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बी एआरसी न्यूज़लैटर

BARC NEWSLETTER

IN THIS ISSUE

In the next issue

Fatigue Studies on Carbon Steel Piping Materials and Components: Indian PHWRs

Low Cycle Fatigue (LCF) damage of piping systems is inevitable due to repeated thermal stresses, generated during the operation of PHWRs. Therefore, factors relating to LCF and cyclic stress strain behaviour are important in the design and integrity analysis of these piping components. The Reactor Safety Division has initiated a component test programme to understand, demonstrate and verify issues, related to the design, safety and life extension of the components. Under this programme, studies were carried out on seamless pipes of different varieties used in Indian PHWRs. The results of these studies are described in this article.

बीएआरसी न्यूज़लैटर
BARC NEWSLETTER

CONTENTS

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बीएआरसी न्यूज़लेटर
BARC NEWSLETTER

INDIAN REAL TIME ONLINE DECISION SUPPORT SYSTEM (IRODOS)

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INTRODUCTION

Multi-level safety features are an inherent characteristic of nuclear technology and these are necessary to :

- Prevent an accident from occurring in the first place.
- Limit its magnitude in the unlikely event of an accident.
- Limit the consequences of the accident itself, in case it takes place.

In keeping with the traditional emphasis on safety, nuclear technologists were prompted by the Chernobyl accident (1986), to consider the consequences of accidents Beyond the Design Basis Accident (BDBA) scenarios, despite the fact, that the probability of such an occurrence was considered extremely low. These consequences, though highly unlikely, necessitate additional measures to protect the public from possible adverse radiological impact and it is in this context, that there is need for drawing up emergency preparedness plan for such contingencies.

The foremost part of a nuclear emergency planning are :

- An early prediction or assessment of the extent and significance of any accidental release of radioactivity to the environment.
- Rapid and continuous assessment of the accident.

The current emergency plans prepared and approved for practice in Indian Nuclear Power Plants (NPPs), fully depend on environmental radiation monitoring. This, along with prevailing site specific meteorological conditions are used, at deciding the areas / sectors effected for implementing countermeasures like iodine prophylaxis, sheltering, temporary relocation, evacuation etc.

This approach may have limited application in case of a BDBA scenario, wherein a long term release of the activity is anticipated, leading to change in effected sectors with time, due to change in meteorological conditions (specially the wind direction). Additionally, any countermeasure will require a certain duration (time lag) before it is being implemented, requiring an advance prediction of the sectors effected. Also, in case of a temporary relocation, it is important that during the transit period, the public should not be crossing the sectors having high radioactivity during their movement/ transport, thereby requiring the best escape route prediction, leading to minimum exposure

to public, during such type of eventualities.

Keeping in view these limitations / requirements, a real time online nuclear emergency response system, with 72 hours meteorological and radiological forecasts, for off-site nuclear emergency under the frame work of "Indian Real time Online Decision Support System "IRODOS", for Nuclear Power Plants (NPPs) has been designed and developed, which takes care of the predictive requirement for emergency planning.

It is an inter-divisional programme of the Health, Safety and Environment Group, BARC.

SALIENT FEATURES OF IRODOS

- This is a decision support system, to handle an offsite nuclear emergency, arising out of an unlikely event of a nuclear accident.
- It is a system similar to an operational European emergency response system RODOS.
- This system shows a 72 hr weather and radiological forecast at any instant of time.
- The system is designed for fixed sites (i.e. taking care of topography and local characteristics).
- The 72 hr weather forecast with an hourly resolution for this region, in a 10 km x 10 km, is provided by the National Centre for Medium Range Weather Forecasting (NCMRWF), Noida. This NWP (Numerical Weather Prediction) is updated every 24 hours.
- The NWP is used by RIMPUFF (Riso Mesoscale Puff Model) and predicts the atmospheric concentration, ground deposition, the atmospheric activity, below plume activity, deposited activity etc. on a 1 km x l km resolution, for various radionuclides (64). Finer grid resolution is achieved by mass consistency interpolation technique.
- These concentrations are used by a radiological dose code, COSYMA (Code SYstem from Maria) to predict the dose received by human population (public). This takes into account, the inhalation dose, plume dose, dose due to deposited activity etc.
- These doses based on the avertable dose concept are utilized in forecasting optimum counter measures like Iodine prophylaxis, Sheltering, areas requiring Evacuation on a GIS (Geographical Information System).
- GIS shows the area, villages, cities etc. on which countermeasures are to be applied.
- Query specific population in a particular area, nearest Public Health Care Centres, nearest rallying point (collection centre), sheltering locations etc. are also provided to the user in the GIS.
- GIS also shows the logistics available like transportation, manpower, availability of Iodine tablets etc. to carry out the countermeasures.
- The system shows the optimum transportation route to be followed, in order to have minimum exposure to radiological activity, during the implementation of countermeasures.
- In the day-to-day operation, a hypothetical, Beyond Design Based Accident (BDBA) scenario (NORMAL MODE) with high activity release is simulated, so that, all modules are activated at any instant of time. Information on the likely areas to be affected, areas requiring monitoring etc. in case of an accident are thus available to the user, at any instant of time.
- In case of a real emergency, which is detected by the field Environmental Radiation Monitors (ERMs), placed in the form of two rings, the system switches over to an EMERGENCY MODE from the NORMAL operating mode. Visual changes in the GIS display, along with alarm sound systems are activated, for alerting the operators.
- The ERMs are stand-alone solar power-based GM detectors with GSM communication devices.
- Based on the ERMs readings, the system calculates the likely source term using inverse calculation

and the actual meteorological conditions of the site.

- The realtime weather conditions are monitored using the Automatic Weather Stations (AWS) supplied by ISRO. The AWS are solar powered and data transmission is through satellite.
- The concentrations and dose fields calculated in the NORMAL mode are either downscaled or upscaled, for initial phase action in the EMERGENCY mode. The entire calculations are re-run to simulate the scenario using the estimated release rate, for later phase EMERGENCY actions.
- Since a practical duration is required in a real world, the advanced radiological forecast and advanced counter measures predicted by the IRODOS system, will be very useful, to the Emergency Response Team handling the crisis.

A flow sheet of the IRODOS system is shown in Fig. 1.

NUMERICAL WEATHER PREDICTION

The system in its present form gets 72 hours forecasted meteorological data [Numerical Weather Prediction (NWP)] from mesoscale weather forecast model MM5, operational at NCMRWF, Noida. The NWP is available in grid size of 10 km x 10 km over the horizontal domain of 150 km x 150 km with NPP at the centre and covering a vertical height of about 15 km.

ATMOSPHERIC TRANSPORT MODELLING

The NWP data is used in driving the atmospheric contaminant dispersion model, a model based on the concepts of RIMPUFF, to simulate the transport and deposition of various radionuclides in case of an accident at NPP, with output in a grid size of 1 km x 1 km and a time resolution of 1 hour upto a radial distance of 75 km from the reactor centre.

RADIOLOGICAL DOSE MODELLING

The dispersion model results are utilized in calculating the radiological doses, received by the population, through various intake pathways, using COSYMA code. Optimum countermeasures, based on IAEA's avertable dose concept are also predicted using this code.

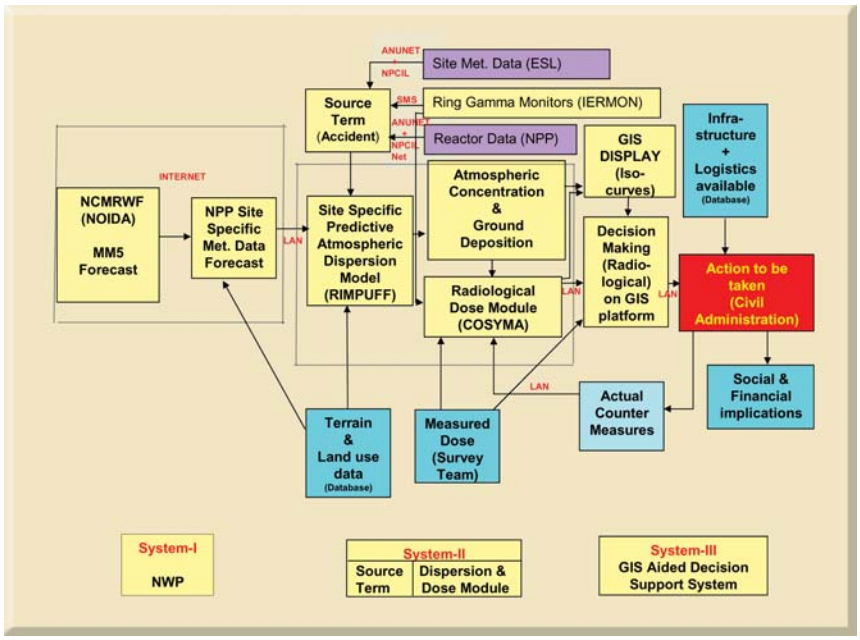

Fig.1: Flow sheet of IRODOS.

NORMAL AND EMERGENCY OPERATION

The system in its normal operation runs with a high release term (possibilistic source term), to simulate a Beyond Design Based Accident (BDBA) scenario, with all countermeasure options activated. An accident / event is sensed by the IRODOS system using the reactor (NPP) status sensors and / or from the field environmental radiation monitors, located around each

NPP. The environmental radiation monitoring network planned in the form of two rings (one at 500 m and another at 1600 m) around each of the NPPs to sense an accident is shown in Fig. 2.

The indigenously developed solar powered environmental radiation monitor to be used in the above network, is also shown in Fig. 2. Data from these monitors is continuously received and updated at the IRODOS centre, using GSM-based wireless data communication devices, inbuilt in this system.

Once an event / accident is sensed, IRODOS system switches over to an emergency mode. In this mode, it calculates the likely source term based on the ring monitors (inverse calculations) or from the NPP status data and using the realtime weather data from AWS. The atmospheric concentration and dose contours are updated, based on this source term for early phase action. The entire dispersion and dose calculation with the new source term is activated along with the estimation of optimum countermeasures, for later phase decisions.

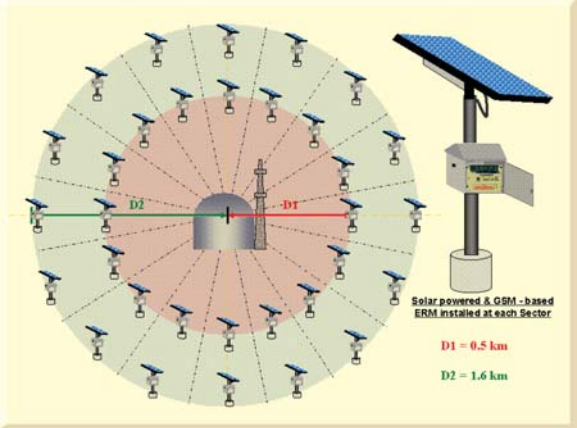

Fig. 2: Environmental radiation monitoring network

SOURCE TERM CALCULATION

Estimation of the release rate, after an accident has taken place, is the most important, difficult and debatable component, deciding the impact and course of emergency action plan.

In IRODOS, there are two approaches for estimating source term

- First is by using pre-release estimates (anticipated from nuclear power corporations Centralised Operating Plant Information System; COPIS), which are based on actual NPP process status (if available) and based on postulated accident scenarios.
- Second is by using post release estimates based on the gamma dose rate measurements of the installed online environmental radiation monitors.

The main assumptions used, in estimating the source term using the second approach is that, the integrity of the containment would remain intact, however, the release may occur through stack or through leakages at the ground level or both.

Measured dose rate D_{ik}, recorded at receptor (500m or 1600m) can be represented by

$$D_{ik} = \sum_j Q_j \times DRF_{ijk}$$

where 'i' is the index for weather category, 'j' is the index for height of release, 'k' is the index for receptor location, Q_j is the quantity of radionuclide released at height j and 'DRF' represents Dose Response Function for respective i, j and k for unit activity (from a possible mixture of radionuclides).

Using the above relation and an iterative inverse approach, a time-dependent source term (Q_j) along with likely radionuclide spectrum is estimated.

GEOGRAPHICAL INFORMATION SYSTEM (GIS)

The atmospheric concentration, deposition and radiological doses are displayed on a GIS platform. The various database (layers) available in GIS include city and village boundaries, hospitals, schools, police

and fire stations, sheltering and rallying points, vegetation cover and live stocks, transportation, logistics available, road network etc. Figs. 3 and 4 show a typical concentration output and counter measures predicted for a hypothetical release at NAPS, Narora for visualization and for action to be taken by decision makers.

IMPLEMENTATION

The first prototype system developed under this programme for NAPS, Narora, is operational at the Emergency Response Centre of BARC, Mumbai for the last two years and the demonstration version at NAPS, Narora is operational since the last six months. It is planned to deploy these systems in a phased manner at various NPPs of the Nuclear Power Corporation of India Limited (NPCIL).

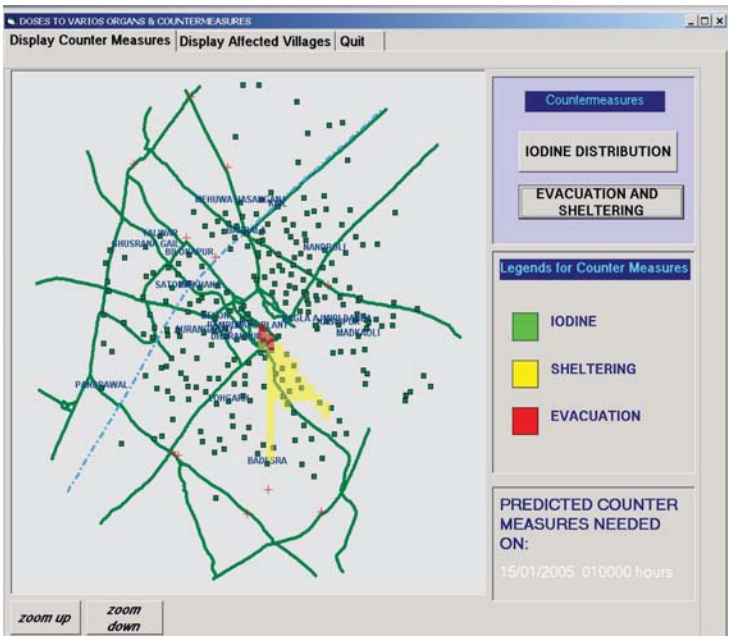

Fig. 4: Display of countermeasures required on a GIS platform.

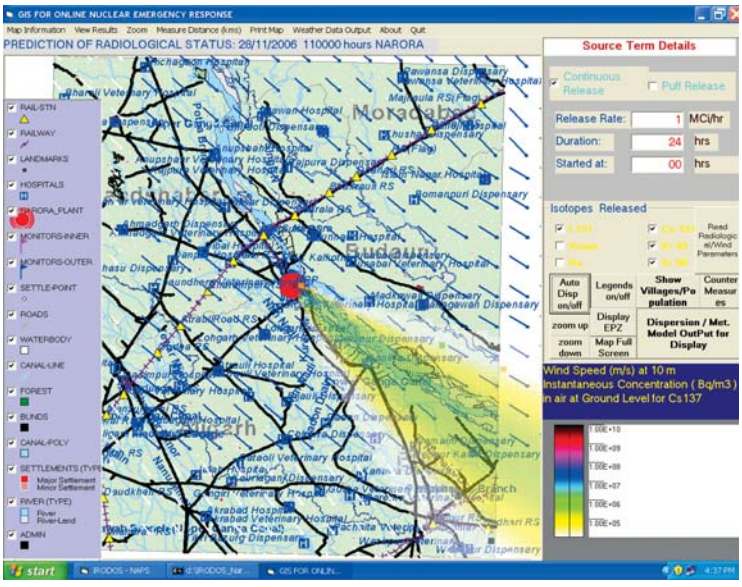

Fig. 3: Display of instantaneous ^{137}Cs concentration on a GIS platform.

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SEPARATION OF PALLADIUM FROM HIGH LEVEL LIQUID WASTE, GENERATED FROM REPROCESSING OF PHWR SPENT FUEL

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Palladium (Pd) is one of the rare elements found in the earth's crust. High melting point, extraordinary catalytic and corrosion resistant properties both as a pure metal and as an alloy make it important in several applications. Trends in production, demand and prices show[1,2] that there has been a growth in the demand for Platinum Group Metals (PGM), particularly of palladium, over the years. In order to meet this increasing demand and in view of its scarce availability, there is a need to look for new sources of PGM. Palladium is produced as a fission product in nuclear reactors and about 4 kg and 19 kg of PGM, per tonne of heavy metal, are produced in Light Water Reactors and Fast Breeder Reactors respectively. Hence, spent fuel forms a major source of PGM. During the reprocessing of spent fuel by the PUREX process, palladium and other PGM get distributed between high level solid waste and High Level Liquid Waste (HLLW). Nearly 1000 tonnes of palladium is estimated to be present in HLLW the world over.

The International Atomic Energy Agency published a report[3], to provide a basis for further consideration of the options for PGM recovery from HLLW and for the formulation of appropriate strategies. A review of the different methods used for the recovery of palladium from reprocessing waste solutions has been done earlier[4]. The methods tried previously for the recovery of palladium, involved multi-step separation techniques, with feed conditioning. Some of the solvents used were not suitable for its selective separation. Hence, studies were carried out, to develop simple and rapid separation techniques for Pd from HLLW that can be employed over a wide range of nitric acid concentrations, with high salt content and radioactivity.

This article describes the separation of palladium by solvent extraction technique using alpha benzoin oxime[5] (ABO) in solvesso 100 and by a precipitation method, using the sodium salt of di-methyl glyoxime[6] (DMG). Detailed studies on the composition of the extracted species during solvent extraction were also carried out. Analytical methods were developed in the course of studies and adopted to determine the concentration of palladium in HLLW. Based on the recovery studies using simulated HLLW of spent fuel from PHWR, a flow-sheet has been proposed and used, to separate Pd at sub mg level, from an actual PHWR-HLLW.

ABO in solvesso 100 (1.1×10^{-2} M) was used as an extractant. 4 M NH_4OH and 0.05 M thiourea in 0.1 M HNO_3 were used as strippant. Palladium nitrate solution (1×0^{-2} M) was prepared from palladium chloride as per standard procedure. Suitable aliquots from this solution, were diluted in desired concentrations of HNO_3 and used as feed for various experiments. In precipitation studies,

sodium salt of DMG (0.1% in water) was used as precipitant. Tracers of plutonium and uranium were obtained from purified product streams of PUREX and THOREX processes. Fission products *viz* ^{137}Cs, ^{125}Sb, ^{106}Ru etc. were used as composite activity from HLLW or from a ^{252}Cf source, using aluminum capture foil followed by its dissolution. ^{109}Pd tracer was obtained by irradiating spectrochemically pure ammonium chloropalladate in the APSARA research reactor, which was dissolved and converted into nitrate form.

HLLW

Two types of simulated PHWR-HLLW[7], one containing uranium, plutonium and fission products in the form of natural isotopes of the sameelements and the other containing uranium, plutonium along with radiotracer of ^{109}Pd and radioactive fission products were used. Actual HLLW generated from the processing of spent fuel from power reactor (burn-up ~6000 MWD/Te) in PREFRE Plant, Tarapur was used.

Separation using solvent extraction procedure

Extraction

Fixed volume (2-5 mL) of aqueous phase, containing simulated HLLW spiked with known concentration of Pd at desired concentrations of nitric acid in the range of (0.1 M to 6 M) or actual HLLW sample solution was used as feed in these batch extraction experiments. This was contacted with equal volume of organic phase (1.1 x 10^{-2} M ABO in solvesso100) for about 5 min. Palladium loaded organic phase was scrubbed with 0.1 M HNO_3 prior to its stripping. Diluted ammonia solution (4 M) or 0.05 M thiourea in 0.1 M HNO_3 were used as strippant. In all the batch extraction studies, the concentration of palladium in the feed was maintained at 1×10^{-3} M as encountered in PHWR-HLLW.

The results of Pd extraction using ABO at varying concentrations of HNO_3 and HCl are given in Fig. 1. From the results it can be observed, that percentage extraction of palladium decreases with increasing concentration of HCl in the feed, whereas, quantitative extraction of Pd is observed for the entire concentration range of HNO_3. This suggests that extraction of palladium using ABO from HLLW can be achieved, without any feed acidity adjustment followed by stripping, using higher concentrations of HCl.

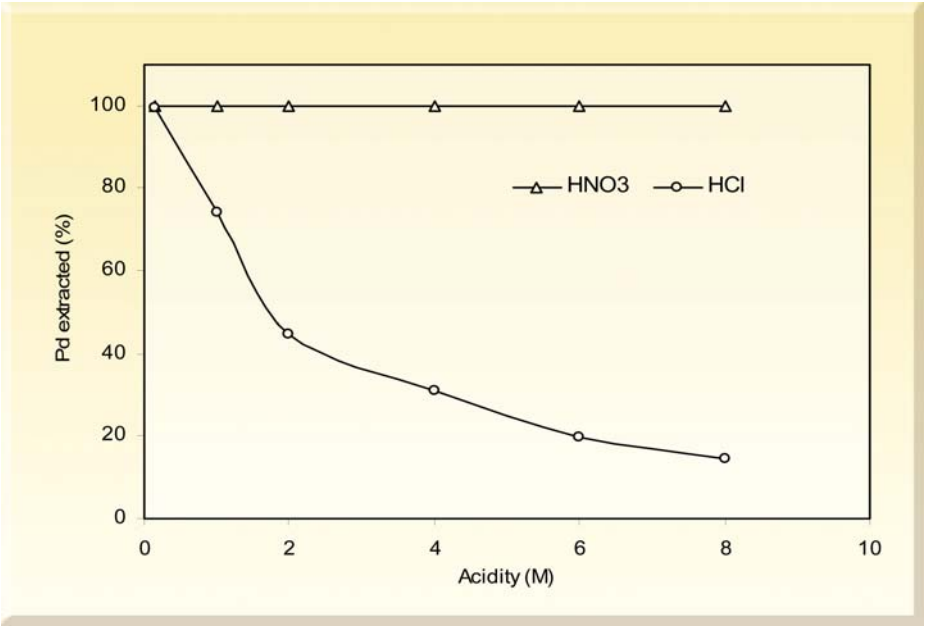

Fig. 1: Extraction of Pd using ABO in solvesso 100 as a function of [HNO_3] and [HCl]

Stripping

Palladium loaded organic phase from the extraction experiments were used for stripping studies, using commonly used reagents such as HCl, Na_2CO_3, ammonia solution and a mixture of thiourea and HNO_3. Among them, 0.05 M thiourea in 0.1 M HNO_3 and 4 M ammonia solution were found to be suitable for quantitative stripping of Pd. HCl though an effective strippant (Fig.1), being corrosive, was not followed up further.

In order to know the decontamination factors with respect to uranium, plutonium and individual fission products such as ^{137}Cs, ^{144}Ce, ^{125}Sb, ^{106}Ru and ^{95}Zr, the extraction of Pd was studied from the feed solutions containing HNO_3 at different concentration ranging from 0.1 M to 4 M after spiking them at tracer activity levels. The results from these experiments are presented in Table 1. It is observed that the decontamination factors (DF) for all the metal ions are observed to be better from feed solutions with lower concentrations of nitric acid, suggesting that, lower acidity of HLLW will favour the decontamination of Pd, from these radionuclides.

In a separate experiment, the kinetics of Pd extraction was studied. The result indicated fast quantitative extraction showing attainment of complete equilibrium within 30 seconds. However, in all the extraction experiments, a contact time of ~5 min. was followed.

On the basis of the above findings, the extraction of Pd was studied using Pd spiked simulated PHWR-HLLW solutions without radioactive fission products as described above. Like other extraction experiments, the concentration of Pd in the feed was kept at 1×10^{-3} M. Quantitative extraction of Pd was observed in single batch contacts using ABO. Organic phase after scrubbing with 0.1 M HNO_3 was stripped with 4 M ammonia solution. Results indicated a Pd recovery of higher than 99%.

The above separation procedure was tested using the simulated PHWR-HLLW containing radioactive fission products as described above. Fig. 2 gives the gamma spectrum of feed and Pd-loaded organic phase, after extraction and scrubbing.

These spectra indicate the selective separation of Pd from HLLW using ABO. Radioassay of Pd in feed and organic phase, confirmed the quantitative recovery of palladium by the present method. The results from this experiment also showed very high decontamination factors for Pd, with respect to the other elements present in milligram quantities during the extraction.

Table 1: Extraction behaviour of U, Pu and FPs during extraction of Pd by ABO

Conc. of HNO_3 in feed (M)	DF (Decontamination Factors) of Uranium	DF (Decontamination Factors) of Plutonium	DF (Decontamination Factors) of individual Fission products				
			^{144}Ce	^{125}Sb	^{106}Ru	^{137}Cs	^{95}Zr
0.1	6.6×10^3	$>1.9\times10^4$	>650	>100	83	2109	>150
1.0	4.73×10^2	1.02×10^3	>650	>100	83	2109	>150
2.0	3.43×10^2	1.67×10^2	>650	>100	76	1809	>150
4.0	78	1.22×10^2	>650	>100	35	1515	>150

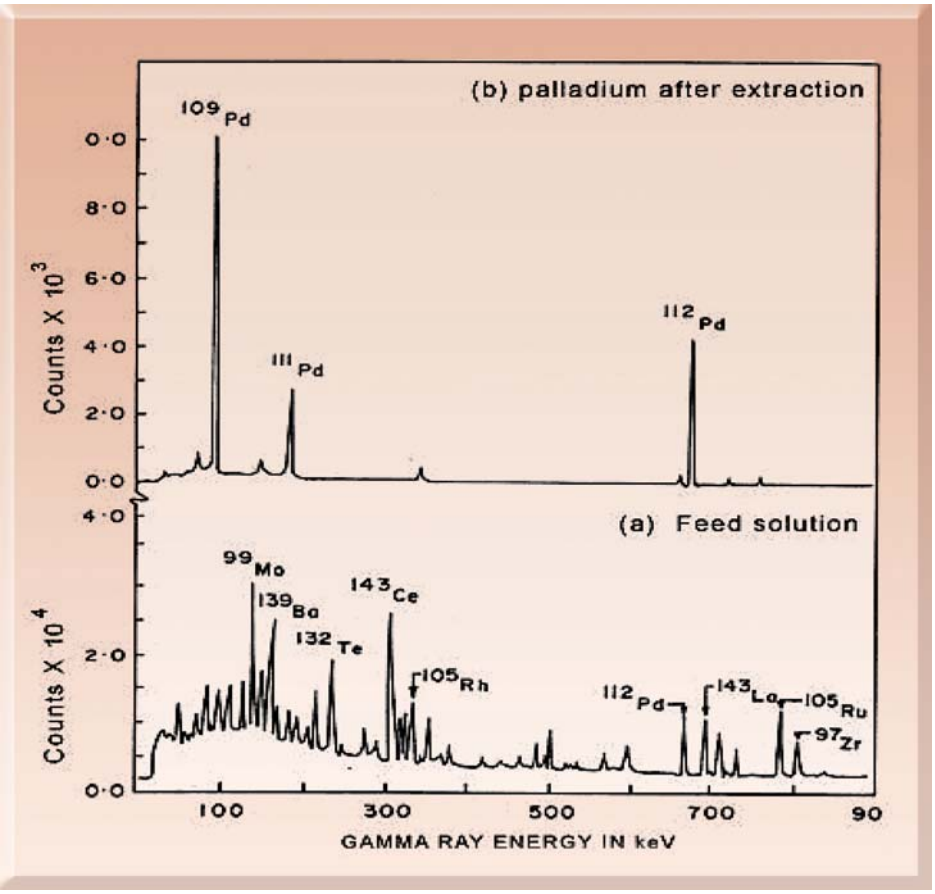

Fig. 2: Gamma spectra of synthetic HLLW before and after solvent extraction

Composition of Pd-ABO complex

Fig. 3 gives absorption spectra of Pd in nitric acid as well as Pd-ABO in solvesso100. Maximum absorption for palladium in nitric acid medium obtained is at 415 nm which is shifted to lower wavelength after complexing with ABO in solvesso 100. The spectrum of Pd-ABO shows maxima at 360 nm with inflation at 410 nm. Molar extinction coefficient of palladium nitrate aqueous solution and palladium extracted by ABO in solvesso 100 were found to be 180 and 3.5 ´ 10^3 $L.M^{-1}.cm^{-1}$ respectively.

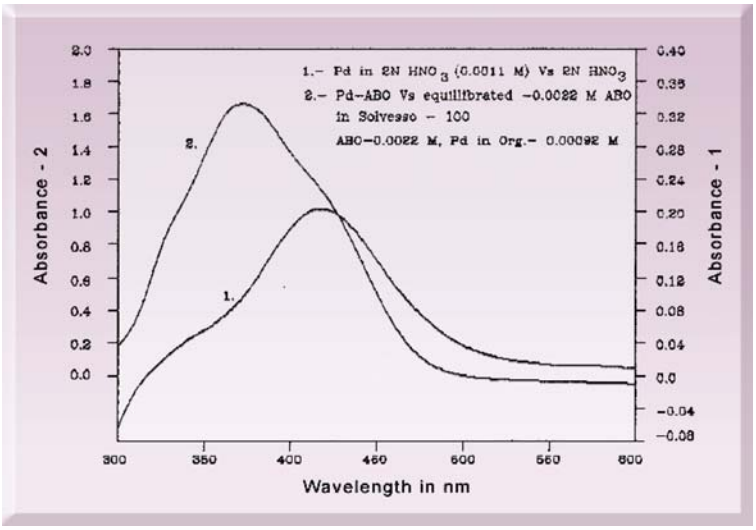

Fig. 3: Absorption spectra of palladium nitrate and Pd-ABO in solvesso 100

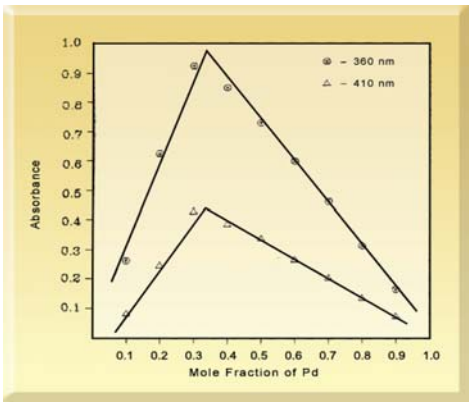

Fig. 4: Isomolar series method using absorbance measurement

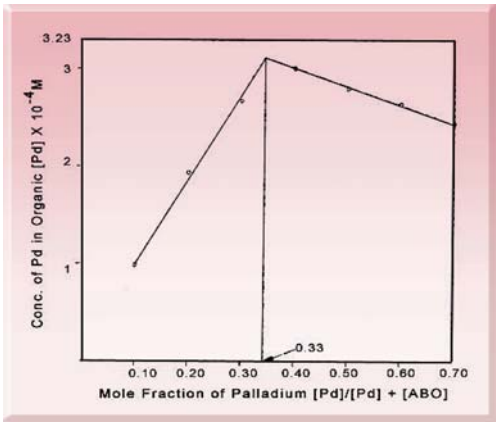

Fig. 5: Isomolar series method using Pd conc. measurement

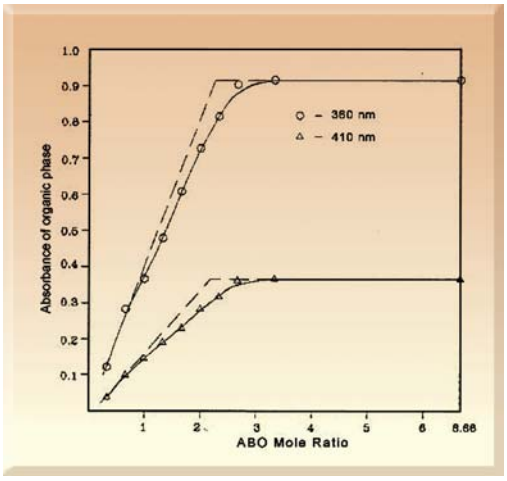

Fig. 6: Mole ratio method -organic phase absorbance measurement

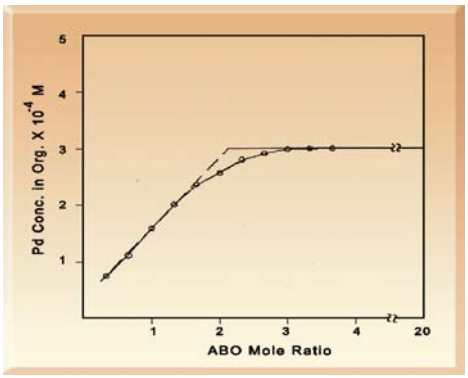

Fig. 7 : Mole ratio method - organic phase palladium concentration measurement

A detailed study to determine the molar composition of palladium and ABO in solvesso 100 during solvent extraction was carried out. Among the methods described in the literature, Isomolar series method [8-10] extended to two phase system [11] and mole ratio method [12, 13] have been employed. The results from these experiments are depicted in Figs. 4-7. These studies indicate the metal to ligand ratio to be 1 : 2.

From the mole ratio curves degree of dissociation and stability constant of the complex were calculated and the values were found to be 0.162 and 5.4×10^9 respectively.

Separation using Precipitation Technique

Method

5 mL of palladium solution (1×10^{-3}M) along with different constituents of HLLW was mixed with 3.5 mL of 0.1% Na-DMG. After 15 minutes, the precipitate was filtered. The filtrate was analyzed for palladium and other constituents. Palladium in the precipitate was dissolved in 5 M HNO_3 and analyzed. Analysis of palladium in various samples was carried out by spectrophotometry, which was developed during the course of the present work the details of which are described in this article.

Precipitation studies carried out on the optimization of the concentration of precipitant showed, that a

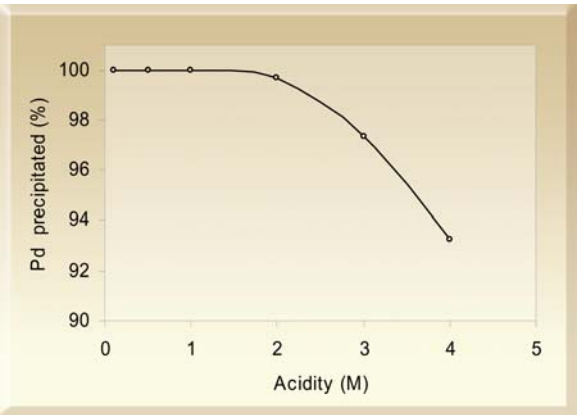

Fig. 8: Effect of acidity on the precipitation of Pd by Na-DMG

reagent concentration of 0.085%, is sufficient for quantitative precipitation of Pd. This corresponds to the ligand-to-metal ratio of ~60. However, in further experiments reagent concentration of 0.1% was maintained that corresponds to ligand / metal ratio of ~100. Fig. 8 shows the effect of nitric acid concentration on the precipitation. It is evident from the figure that quantitative precipitation of Pd is achieved, when the concentration of HNO_3 is in the range of 0.1 to 2 M. The percentage of palladium precipitated decreases beyond 2 M. Hence, for quantitative precipitation of Pd, the acidity of the feed solution should be below 2 M. Solubility of Pd-DMG precipitate was studied as a function of nitric acid concentration and it was found that it dissolved completely in 5 M HNO_3.

In order to find the decontamination factors with respect to various metal ions, synthetic HLLW containing uranium, palladium and other inactive fission product elements were subjected to precipitation procedure and the Pd-DMG dissolved solution was analyzed for various metallic impurities by ICP-AES. The results are shown in Table 2 which show very high decontamination factors from all the fission product elements. Nickel and molybdenum which are normally precipitated with DMG were also not found to interfere in the Pd separation. This is due to the fact, that these metals are precipitated by DMG in slightly alkaline medium, whereas, the present experiment conducted was in acidic medium.

Separation of Pd from actual HLLW using ABO in solvesso 100

Solvent extraction procedure, developed for the separation of palladium using ABO in solvesso 100, was followed from a typical high level liquid waste sample of power reactor reprocessing plant, Tarapur.

Table 2: Impurity analysis of Pd separated from simulated HLLW by ICP-AES

Element	Conc. (µg/mL)	DF
Strontium	0.11	850
Zirconium	1.87	200
Molybdenum	1.03	350
Cadmium	BDL	high
Barium	1.13	150
Calcium	0.4	330
Cerium	0.91	300
Praseodymium	0.21	510
Neodymium	0.41	1050
Samarium	0.17	500
Europium	BDL	high
Gadolinium	BDL	high
Dysprosium	BDL	high
Uranium	10.68	900
Sodium	12.4	120
Iron	0.81	310
Chromium	BDL	high
Nickel	0.4	500

The concentrations of nitric acid, uranium and plutonium of the sample were 5.0 M, 10.16 g/L and 4.15 mg/L respectively. It contained gross beta activity of ~63 Ci / L and gamma activity of ~18 Ci / L. During extraction, 4 mL of the waste solution was contacted with 4 mL of 1.1 x 10^{-2}M ABO in Solvesso 100, in a glass vial, for about 10 minutes. The loaded organic phase was scrubbed with water. Two contacts were given to get additional decontamination from uranium, plutonium and fission products. Palladium from the organic phase was stripped with 4 mL of 0.05 M thiourea in 0.1 M HNO_3. Three contacts were required for quantitative recovery of Pd. The concentration of Pd was found to be 122 mg / mL. Nearly 0.5 mg of reactor produced palladium was isolated from the HLLW of PREFRE, Tarapur. Fission products activities of the feed as well as product solution were analyzed by gamma spectrometry and the results are shown in Table 3.

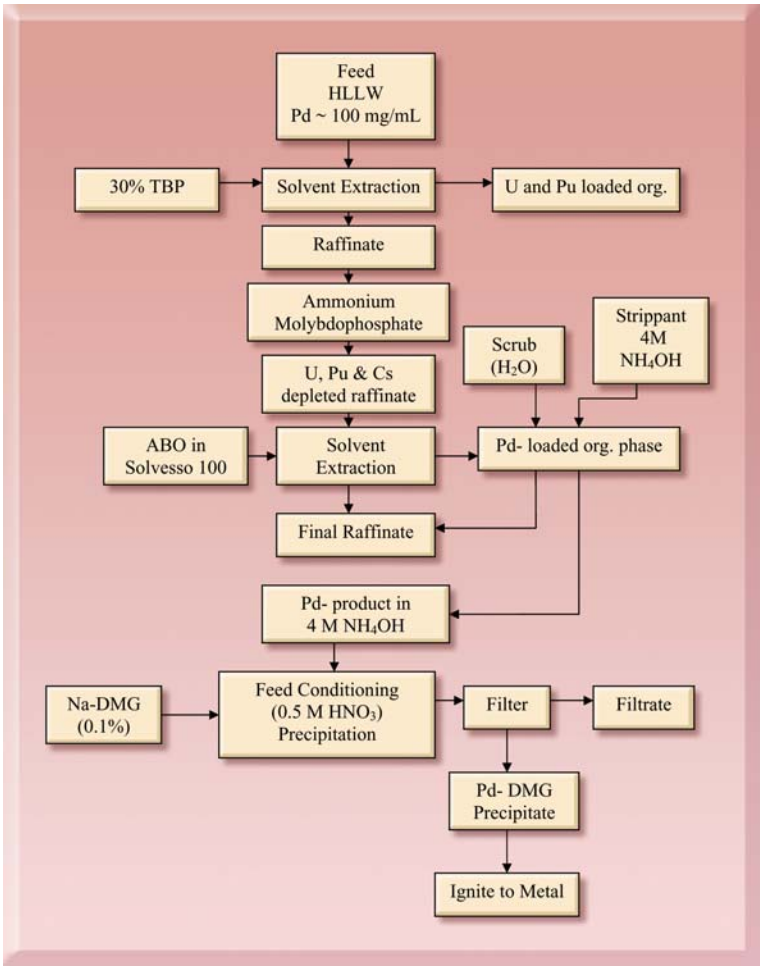

Fig. 9: Proposed scheme for separation of Pd from PHWR-HLLW

Table 3 : Separation of palladium from HLLW of PHWR origin
(Feed: 4mL HLW, Phase ratio =1, Contact time 10 min.)

Fission products	Activity in HLW (mCi/mg of Pd)	Activity in Product (mCi/mg of Pd)	DF
^{106}Ru	3.03×10^{3}	2.79	1.09×10^{3}
^{137}Cs	5.89×10^{4}	5.88×10^{-2}	1.00×10^{6}

The HLLW taken up in the present study, was a long cooled waste sample from PHWR spent fuel reprocessing, which contained the long lived fission products viz. ^{137}Cs, ^{90}Sr and ^{106}Ru. Other fission products were not present in significant quantities. Decontamination factors for ^{137}Cs and ^{106}Ru were only evaluated and found to be of the order of 10^6 and 10^3 respectively, after one cycle of extraction, scrubbing and stripping. Above studies clearly indicate that a DF of greater than 10^4 can be achieved, for all the radionuclides present in the waste. Based on the above two separation methods studied, a flow-sheet is proposed which is shown in Fig. 9.

Analytical method for the Determination of Pd in HLLW

During the solvent extraction studies of palladium using ABO, thiourea was used as stripping agent for its back extraction. Possibility of using Pd complex of thiourea was investigated for its analytical determination using spectrophotometry.

Fig. 10 shows the absorbance spectra of thiourea and Pd-thiourea complex, against distilled water and reagent blank respectively. It is evident from the spectra, that the reagent has an absorption maxima at 290 nm whereas the Pd-thiourea complex has the λ_{max} at 297 nm, a shift in the wavelength on the higher side, as compared to the pure reagent.

Calibration graph for determination of palladium was prepared which is shown in Fig. 11. Regression analysis shows a coefficient of linearity of 0.994 suggesting good linearity in the range between 10 to 100 mg

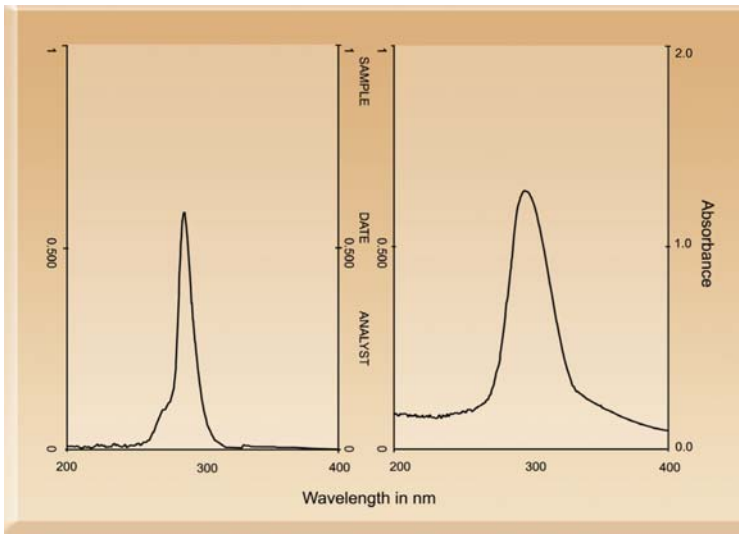

Fig. 10: Absorption spectrum of thiourea and Pd-thiourea

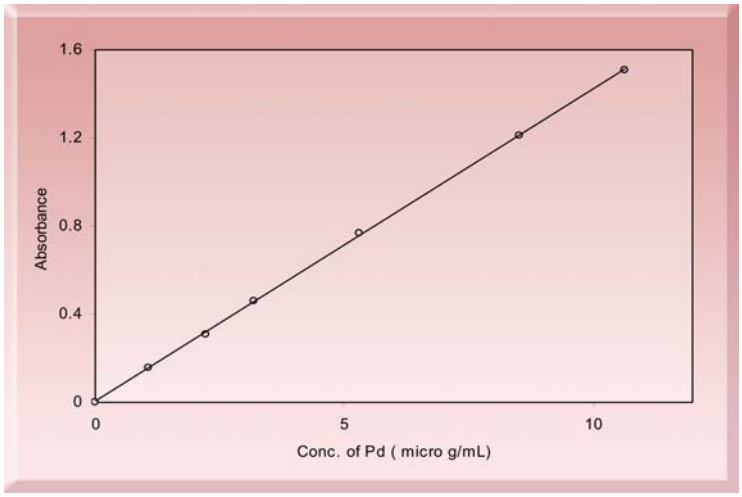

Fig. 11: Calibration curve for palladium concentration

obeying the Beer's law. The method is applicable for the determination of Pd in HLLW after extracting it in ABO followed by its stripping using 0.05 M thiourea in 0.1 M HNO_3. Absorbance of the stripped product can be measured directly at 297 nm.

Molar extinction coefficient of the complex is found to be 2.2×10^4 $L.M^{-1}.cm^{-1}$ indicating that the method is highly sensitive. The complex was found to be stable

Table 4 : Analysis of Pd in synthetic HLLW sample
(Dilution factor for each sample =50)

Samples	Conc. of Pd spiked (µg/mL)	Absorbance measured	Conc. of Pd observed (µg/mL)	Deviation (%)
Pd std.	106.4	0.304	-	-
HLLW*	0	0	0	-
HLLW-1	106.4	0.308	107.8	+1.3
HLLW-2	212.8	0.606	212.1	-0.3
HLLW-3	319.2	0.885	309.8	-2.9

for nearly four days. The method was tested for the determination of Pd in four synthetic PHWR HLLW samples and the results are shown in Table 4.

These results also indicate that the precision and accuracy of the method is better than 3%. Synthetic PHWR-HLLW containing no palladium, subjected to the analytical procedure showed zero absorbance, indicating that the other constituents including uranium, do not interfere in the analysis.

Analysis of Pd in actual HLLW sample

The method developed above, was used to determine Pd in an actual PHWR-HLLW sample from PREFRE Tarapur. Spectra obtained for thiourea complex of Pd standard and Pd separated from PHWR-HLLW are found to be identical, which are shown in Fig. 12.

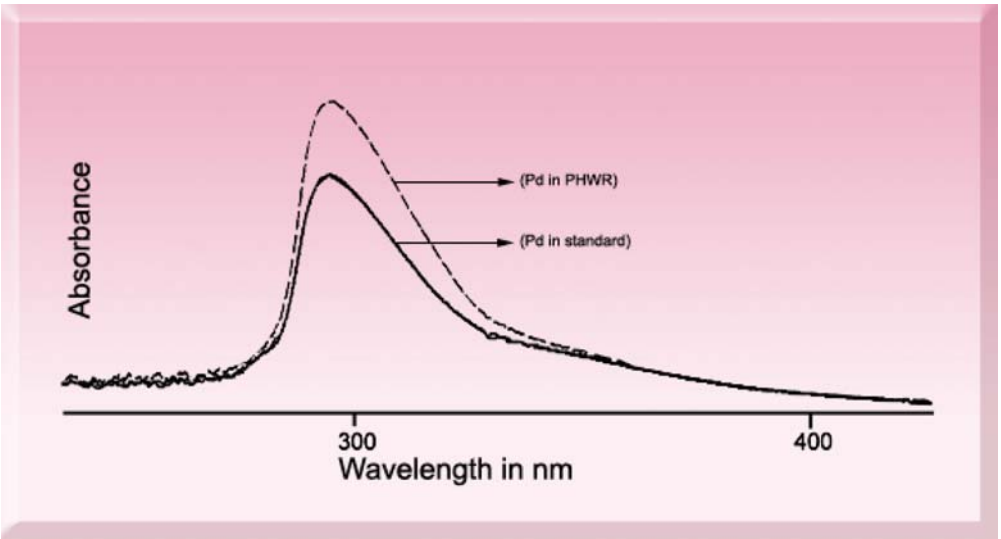

Fig. 12 : Spectra of Pd-thiourea complexes
(--- Pd standard, — Pd separated from PHWR-HLLW)

Concentration of palladium in HLLW was calculated from the absorbance measurements of standard and sample and concentration of palladium in the HLLW was found to be 122 mg / L.

Conclusions

The studies carried out show, that both solvent extraction using ABO in solvesso 100 and precipitation methods using 0.1% of aqueous solution of Na-DMG can be used, for the separation of Pd from PHWR-HLLW. The methods are simple and rapid. Solvent extraction method does not require feed conditioning with respect to acidity, whereas, precipitation method needs feed acidity below 2 M for better recovery. Under optimized conditions, the recovery of Pd by both the methods is better than 99%. Using advantages from both the methods a flow-sheet is proposed for the separation of Pd of desired purity from PHWR-HLLW. The analytical method using absorbance measurement of its thiourea complex is sensitive and can be used for the determination of Pd in HLLW.

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MOU TO SUPPLY UMAC (ULTRASONIC MEASUREMENT OF AXIAL CREEP) SYSTEM TO NPCIL

Axial creep monitoring of the coolant channels, is required to be done during each bi-annual shutdown, in Pressurized Heavy Water Reactors. Presently a system called TMAC (Technique for Measuring Axial Creep), developed by the Refuelling Technology Division is in use, to measure creep in all operating PHWRS. Fuelling Machines make contact with each channel to monitor the creep. The measurement takes about 15 hrs.

To reduce measurement time and to make the system more operator-friendly, an improvised axial creep measurement system called UMAC (Ultrasonic Measurement of Axial Creep) has been developed at the Refuelling Technology Division. The technique is based on non contact ultrasonic sensors which are brought to the reactor face by fuelling machines. The system takes less than six hours to carry out the measurement.

The system has been successfully used in TAPS-3&4, KAPS-1, RAPS-2, RAPS-3&4, KGS-2 and KGS-3. The system was also used for measuring thermal expansion of the channels.

An MoU was signed on 10th December, 2007 at NPCIL, Mumbai by Mr. R.K. Sinha, Director, RD&DG, BARC and Mr. Nageswara Rao, Director (Operation), NPCIL to supply nine sets of the system to NPCIL. Mr. R.G. Agrawal, Head, RTD, Mr. R.J. Patel, Head, FHDDS,RTD, Mr. Rites Ranjon, RTD, Mr. S. Bhattacharya, RTD, Mr. A.S. Bagadi, TT&CD were present from BARC. Mr. K.B. Dixit, Ex Director (Engg), Mr. C. Avasthi, Ex Director (QA),Mr. S. Vijaykumar, CE (CCD), Mr. A.K. Sinha, ACE (Maint.) and other senior officials from NPCIL were also present.

Seen in the photograph sitting (from left to right) Mr. K.B. Dixit, Ex. Director (Engg), NPCIL, Mr. R.K. Sinha, Director, RD&DG, Mr. Nageswara Rao, Director (Operation) NPCIL and Mr. R.G. Agrawal, Head, RTD, BARC and standing (from left to right) Mr. R.J. Patel, Head, FHDDS, RTD, BARC, Mr. Rites Ranjon, RTD, BARC, Mr. A.S. Bagadi, TT&CD, BARC, Mr. S. Bhattacharya, RTD, BARC, Mr. S. Vijaykumar, ACE (CCD), NPCIL, Mr. V.N. Konda, Ex- Engr. (Operation), NPCIL

HEALTH PHYSICS PROFESSIONALS AND STATION ALARA COORDINATORS MEET 2008 : A REPORT

The Health Physics Division, Bhabha Atomic Research Centre, Mumbai organized the meeting of all Station Health Physicists and Station ALARA Coordinators at the Station Training Centre, Narora Atomic Power Station, during February 6 and 7, 2008. Station Health Physicists and Station ALARA Coordinators from Tarapur Atomic Power Station 1&2, 2&4, Rajasthan Atomic Power Station, Kakrapar Atomic Power Station 1&2, 3&4 and Kudankulam Nuclear Power Plant participated in the meet. Station Health Physicists discussed salient points related to radiological safety aspects of the plant (Collective dose consumption, effluent releases to the environment, waste disposal to depositories etc.) and improvements carried out in radiological information dissemination to all plant personnel which include just-in-time briefs, significant event reports and operating plants. Station ALARA Coordinators briefed on the Station collective dose budgets, achievements and constraints during the plant operation and maintenance activities. Efforts to control the dose rate in the work environment such as providing additional shielding, dilute chemical decontamination of the active systems, prompt removal of radioactive wastes from the work locations, innovative material handling systems were also discussed during the meet.

The program was inaugurated by Mr. D.K. Goyal, Station Director, Narora Atomic Power Station, Mr. S.G. Ghadghe, Associate Director (RS&A), Nuclear Power Corporation of India Limited, Mumbai, Mr. K.A. Pendarkar, Head, Internal Dosimetry Division, BARC and Mr. M.L. Joshi,Head, Health Physics Division, BARC addressed the delegates.

Mr. M.L. Joshi, Head, Health Physics Division deliberated on the need and requirement of radiation exposure control programme in power stations with illustrations and shared the developmental work carried out at Asian ALARA Coordination Centre at Japan.

Station Health Physicist from RAPS 5&6 shared his peer review experience of the reactors at United States of America and Canada related to radiation exposure control, radiation instrumentation and access control aspects.

Station Health Physicist from Tarapur 3&4 shared his experience on the training provided by Korean specialists under International Atomic Energy Agency in handling radiation emergencies and the IAEA assistance programme.

On the conclusion of the programme Mr. B. Ramamirtham, Assistant Chief Engineer, Health, Safety Environment and Public Awareness Group, NPCIL, Mr. P.S. Nair, Head, Power Project Safety Section, Health Physics Division, BARC, Mr. K.A.Pendarkar, Head, Internal Dosimetry Division, BARC and Mr. M.L. Joshi, Head, Health Physics Division, BARC participated in the panel discussion.

Mr. M.L. Joshi appreciated the efforts by Mr. K.A. Pendarkar in explaining the salient features of the ICRP recommendations and Internal Dosimetry aspects. He suggested that the presentations by the station health physicists and station ALARA coordinators needed to be complementary to each other and greater focus would have to be on the good practices and developmental activities. Focus needs to be on areas for improvements, analysis of events and incidents and lessons learnt for effectively on the accomplishments. Health physicists need have study

groups to upgrade their knowledge on currents information and strategies to eliminate unplanned exposures.

He stressed on all round growth of technical skills of the radiation protection groups and improvements on the radiological safety aspects in the stations.

Mr. P.S. Nair had summarized the proceedings and brought out the good practices in several stations.

Good practices include radiation hotspot management follow-up programme software for radiation dose management at TAPS 1&2, radiation protection information dissemination and training facilities at TAPS 3&4, radiation hotspot display systems standardization at RAPS, training facilities, remote assessment of surface contamination levels, barcode system on dosimeters, issue of TLDs to contractor employees on demand to optimize the number of TLDs etc. at MAPS, battery operated display system, communication of air activity levels in the work environment to the plant personnel through telephone, instrument system for assessment of surface contaminatioon, CCTV at main air lock, to monitor compliance of radiation protection at KAPS etc.

He expressed concern at the appearance of Antimony acitivity in various systems in power stations and stressed the need to investigate the source of this activity to incorporate measures to eliminate the potential for external exposures to plant personnel.

New Publication

FUNCTIONAL FRACTIONAL CALCULUS : for system identification and control
by
Shantanu Das
Reactor Control Division, BARC
October 2007
ISBN 978-3-540-72702-6

Calculus as a discipline, was discovered independently in the mid 17th century, by Newton and Leibniz. Fractional Calculus is also equally old. Previously, Fractional Calculus was the exclusive domain of Mathematicians. It is only recently that it has found applications in the fields of Engineering, Science and Economics.

In this book, an attempt has been made to keep the subject of Fractional Calculus application-oriented, for regular scientific and engineering applications. Therefore, Mathematics has been kept at a bare minimum. The book is organized into ten chapters. It begins with a basic introduction to Fractional Calculus followed by important functions relevant to fractional Calculus. Scientific and Engineering applications of Fractional Calculus particularly to nuclear reactors and electromagnetism are discussed and an insight into fractional integration, fractional differentiation and fractional differintegral with physical and geometric meaning for these processes is also given. Other areas covered in this book include: the concept of initialization function, the La Place Transform theory, Scalar and vector problems, application of Fractional Calculus in electric and electronic circuits, system modeling and control.

The author also discusses the application of Fractional Calculus to an over-all fuel-efficient nuclear power plant control system which is different from the conventional Proportional Integral and Derivative (PID) scheme, used in existing nuclear power plants.

65 TH BRNS-IANCAS NATIONAL WORKSHOP ON RADIOCHEMISTRY AND APPLICATIONS OF RADIOISOTOPES

The Indian Association of Nuclear Chemists and Allied Scientists (IANCAS) organized the 65th BRNS National Workshop on Radiochemistry and Applications of Radioisotopes from 29th November to 8th December 2007 at the University Department of Physics, Kurukshetra University, Kurukshetra.

The workshop was inaugurated by the Chief Guest Mr. S. A. Bhardwaj, Director (Technical), NPCIL at a function presided over by Prof. Nand Lal, Dean, Faculty of Science, Kurukshetra University. The welcome address was given by Prof. Shyam Kumar, Director of the Workshop. Dr. V.K. Manchanda, President, IANCAS, explained the role of IANCAS and its activities to the participants. An introduction to the course content of the Workshop was given by the Workshop Coordinator, Dr. P.C. Kalsi.

At the inauguration function, seated from left to right: Dr. Anu Sharma, Secretary, Dr. Sanjeev Aggarwal, Convener, Prof. Shyam Kumar, Director of the Workshop, Prof. Nand Lal, Dean Faculty of Science, Univ. of Kurukshetra, Mr. S.A. Bhardwaj, Director (Technical), NPCIL, Dr. V.K. Manchanda, President, IANCAS and Dr. P.C. Kalsi, Coordinator, IANCAS.

Mr. Bhardwaj in his inaugural address gave an overview of Nuclear Energy programme in India. Prof. Nand Lal in his presidential address elaborated on the uses of radioactivity and isotopes. He urged the participants to derive maximum benefit out of this workshop. Dr. Sanjeev Aggarwal, who was the Convener of the Workshop from Kurukshetra University, gave the vote of thanks.

Eighty participants from all over Haryana as well as nearby States participated in the workshop. Mr. Bhardwaj gave the key-note address on the opening day on "Nuclear Energy in general and Nuclear Reactors in particular".

Dr. Manchanda delivered a special lecture on "DAE activities at a glance." The lecture and practical sessions were conducted by eight resource persons from DAE. The lectures consisted of: Introduction to Radioactivity, Nuclear structure and stability, Nuclear Reactors, Interaction of radiation with matter, Nuclear detectors, Solid state nuclear track detectors, Accelerator-based multidisciplinary research, How to set up a Radioactive Lab, Introduction to radiation chemistry, Applications of radioisotopes in Physical and Chemical Sciences, Industry, Agriculture and Medicine. The lectures were held during the morning sessions and the afternoon sessions were reserved for the practicals. Seven practical sessions were conducted to give the participants a feel of handling and counting radioactivity and the use of tracers for radiochemical work. The experiments generated wide interest amongst the participants.

A special lecture was given by Dr. S. Kailas, Associate Director, Physics Group, BARC on the role of Accelerators in frontline research.

The Valedictory function was held on 8th December, 2007. Prof. Shyam Kumar, Chairman, Department of Physics, Kurukshetra University, Kurukshetra presided over the function. Feedback was arranged in this session. The participants were highly appreciative of the Workshop. Dr. P.C. Kalsi, Coordinator of this Workshop responded to the queries of the participants. He also gave a brief report about the Workshop. He particularly felt the need of propagating this branch of science in Universities.

Prof. Shyam Kumar in his presidential address explained the benefits of conducting such workshops to the teachers. The four top scorers in the test conducted after the completion of the Workshop were given cash prizes. Dr. P. C. Kalsi and Prof. Shyam Kumar distributed the certificates to the participants. Dr. P. C. Kalsi also presented one G.M Counting setup and a NaI(Tl) detector assembly to Prof. Shyam Kumar, Chairman, Department of Physics, Kurukshetra University, Kurukshetra for use in their M Sc course and for research work. The workshop concluded with a vote of thanks by Dr. Anu Sharma, Secretary for the Workshop.

BRNS-IANCAS PROGRAMME ON "50 YEARS OF RADIOCHEMISTRY IN DAE"

A one day seminar was organized to celebrate "50 years of Radiochemistry in DAE" and "Silver Jubilee of IANCAS" on January 2, 2008 at Multipurpose Hall, Anushaktinagar. Nearly 400 participants both from the past and present batches of Radiochemists from BARC, IGCAR and from other academic institutes attended the seminar.

Dr. Anil Kakodkar, Chairman, AEC and Secretary, DAE, Government of India, inaugurated the programme in a function presided over by Dr. S. Banerjee, Director, BARC. He highlighted the important role played by Radiochemists in the development of plutonium-based fuels and addressing the challenges of the back end of the fuel cycle. He also referred to the significant role played by IANCAS in disseminating information on Nuclear Sciences, through publications and workshops. He mentioned that IANCAS is a unique organization which has been carrying out excellent work for the last 25 years. Dr. Banerjee released the Special Bulletin brought out by IANCAS commemorating the occasion and which carried the articles of the various presentations in the programme and the reminiscences of the senior (retired) colleagues who responded wholeheartedly to the invitation and were present in large numbers. He particularly lauded the active role played by Radiochemists in fuel cycle programme. A poster exhibition depicting the highlights of various facilities and activities pursued in the field of Radiochemistry both at BARC and at IGCAR was also inaugurated by Chairman, AEC.

All the past and present Presidents and Secretaries of IANCAS were felicitated by Dr. Kakodkar during the inauguration programme.

Dr. Anil Kakodkar, Chairman, AEC at the inauguration of the poster session

Dr. Anil Kakodkar speaking at the inauguration programme of 50 years of Radiochemistry in DAE. On the dais seated from left to right are Dr. V.K. Manchanda, Dr. S. Banerjee, Director, BARC. Dr. V. Venugopal and Dr. G.A. Rama Rao

Dr. V.K. Manchanda, Head, Radiochemistry Division and Convener of the programme welcomed the guests and Radiochemistry fraternity present on the occasion. He gave a brief account of the programme. He particularly thanked retired colleagues from DAE and non-DAE institutions, who had made immense contributions to the growth of Radiochemistry in the country. Dr. V. Venugopal, Director, RC & I Group and Chairman of the Organizing Committee recounted the growth of Radiochemistry Programme starting from 1957 at South site BARC to the present well equipped laboratories at North site. Dr. G.A. Rama Rao, Secretary of the Organizing Committee offered a formal vote of thanks.

The first technical session started with Dr. Venugopal who gave a detailed account of the progress of Radiochemistry for the last 50 years and its contribution to the DAE programme. Dr. P.R. Vasudeva Rao, Director, Chemistry Group and Metallurgy & Materials Group, IGCAR explained various facilities that were set up at IGCAR and their contributions to the FBTR programme at Kalpakkam. Dr. Manchanda gave an account of the pivotal role played by Nuclear and Radiochemistry in the entire nuclear fuel cycle. Dr. S.K. Aggarwal, Head, Fuel Chemistry Division presented the scope of Radiochemistry in the utilization of thorium in nuclear technology. Dr. D.D. Sood, Former Director, RC & I Group, BARC and Dr. C.K. Mathews, Former Director, Chemistry Group, IGCAR chaired the session.

The second technical session dealt with the future of Radiochemistry wherein Dr. S.C. Parida, BARC, Dr. R. Tripathi, BARC and Dr. R. Ganesan, IGCAR presented talks on "New Horizons in the Nuclear Fuel Cycle", "Future Perspectives in Nuclear Chemistry" and "Chemical Sensors for Nuclear Energy Programme" respectively.

In the third session academicians from universities gave an account of teaching and research, related to radiochemical work carried out at their institutes. These talks were presented by Prof. Susanta Lahiri, SINP, Kolkata, Dr. D.V. Parwate, Nagpur and Dr. Anil Bajpai, Jabalpur.

In the last session many stalwarts of Radiochemistry reminisced about their experiences and contributions, which were well received and appreciated by the young participants in the programme.

9TH TROMBAY SYMPOSIUM ON RADIATION & PHOTOCHEMISTRY (TSRP 2008) : A REPORT

Trombay Symposium on Radiation & Photochemistry (TSRP 2008) was held at the Yashwantrao Chavan Academy of Development Administration (YASHADA), Pune, during January 7 – 11, 2008. This symposium organized by the Radiation & Photochemistry Division, BARC, was the 9th in the series of TSRP and was held in a venue outside Mumbai for the first time. The symposium was sponsored by the Board of Research in Nuclear Sciences (BRNS) in collaboration with Indian Society for Radiation & Photochemical Sciences (ISRAPS). The main objective of this symposium was to discuss the most recent developments in the field of radiation and photochemistry and their applications. About 250 scientists and students both from India and abroad participated in the symposium.

Dr. D.K. Palit, Co-Convener of the symposium, welcomed the participants. Dr. T. Mukherjee, Director, Chemistry Group and the Chairman of the Symposium Organizing Committee, gave an introduction to the earlier TSRP series of conferences and also to the present one. Dr. S.K. Sarkar, Head, Radiation & Photochemistry Division, BARC, elaborated on the important aspects of TSRP 2008. Dr. S. Banerjee, Director, BARC, inaugurated the symposium by lighting a lamp and released the proceedings of TSRP 2008 and also a special issue of the ISRAPS Bulletin. In his inaugural address, he emphasized the role of Radiation and Photochemistry in the ongoing programme of DAE. The inauguration function later concluded with a formal vote of thanks by Dr. T. Bandyopadhyay,

Dr. S. Banerjee, Director, BARC, releasing the Proceedings of TSRP 2008

Co-Convener of the symposium.

The scientific programme of the symposium included invited talks and contributed papers in the form of poster presentations. A total of fifty invited talks by speakers from India (16) as well as abroad (24) and 150 posters, including nine posters from abroad, were presented. The symposium covered the key areas of Radiation & Photochemistry, viz. (a) Ultrafast spectroscopy & dynamics of photoinduced chemical processes, (b) Gas phase reaction dynamics in bulk and beams, (c) Radiation & Photochemistry in nuclear fuel cycle, (d) Radiation and Photochemistry of atmosphere and environment, nanoscale materials as well as biological compounds, antioxidants and drugs, and (e) Industrial and societal applications of radiation and photochemistry. An exhibition of lasers, optics, detectors and other industrial products was arranged for two days at the symposium venue. Two evening talks by the exhibitors on recent developments in the techniques of chirped pulse amplification of ultrashort laser pulses and on the Electron-Multiplied CCD (EMCCD), were very useful for scientists working in the field of Photochemistry and Spectroscopy. Ten students below the age of 32 were awarded the 'Best Poster Presentation' awards by the Indian Society for Radiation & Photochemical sciences (ISRAPS). Dr. Sharmistha Dutta-Chowdhury of Radiation & Photochemistry Division, BARC, was awarded the 'P. K. Bhattacharya Memorial Award' given by ISRAPS.

In the concluding session, Dr. Jai Pal Mittal, Raja Ramanna Fellow of BRNS and past President of ISRAPS, presented a brief summary of the symposium and expressed satisfaction over the gradual improvement in the quality of the TSRP series of symposia following its inception in the year 1992. This was followed by feedback comments from the invited speakers from abroad as well as from young student participants.

Dr. S. Banerjee, Director, BARC, delivering the inaugural address

13TH ISMAS SYMPOSIUM-CUM-WORKSHOP ON MASS SPECTROMETRY : HIGHLIGHTS

The 13th ISMAS Symposium-cum-Workshop on Mass Spectrometry (13th ISMAS-WS 2008) was organised by the Indian Society for Mass Spectrometry (ISMAS) and was co-sponsored by Scientific Departments (BRNS, CSIR and DST) of the Government of India. The Symposium-cum- Workshop was held at Multipurpose Hall, Training School Hostel cum Guest House, BARC, Anushakti Nagar, Mumbai during January 27 to 31, 2008. The inaugural function was preceded by Registration and a Social get-together in the evening on January 26, 2008 at Training School Hostel.

13th ISMAS-WS 2008 was inaugurated by Dr. V. Venugopal, Director of Radiochemistry and Isotope Group, BARC on January 27, 2008. Dr. T. Mukherjee, Director, Chemistry Group, BARC, delivered the presidential address. Dr. S.K. Aggarwal, Chairman of the Organizing Committee, 13th ISMAS-WS 2008 delivered the welcome address and briefed the audience about the activities of ISMAS. Mr. P.G. Jaison, Convener of the Organizing Committee, highlighted the scope of the 13th ISMAS-WS 2008 and Ms. D. Alamelu, Co-convener of the Organizing Committee, proposed the vote of thanks. During the inauguration function, the bound volume of the Proceedings of the 13th ISMAS-WS 2008 were released by Dr. V. Venugopal. A special Souvenir-cum-Bulletin was brought out by ISMAS at this occasion and it was released by Dr. T. Mukherjee. The inauguration was

Inaugural Function of the 13th ISMAS-WS 2008 On the dais from left to right: Mr. P.G. Jaison, Convener, Organizing Committee; Dr. S.K. Aggarwal, Chairman, Organizing Committee & Head, FCD; Dr. V. Venugopal, Director, Radiochemistry & Isotope Group, BARC; Dr. T. Mukherjee, Director, Chemistry Group, BARC and Ms. D. Alamelu, Co-convener, Organizing Committee.

Dr. V. Venugopal, Director, Radiochemistry & Isotope Group, BARC, delivering the Inaugural address

followed by a formal opening of the Exhibition stalls arranged by different manufacturers and suppliers of Mass Spectrometers.

Over 175 participants including 11 overseas speakers participated in the 13th ISMAS-WS 2008. The Symposium-cum-Workshop provided a forum for Research Scholars and Scientists from industry and other institutes to discuss their experiences and share new developments in the field of Mass Spectrometry. The scientific programme of the Symposium cum Workshop was spread over 20 technical sessions. There were 17 Invited Talks by distinguished mass spectroscopists from within the country and from overseas. Invited Talks covered various applications of Mass Spectrometry in contemporary research such as Nuclear Safeguards, Fundamental, Biomedical, Forensic Science, Environmental Science, Petroleum Industry etc.

Invited speakers from overseas included Prof. Akos Vertes (George Washington University, USA), Dr. I.B. Brenner (Israel), Dr.Ronald Hergenroeder (ISAS-Institute for Analytical Sciences, Germany), Prof. Jan Andersson (University of Munster, Germany), Prof. A.J.T. Jull (University of Arizona, USA), Prof. K.C. Lin (National Taiwan University, Taiwan), Dr. Mathias Schafer (University of Cologne, Germany), Dr. S.K. Sahoo (National Institute of Radiological Sciences, Japan), Prof. James Scrivens (University of Warwick, UK), Dr. Varga Zsolt (Institute of Isotopes, Hungary) and Prof. Thomas Walczyk (National University of Singapore, Singapore).

Speakers from India included Prof. A.K. Chakraborti (NIPER, Mohali), Dr. B.R. Chakraborty (NPL, Delhi), Prof. A.K. Choudhary (IIT, Roorkee), Dr. M.K. Malve (DFSL, Mumbai), Prof. Deepak Mathur (TIFR & UM-DAE Centre for Excellence in Basic Science, Mumbai) and Dr. A.S. Sarpal (IOCL, Faridabad).

There were 29 papers which were presented as posters in the Contributory Papers session. This session covered various fields of research such as Nuclear Technology, Indigenous Development of Mass Spectrometry Instrumentation, Environmental Science, Hydrology, Thermodynamics, Organic Mass Spectrometry, Basic Research etc. There were 7 presentations by Instrument Suppliers updating the knowledge of the delegates on the latest developments in the field of Mass Spectrometry Instrumentation. Seven research scholars were provided with the opportunity to make oral presentations of their research work. The presentations

made by the research scholars and the poster presentations of the contributory papers were evaluated by a panel of judges for awards.

The 13th ISMAS-WS 2008 also consisted of panel discussions which were interactive in nature. There were five panel discussions on topics of current interest viz. 'Recent Developments in SIMS', Chaired by Dr. B.R. Chakraborty, NPL, Delhi; 'Problems and Solutions in Mass Spectrometry Instrumentation', Chaired by Mr. V.K. Handu, Head, VPID, BARC; 'Gas Chromatography-Mass Spectrometry: Where it stands?', Chaired by Dr. S.C. Tripathi, FRD, BARC; 'MC-ICPMS vs TIMS: Critical Discussion', Chaired by Dr I.B. Brenner, Israel; 'MS of Actinides: Present Status and Future Requirements' Chaired by Dr. S.K. Aggarwal, Head, FCD, BARC. These panel discussions were appreciated by the delegates and were highly useful to the participants.

There were two tutorial lectures aimed at exposing novices to the various fields of Mass Spectrometry applications. The first tutorial session on "Sample Preparation and ICPMS" was conducted by Dr. I.B. Brenner (Israel) and the second tutorial session on "Lasers in Mass Spectrometry" was jointly conducted by Dr. R.K. Vatsa and Mr. Pramod Sharma (CD, BARC). Both the tutorial sessions were informative and were well received by the participants.

13th ISMAS-WS 2008 concluded with a valedictory function on January 31, 2008. During this function, prizes were awarded to the authors of the best posters and the best oral presentations by research scholars. The delegates expressed their satisfaction over the technical contents and scientific discussions held during the Symposium-cum-Workshop.

Group photograph of the delegates of the 13th ISMAS-WS 2008.

WORKSHOP ON RADIATION AND PHOTOCHEMISTRY

A workshop on Radiation and Photochemistry was held at the Multipurpose Hall, Anushaktinagar, during January 3-5, 2008. This workshop was jointly organized by the Indian Society for Radiation and Photochemical Sciences (ISRAPS) and the Radiation & Photochemistry Division of BARC. The objectives of the workshop were 1) to introduce fresh research students to these twin thrust areas of research, 2) to emphasize the complementariness of the two areas, 3) to introduce the participants to the realm of fast chemical reactions and 4) to upgrade the basic understanding of the participants to appreciate both the invited and poster presentations at the 9th Trombay Symposium on Radiation and Photochemistry, held during January 7-11, 2008 at Pune. Dr. S.K. Sarkar, Vice-President, ISRAPS & Head, RPCD, BARC and Dr. A.V. Sapre, Member ISRAPS Executive Council, acted as workshop conveners. They were assisted by Dr. D.B. Naik, Secretary, ISRAPS. The workshop consisted of 13 talks and a half-day visit to different instrumental facilities at RPCD, BARC. The talks were given by eminent scientists in their

A group photograph of the participants

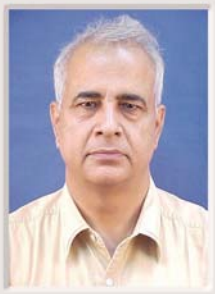
respective fields of research from BARC (Dr. T. Mukherjee, Dr. D.B. Naik, Dr. A.C. Bhasikuttan, Dr. (Mrs.) S. Dhanya, Dr. S. Sabharwal, Dr. D.K. Patil, Dr. A.K. Singh, Dr. D.K. Maity), IIT, Bombay (Prof. Anindya Datta), Dr. P.K. Gupta (RRCAT, Indore) Dr. A.V. Sapre (Ex. BARC) and two distinguished scientists from abroad: Prof. K. Bobrowski and Prof. K. Michalik from Institute of Nuclear Chemistry Group. Each participant was provided with a copy of bound notes of all the lectures.

Out of 56 participants who attended the workshop, 2 were from University of Sheffield, UK. Most of the Indian participants were research students from different universities and institutes. Apart from a few research students from Radiation & Photochemistry Division, there were participants from other divisions of BARC, viz. Radiation Biology & Health Sciences Division and Radiation Technology Development Section.

In the concluding session, a few of the participants expressed their impressions about the workshop. Professor Bobrowski remarked about the active participation of large number of young researchers in the field of Radiation and Photochemistry in India. Dr. T. Mukherjee, Director, Chemistry Group, BARC & President, ISRAPS in his address explained the purpose of holding the workshop prior to TSRP-2008. Dr. J.P. Mittal, former Director, Chemistry & Isotope Group, BARC and Raja Ramanna Fellow, DAE, briefly reviewed the importance of research in Radiation and Photochemistry. Chief Guest, Dr. S. Banerjee, Director, BARC appreciated the efforts of organizers in conducting such a workshop. Dr. S. Banerjee also gave away certificates to all the workshop participants. At the end of the workshop Dr. S.K. Sarkar, Vice-President, ISRAPS remarked about the success of the workshop and thanked all the resource persons as well as the participants.

भा.प.अ. केंद्र के वैज्ञानिकों को सम्मान

BARC SCIENTISTS HONOURED



Dr. J.V. Yakhmi

डॉ. जे.वी. यख्मी, सह निदेशक (एस), भौतिकी वर्ग एवं अध्यक्ष, तकनीकी भौतिकी एवं प्रोटोटाइप इंजीनियरिंग प्रभाग को मेटीरियल रिसर्च सोसाइटी ऑफ इन्डिया के द्वारा वर्ष २००८ का एमआरएसआइ-आइसीएससी सुपरकंडक्टिविटी एन्ड मेटीरियल साइंस पुरस्कार से सम्मानित किया गया। प्रस्तुत पुरस्कार तीन वर्षों में एक बार दिया जाता है और डॉ. यख्मी अभी तक इसके छठे प्राप्त कर्ता हैं। इससे पहले वर्ष १९९६ में इन्हें एमआरएसआइ-आइसीएससी सुपरकंडक्टिविटी एन्ड मेटीरियल साइंस के वार्षिक पुरस्कार से भी सम्मानित किया जा चुका है।

डॉ. जे.वी. यख्मी अंतर्राष्ट्रीय अकादमी ऑफ फिज़िकल साइंसिज़ (अलाहाबाद) के स्नातक सदस्य भी चुने गए हैं।

Dr. J.V. Yakhmi, Associate Director (S), Physics Group and Head, Technical Physics & Prototype Engineering Division has been declared the winner of the 2008 MRSI-ICSC Superconductivity and Materials Science Award (Senior) by the Materials Research Society of India. This Award is given once in 3 years and Dr. Yakhmi is the 6th recipient so far. In 1996, he was also awarded the MRSI-ICSC Superconductivity and Materials Science Annual Prize.

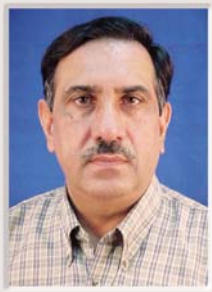
Dr. J.V. Yakhmi has also been elected as a Fellow of the International Academy of Physical Sciences (Allahabad).


Dr. S.K. Apte

डॉ. श्रीकुमार आपटे, सह निदेशक, जैव आयुर्विज्ञान वर्ग (बी) एवं अध्यक्ष, आण्विक जैविकी प्रभाग, भा.प.अ. केंद्र को विकिरण एवं आइसोटोप संबंधी प्रौद्योगिकी एवं उनकी चिकित्सा, कृषि तथा उद्योगों सहित विविध क्षेत्रों में अनुप्रयोग हेतु भारतीय नाभिकीय संस्था द्वारा आईएनएस पुरस्कार-२००६ प्रदान किया गया। मूलभूत जैविकी अनुसंधान एवं जैव प्रौद्योगिकी अनुप्रयागों में विकिरण एवं आइसोटोपों के प्रयोग के प्रतिभाशाली प्रदर्शन के लिये उन्हें यह पुरस्कार दिया गया। इसमें नकद पुरस्कार एवं मान चिन्ह हैं। २१ नवंबर २००७ को हैदराबाद में INSAC-२००७ के दौरान आयोजित समारोह में प्रो.वी.रामा राव, पूर्व सचिव, विज्ञान एवं प्रौद्योगिकी विभाग व मनोनीत अध्यक्ष भारतीय, नाभिकीय संस्था द्वारा यह पुरस्कार दिया गया।

The Indian Nuclear Society conferred the INS Award-2006 for Radiation and Radioisotopes related Technologies and their Applications in different areas including Medicine, Agriculture and Industries upon Dr. Shree Kumar Apte, Associate Director, Biomedical Group (B) and Head, Molecular Biology Division, BARC. The award was given in recognition of his brilliant exposition of the use of radiations and radioisotopes in basic biological research and biotechnological applications. The award consists of a cash prize and a citation and was presented by Prof. V. Rama Rao, Ex-Secretary, Department of Science and Technology and the President-elect, Indian Nuclear Society at a ceremony held during INSAC-2007 in Hyderabad on November 21, 2007.

डॉ. एस.एम. शर्मा, अध्यक्ष, उच्च ताप भौतिकी प्रभाग को उच्च दाब के अधीन ठोस पदार्थ में विभिन्न घटनाओं की खोज में योगदान हेतु इन्डियन अकादमी ऑफ साइंस के द्वारा फेलो निर्वाचित किया गया।


Dr. S.M. Sharma

डॉ. शर्मा वर्ष २००५ से नैशनल अकादमी ऑफ साइन्सिज़ के सदस्य भी हैं।

Dr. S.M. Sharma, Head, High Pressure Physics Division has been elected a fellow of The Indian Academy of Science, for his contributions to the investigations of behaviour of different phenomena in solid materials under high pressures.

Dr. Sharma is also a fellow of the National Academy of Sciences.


Dr. Jayshree Ramkumar

मैसूर विश्वविद्यालय, मानसगंगोत्री, मैसूर में आयोजित डीएई-एसएसपीएस २००७ में "अपटेक ऑफ रोडॉमाइन ६G डाई बाइ बोरोसिलिकेट ग्लासेस" नामक पोस्टर के लिए डॉ. जयश्री रामकुमार को उत्कृष्ट पोस्टर पुरस्कार प्रदान किया गया।

डॉ. जयश्री रामकुमार ने चेन्नई के मद्रास विश्वविद्यालय से एम.एस.सी. करने के पश्चात प्रशिक्षण विद्यालय के ३७ वें सत्र के बाद भा.प.अ. केंद्र में कार्यरत हुई। तत्पश्चात् विश्लेषणात्मक रसायनिकी प्रभाग में उनकी तैनाती हुई। तब से, वे झिल्लियों और अधिशोषकों के प्रयोग द्वारा विविध धातु एवं विषैले पदार्थों के विकास से जुड़ी हैं। विनिमय पर उनके कार्य एवं नैफियान झिल्ली के प्रयोग से संबंधित अध्ययन के लिये उन्हें वर्ष २००५ में पीएचडी की उपाधि दी गई। झिल्ली पृथक्करण के क्षेत्र में २५ से भी अधिक अंतरराष्ट्रीय पत्रिका प्रकाशन उनके नाम हैं।

Dr. Jayshree Ramkumar was conferred the best poster award for the poster entitled "Uptake of Rhodamine

6G dye by Borosilicate Glasses" at the DAE –SSPS 2007, held at the University of Mysore, Manasagangotri, Mysore.

Dr. Jayshree Ramkumar joined BARC from the 37th batch of training school after completion of M.Sc. from the University of Madras, Chennai. Subsequently she joined the Analytical Chemistry Division. Since then, she is involved in the development of new separation procedures for different metal ions and toxic substances using membranes and adsorbents. She was awarded Ph.D in 2005 on her work on ion exchange and related studies using Nafion membrane. She has more than 25 international journal publications to her credit in the field of membrane separation.

" मोंटे कार्लो - बेस्ड एएपीएम टीजी४३ डोसिमीटरी पेरॉमीटर्स फॉर बीएआरसी ^{137}सीएस ब्रेकिथिरापी सोर्स " नामक शोध-पत्र को सितंबर ०८, २००७ के दौरान एआइआइएमएस, नई दिल्ली में यूपी - देहली चेप्टर ऑफ एसोसिएशन ऑफ मेडिकल फिज़िसिस्टस ऑफ इन्डिया (एएमपीआइ), द्वारा आयोजित एक गोष्ठी में सर्वश्रेष्ठ मौखिक पुरस्कार प्रदान किया गया। प्रस्तुत शोध-पत्र भाभा परमाणु अनुसंधान केंद्र के विकिरणकीय भौतिकी एवं सलाहकार प्रभाग के श्री. श्रीधर साहू, एवं डॉ. टी. पालानी सेलवम द्वारा लिखा गया है।

एक अन्य शोध-पत्र " मोंटे कार्लो इन्वेस्टिगेशन ऑफ डोसिमेट्रिक प्रोपरटीज़ ऑफ सोलिड फेन्टम्ज़ रेलिवंट इन ब्रेकिथिरापी " को नवंबर २-४, २००७ के दौरान शेर-ए-कश्मीर इन्सटिट्यूट ऑफ मेडिकल साइन्सिज़ द्वाराआयोजित एक " इंटरनैशनल कॉनफरन्स ऑन मेडिकल फिज़िक्स " एन्ड २८वीं ऍन्युअल कॉनफरन्स ऑफ मेडिकल फिज़िसिस्टस ऑफ इन्डिया (एएमपीआइ) गोष्ठी में सर्वश्रेष्ठ मौखिक पुरस्कार प्रदान किया गया। यह शोध-पत्र इसी प्रभाग के श्री आर.एस.विश्वाकर्मा, टी. पालानी सेलवम एवं श्रीधर साहू द्वारा लिखा गया है।

A paper entitled, "Monte Carlo-based AAPM TG43 dosimetry parameters for BARC ^{137}Cs brachytherapy source", was given the Best Oral Paper Award at the meeting "Updates in Medical Physics", organized by the UP-Delhi Chapter of the Association of Medical Physicists of India (AMPI), on September 08, 2007 at AIIMS, New Delhi. The paper was authored by Mr. Sridhar Sahoo and Dr. T. Palani Selvam of Radiological Physics & Advisory Division.

Another paper entitled, "Monte Carlo investigation of dosimetric properties of solid phantoms relevant in brachytherapy", was given the Best Oral Paper Award at the "International Conference on Medical Physics" and 28th Annual Conference of Association of Medical Physicists of India (AMPI), organized by Sher-e-Kashmir Institute of Medical Sciences, Srinagar, Kashmir during 2-4 November, 2007. The paper was authored by the Mr. R.S. Vishwakarma, Mr. T. Palani Selvam and Mr. Sridhar Sahoo of the same Division.


Sridhar Sahoo

श्रीधर साहू, एक आयुर्विज्ञान भौतिकी -वैज्ञानिक, भाभा परमाणु अनुसंधान केंद्र के विकिरणकीय भौतिकी एवं सलाहकार प्रभाग में कार्यरत हैं। आप मोंटे कार्लो विधि का उपयोग करके विकिरण चिकित्सा की मात्रामिति, विकिरण चिकित्सा योजना प्रणाली का स्थानीय विकास तथा रेडियो आइसोटोप (विकिरण समस्थानिक) के आयुर्विज्ञान उपयोग में विकिरण संरक्षण जैसे आयुर्विज्ञान भौतिकी क्षेत्र के अनुसंधान एवं विकास में व्यस्त हैं। आप विभिन्न विकिरण संरक्षण से संबंधित अल्पकालिक कार्यक्रमों हेतु संकाय सदस्य हैं। आप एचबीएनआइ के अधीन प्रभाग के द्वारा संचालित एक वर्ष के डिपलोमा रेडियोलोज़िकल फिज़िक्स कोर्स के भी संकाय सदस्य हैं।

Mr. Sridhar Sahoo is a Medical Physicist working in the Radiological Physics & Advisory Division of BARC. He is involved in R&D activities in the field of Medical Physics such as dosimetry of radiotherapy sources using Monte Carlo methods, indigenous development of radiotherapy treatment planning system and radiation protection in medical application of

radioisotopes. He is a faculty member for various radiation safety related short-term programmes. He is also a faculty member for the one-year Diploma Radiological Physics Course conducted by the Division under the aegis of HBNI.


R.S. Vishwakarma

आर.एस.विश्वकर्मा एक आयुर्विज्ञान भौतिकी-वैज्ञानिक, भाभा परमाणु अनुसंधान केंद्र के विकिरणकीय भौतिकी एवं सलाहकार प्रभाग में कार्यरत हैं। आप मोंटे कार्लो विधि का उपयोग करके विकिरण चिकित्सा की मात्रामिति, विकिरण चिकित्सा योजना प्रणाली का स्थानीय विकास तथा रेडियो आइसोटोप (विकिरण समस्थानिक) के आयुर्विज्ञान उपयोग में विकिरण संरक्षण जैसे आयुर्विज्ञान भौतिकी क्षेत्र के अनुसंधान एवं विकास में व्यस्त हैं। आप विभिन्न विकिरण संरक्षण से संबंधित अल्पकालिक कार्यक्रमों हेतु संकाय सदस्य हैं। आप एचबीएनआइ के अधीन प्रभाग के द्वारा संचालित एक वर्ष के डिपलोमा रेडियोलोज़िकल फिज़िक्स कोर्स के भी संकाय सदस्य हैं।

Mr. R.S. Vishwakarma is a Medical Physicist working in the Radiological Physics & Advisory Division of BARC. He is involved in R&D activities in the field of Medical Physics such as dosimetry of radiotherapy sources using Monte Carlo methods, indigenous development of radiotherapy treatment planning system and radiation protection in medical application of radioisotopes. He is a faculty member for various radiation safety related short-term programmes. He is also a faculty member for the one-year Diploma Radiological Physics Course conducted by the Division under the aegis of HBNI.


Dr. T. Palani Selvam

डॉ. टी. पालानी सेलवम एक आयुर्विज्ञान भौतिक-वैज्ञानिक, भाभा परमाणु अनुसंधान केंद्र के विकिरणकीय भौतिकी एवं सलाहकार प्रभाग में कार्यरत हैं। इनकी अनुसंधान रुचि के क्षेत्र में मोंटे कार्लो तकनीक एवं विकिरण चिकित्सा उपचार योजना के उपयोग से विकिरण चिकित्सा अनुसंधान भी शामिल है। आप २००४-०६ के दौरान कारलटॉन लेबोरेटरी फॉर रेडियोथेरेपी, कारलटॉन यूनिवर्सिटी, ओटावा, केनेडा के स्नातकोत्तर सदस्य (PDF) रहे हैं। आप एचबीएनआइ के अधीन, प्रभाग के द्वारा संचालित एक वर्ष के डिपलोमा रेडियोलोज़िकल फिज़िक्स कोर्स के भी संकाय सदस्य हैं।

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