Fig. 4 A comparison of the critical current density values in Vacuumschmelze and AFD wires at different fields.

A further quality requirement of these superconductors is the filament uniformity. It is usually characterized by fitting the V-I curve to the form $V \propto I^n$. Typically n should be larger than 30 for a filament non-uniformity below 5-10%. From the data in Figures 2 and 3, it was found that n values are in the range of 40 to 50 for both the samples studied, indicating a good filament quality.

Figure 5 displays the V-I curve recorded on a twisted composite superconducting wire sample (1.37 mm diameter, 402 filaments of Nb-Ti/Cu, twist pitch 12.4 mm) recently developed in AFD, BARC for VECC Superconducting Cyclotron program. The figure clearly shows the resistive transition under a field of 5.5 T. In the inset of this figure, the V *vs* I characteristic in a *log - linear* scale is also shown. The continuous line in the inset indicates the voltage criterion of 0.1 μV/cm used for determining the critical current I_c. The noise level in the data

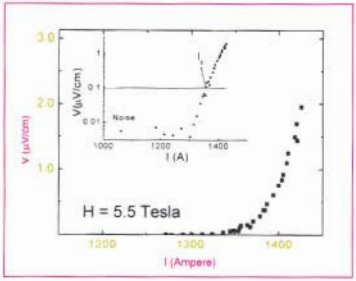

Fig. 5 Voltage-current characteristic measured at 5.5 Tesla on the 1.37 mm diameter twisted AFD Nb-Ti/Cu superconducting composite. In the inset, the voltage axis on a log scale is shown with the dotted line indicating the noise level and the continuous line indicating the voltage criterion used in obtaining the critical current I_c.

(indicated by a dotted line) is an order of magnitude below the voltage criterion used in obtaining the I_c value. The resistive transition index 'n' obtained is 63, which translates into a highly uniform Nb-Ti filament cross-section. It should be mentioned here that, to be able to see the resistive transition without quenching the sample, special care has to be taken when designing the sample mounting arrangement. It is important to provide adequate thermal stabilization to prevent thermal runaway leading to sample quench. In some earlier runs on these wires conducted abroad, the resistive transition index 'n' could not be estimated due to thermal runaway.

To summarize, a facility to characterize Nb-Ti/Cu multi-filamentary composite superconducting wires with current carrying capacity upto 1500 amperes in a variable magnetic field upto ~ 7.4 Tesla has been developed. This is a unique facility in the country, which not only can measure the critical current density but also can assess the quality of the superconducting filaments.

BARC TRANSFERS TECHNOLOGY OF RIG TESTING OF IODINE FILTERS

BARC has transferred the technology of Rig Testing of Iodine Filters, developed by Waste Management Division, BARC, to M/s Industrial Filters, Bharuch. The Combined Particulate and Iodine Filters are employed in Engineered Safety Systems (ESSs) of all Nuclear Power Plants and Research Reactors. The testing of the filters assumes importance since they are intended to have iodine removal efficiency of 99.99% or better.

Mr A.K. Anand, Director, Technical Coordination & International Relations Group, BARC, and Mr Rohit Kumar Madhavji of M/s Industrial Filters greet each other after signing the agreement.

Rig testing of iodine filters is carried out to evaluate its Iodine and methyl iodide removal efficiencies. The test method essentially involves injection of a test vapour tagged with radio-iodine upstream of the filter and measuring the proportion of the radio-iodine in the test vapour downstream.

Mr A.K. Anand, Director, Technical Coordination & International Relations Group (TC&IRG), BARC, and Mr Rohit Kumar Madhavji, of M/s Industrial Filters

signed the Technology Transfer Agreement on July 21, 2000 in the presence of Mr K. Balu, Director, Nuclear Recycle Group, and Mr B.K. Bhasin, Executive Director (O), NPCIL.

BARC TRANSFERS TECHNOLOGY OF TRIODE SPUTTER ION PUMPS

Technology Transfer & Collaboration Division, BARC, has transferred the technology of Triode Sputter Ion Pumps (TSIP) developed by Technical Physics & Prototype Engineering Division (TP&PED), BARC, to M/s Kamal Engineering Works, Mumbai, at a transfer fee of Rs 2.5 lakhs. The Technology Transfer agreement was signed on April 13, 2000 in the office of Mr A.K. Anand, Director, TC&IRG, BARC.

Dr V.C. Sahni, Head, TP&PED, BARC, and Mr Ramesh Panchal, Managing Director, M/s Kamal Engineering Works, Mumbai, greet each other after signing the agreement. Others in the picture are : Mr S.R. Halbe, Mr W.C. J. Carvalho, Mr M. K.V. Rao, Mr Karandikar and Mr Pathak from TP&PED, Dr A. K. Kohli and Mr S. Nawathe from TT&CD and Mr Sameer from M/s Kamal Engineering Works.

TSIPs are used to create Ultra High Vacuum (UHV) in charged particle accelerators, surface analytical spectrometers, mass spectrometers, etc. This technology is for the manufacture of 35, 70, 140 and 270 LPS capacity pumps. These pumps provide very clean operation and have no moving parts or pumping fluids. The operating pressure range is 10^{-3} to 10^{-10} Torr.

VALEDICTORY FUNCTION OF THE TRAINING COURSE ON HEALTH PHYSICS

The Valedictory function of the 7th Batch of the One Year Stipendiary Course on Health Physics, conducted for the Divisions of Health, Safety & Environment Group (HS & E Group) , BARC, and Health Physics Units of NPCIL and IGCAR was held on July 31, 2000 at the Multi-Purpose Hall, Training School Hostel, Anushaktinagar.

Dr Anil Kakodkar, Director, BARC, delivering the Presidential address on the occasion of the Valedictory function

Forty-nine trainees completed this course successfully. This function was presided over by Dr Anil Kakodkar, Director, BARC. Prof. S.P. Sukhatme, Chairman, AERB, was the Chief Guest, and Mr Ch. Surendar, Chairman & Managing Director, NPCIL, delivered the Valedictory address. On this occasion, Dr Anil Kakodkar, Director, BARC,

also released a brochure on the activities of the Divisions of HS & E Group, BARC.

Mr G.S. Jauhri, Head, Health Physics Division, BARC, welcomed the dignitaries and the distinguished invitees.

In his introductory remarks, Dr B.C. Bhatt, Head, Radiological Physics & Advisory Division, BARC, summarised the salient features of this course. He informed the gathering that, during the conduct of this course, special emphasis was laid on environmental monitoring and regulatory aspects, apart from operational health physics.

The Presidential address was delivered by Dr Anil Kakodkar, Director, BARC. He congratulated the trainees for successfully completing the course and welcomed them to the DAE family. He emphasised the need to apply the knowledge gained during the course of the training to various radiation protection problems. He emphasised the importance of measurement of low levels of radioactivity in the environment. After his inaugural address, Dr Anil Kakodkar released the brochure on the activities and achievements of the Health, Safety & Environment Group of BARC.

While delivering his address, the Chief Guest, Prof. S.P. Sukhatme, Chairman, AERB, said that the Operational Health Physicists are the eyes and ears of the Regulatory Board. He stated that the Regulatory Authority depends very much on them for the basic input parameters which are essential to carry out the regulatory functions.

The Valedictory address was delivered by Mr Ch. Surendar, Chairman & Managing Director, NPCIL. Mr Surendar mentioned that the Health Physicist is the first person to survey any operational area and hence he should report his observations and recommendations in an effective manner.

Dr Anil Kakodkar, Director, BARC, releasing the brochure on the activities of Health, Safety & Environment Group, BARC. Mr Ch. Surendar, CMD, NPCIL, and Prof. S.P. Sukhatme, Chairman, AERB, look on.

The first two merit rankers, Mr Santosh H. Shinde and Ms Shobha B. Gachi, were awarded certificates and cash prizes instituted by AERB. These certificates were awarded by Prof. S.P. Sukhatme.

The function concluded with the Vote of Thanks proposed by Mr P.S. Sivasubramanian, Officer-in-Charge, Training Group, HPD, BARC.

BARC PRODUCES HIGH PURITY CERIUM CHLORIDE

Monazite is the principal source of cerium, a rare earth element. Monazite is decomposed with caustic soda converting the uranium, thorium and rare earths values to their hydroxides. The hydroxide cake is leached with hydrochloric acid to get rare earths in solution. A crude cerium concentrate (80%) is obtained by oxidation and precipitation as ceric hydroxide. Further purification (<99.9%) is carried out by solvent extraction process using an organo phosphorous compound as extractant. Cerium is stripped from the organic phase. By evaporations of strip liquor, pure

crystalline cerium chloride is finally obtained. Rare Earths Development Section of Materials Group has supplied high purity cerium chloride to Davos Corporation of USA for pharmaceutical application. The supply, first of its kind from India, opens an international market for high purity non-strategic application of rare earths.

ATOMIC ENERGY JUNIOR COLLEGE REPEATS ITS SUCCESS STORY

For a second time in the last three years, a student of the Atomic Energy Junior College (AEJC), Mumbai, has topped the Mumbai Division in the Higher Secondary Certificate Examination conducted by the Maharashtra State Board in March 2000. The AEJC, Mumbai, has regularly figured among the top high performing junior colleges in the Mumbai Division of the Maharashtra State Board and has been placed sixth this year.

Principal Ms Rani Verma of AEJC felicitating Ms Roumi Gop who topped the Mumbai Division in the HSC Examination, March 2000.

Ms Roumi Gop scored a whopping 576 marks out of a possible maximum 600 in the HSC Examination held in March 2000. Ms Gop also topped the Chemistry paper with a 100% score. Three other students of AEJC, Mumbai, also figured in the Board's list of rank holders. Mr Kedar Kale, Mr Shrish Kadival and Mr Manas Shah ranked 10th, 12th and 14th respectively in the Mumbai Division.

Rank holders of AEJC, Mumbai, at HSC Examination, March 2000. (Sitting L to R) : Principal Rani Verma, Ms Roumi Gop and Electronics-Teacher (late) Mr P. Malla Reddy. (Standing L to R) : Mr Shrish Kadival, Mr Kedar Kale and Mr Manas Shah.

The performance of the students of AEJC, Mumbai, in the HSC Examination conducted in March 2000 is, in fact, an improvement over the performance in the March 1999 HSC Examination. To begin with, the overall pass score of the AEJC students improved from 93.3% in March 1999 to 96.7% in March 2000. In the Science Group, the pass score went up from 94% to 99% and in the Commerce Group, the score improved marginally from 92.68% to 93.03%.

In the Physics, Chemistry and Mathematics (PCM) aggregate, the number of students getting 90% and above was 109 in March 2000, up from 80 in March 1999. In the 95% and above category in the PCM combine, the number was up from 27 in 1999 to 39 in 2000. In the Physics, Chemistry and Biology (PCB) combine, 18 students scored 90% and above in Mach 2000, up from only 8 in March 1999.

In the Commerce Stream too, there has been a noticeable improvement in the students' performance in all the subjects.

The sterling performance of AEJC, Mumbai, mirrors the unwavering support and encouragement extended by the parents, the Principal of AEJC, Mumbai, and the Management of the AEES to the students and teachers.

BARC CELEBRATES FIRE SERVICE WEEK

On every April 14 (National Fire Service Day), the nation pays homage to the courageous, devoted and exemplary fire service personnel who lost their lives gallantly fighting the fire that erupted and the explosions that followed on April 14, 1944 at the Victoria Docks, Bombay Port Trust. BARC too observed the Fire Service Week during April 14-20, 2000.

On April 14, 2000, better known as the Commemoration Day, Mr A.K. Tandle, Chief Fire Officer, BARC, placed wreaths at the memorial erected on the grounds of Mumbai Port Trust and Mumbai Fire Brigade headquarters.

Mid week, the annual Fire Service Pin Flag Fund raising campaign was initiated, with the first pin flag being offered to Dr Anil Kakodkar, Director, BARC.

Chief Fire Officer, Mr A. K. Tandle, offering bouquet to Dr Anil Kakodkar, Director, BARC, on the occasion of the inauguration of fund raising campaign during the Fire Service Week.

In a brief speech, Dr Anil Kakodkar opined that continued efforts should be made to create an awareness on fire safety not only among BARC

A view of the exhibition arranged during the Fire Services Week at Modular Laboratories "B" Block for the benefit of staff members of BARC.

employees and scientists of Anushaktinagar, but also among the public in general. (It would be fitting to mention here that a Training Progamme in fire fighting was conducted in December, 1999 for about 500 NCC cadets in a camp at Anushaktinagar.) The speech was followed by a morale boosting drill competition organised for Fire Service Section personnel where individual skills were amply and and ably displayed.

An exhibition of fire fighting equipment at Modular Laboratories, BARC, and a demonstration on fire fighting, rescue operations and fire safety in handling of LPG cylinders was held at Nilgiri Building, Anushaktinagar. Both evinced encouraging response and were witnessed with keen interest by employees and residents alike.

A ceremonial parade at Cross Maidan which included an impressive contingent of Fire Fighting Section personnel of BARC and fire fighting equipment marked the culmination of the observation of the Fire Services Week, 2000.

FORTHCOMING SYMPOSIA

- The first International Conference on "Vibration Engineering and Technology of Machinery (VETOMAC-1)", organized jointly by Indian Institute of Science, ISRO Satellite Centre, National Aerospace Laboratories, Gas Turbine Research Establishment and the Vibration Institute of India and co-sponsored by Board of Research in Nuclear Sciences, DAE, will be held during October 25-27, 2000 at Bangalore.

The topics for the Conference include : Nonlinear Vibrations, Rotor Dynamics, Random Vibrations, Wave Propagation, Fluid-induced Vibrations and Dynamic Aeroelasticity, Vibration Control and Control-Structure Interaction problems, as well as recent advances in Vehicle Dynamics, Dynamic Model Synthesis and Identification, MEMS and Smart Systems.

The Conference will be preceded by a two-day Workshop on "Rotor Dynamics" to be held during October 23-24, 2000. A technical exhibition by leading manufacturers of vibration equipment and software, as well as industry/product presentations, will form a part of the Conference.

(Contact : Prof Kartik Venkatraman, Department of Aerospace Engineering, Indian Institute of Science, Bangalore-560 012; Phone : (91)80-3092874, 3092420; Fax : (91)80-3345134, 3341683, 3342085; E-mail: kartik@aero.iisc.ernet.in, kartik@theodorsen.aero.iisc.ernet.in, kvenkatraman@yahoo.com)

- The XVth National Symposium of Indian Photobiology Society on "Light Regulated Processes & their Application to Human Welfare" will be held at the Department of Botany, Goa University, Goa-403 206 during November 8-10, 2000. The Symposium, organised by the Indian Photobiology Society and the Department of Botany, Goa University, and co-sponsored by the Board of Research in Nuclear Sciences, DAE, will provide insight into exciting development in the field of photobiology and photochemistry. The symposium will consist of plenary lectures, oral presentations and poster presentations along with special lectures by distinguished experts in diverse areas related to photobiology and photochemistry.

(Contact Dr P.K. Sharma, Convenor, XVth National Symposium of Indian Photobiology Society, Department of Botany, Goa University, Goa-403 206; Phone : (Off.) 221 345, 221 346, 221 347 Ext. 354; (Res.) (0832)238 556; Fax: (0832) 224 184; E-mail: pksharma@unigoa.ernet.in)

- The 15th National Symposium on "Plasma Science and Technology : Plasma 2000", organised by Saha Institute of Nuclear Physics and Plasma Science Society of India and sponsored by Board of Research in Nuclear Sciences, DAE, is proposed to be held at Saha Institute of Nuclear Physics, Calcutta, India, during December 5-8, 2000.

Broad topics to be covered in the Symposium include : Basic Plasma Physics, Space and Astrophysical Plasmas, Fusion Plasmas, Plasma Processing & Industrial Plasmas, Dusty Plasmas, Non-neutral Plasmas, Quark-gluon Plasmas and Solid-state Plasmas.

(Contact : Mr Ratneswar Ray, Convener, Plasma-2000, Saha Institute of Nuclear Physics, 1/AF, Bidhannagar, Calcutta-700 064; Tel. : (Off.) 033-3370379, 3370313, 3375345--46; Fax: (+91)(33) 3374637; E-mail: plasma2k@plasma.saha.ernet.in)

- Symposium on the "Use of Nuclear & Molecular Techniques in Crop Improvement", sponsored by the Board of Research in Nuclear Sciences (BRNS), DAE, will be held at BARC, Trombay, during December 6-8, 2000. The Department of Atomic Energy has contributed to the cause of genetics and crop improvement through the use of radiation and radioisotopes for induction of mutation or through tracer studies in biology and agriculture at national level through its own programme and programmes supported by BRNS. With such a backdrop, the following themes have been identified for deliberations during the symposium: (a) Production characterisation and utilisation of mutants resulting in improvement of yield, biotic and abiotic stress tolerance or similar agronomically important traits in crop plants; (b) Use of radioisotopes in induction and studies of mutation, conventional and molecular genetics, plant biotechnology where characters of economic importance in crop plants have been studied; (c) Application of recent ideas in comparative genomics, structural and functional genomics to identify new gene sources and their potential in crop improvement; (d) Use of molecular methods in mutant and varietal characterisation and identification as a tool in crop improvement and in the new IPR regime.

(Contact: Dr S.G. Bhagwat, Convenor, DAE-BRNS Symposium, Nuclear Agriculture & Biotechnology Division, Bhabha Atomic Research Centre, Trombay, Mumbai 400 085, India; Fax : (+91)(22) 5505151; E-mail : sgbhagwat@apsara.barc.ernet.in)

BARC SCIENTIST HONOURED

Dr V.K. Jain of Novel Materials & Structural Chemistry Division, BARC, has been chosen to receive the Chemical Research Society of India (CRSI) medal in recognition of his contributions to research in chemistry. Prof. C.N.R. Rao is the current President of CRSI. Dr Jain has been actively working on organometailic compounds of platinum group metals and main group elements and their possible applications in materials science. Dr Jain is the recipient of several awards including "Homi Bhabha Science & Technology Award" (1996) of Department of Atomic Energy.

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