उच्च प्रौद्योगिकी केन्द्र
(पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय)

सीएचटी

Centre for High Technology
(Ministry of Petroleum & Natural Gas, Govt. of India)

CHT/SAC-73/ 8580

Date: 17th December 2013

To

Chairman, Members, Permanent & Special Invitees
of Scientific Advisory Committee (SAC) on Hydrocarbons of MoP&NG
(as per list attached)

Sub: Minutes of the 73rd Meeting of the Scientific Advisory Committee (SAC) on Hydrocarbons of Ministry of Petroleum & Natural Gas

Dear Sir,

Enclosed please find a copy of the Minutes of 73rd Meeting of the SAC on Hydrocarbons of Ministry of Petroleum & Natural Gas held on 7th October 2013 at The Park Hotel, Hyderabad, for your kind information and necessary action.

With kind regards,

Yours Sincerely,

18/12/2013

(B.D.Ghosh)
Executive Director

Encl: As above

PF - SAC file

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Chairman, Members, Permanent Invitees and Special Invitees to the Scientific Advisory Committee

1. Shri Arun Balakrishnan — Chairman
   C – 122, 12th Floor,
   Trinity Tower,
   DLF Phase – V,
   Gurgaon – 122 002

2. Dr. J. P. Gupta, — Member
   Director,
   Rajiv Gandhi Institute of Petroleum Technology,
   Ratapur Chowk,
   Rae Bareli – 229 316 (U.P.)

3. Dr. M.O.Garg, — Member
   Director,
   Indian Institute of Petroleum,
   P.O.IIP, Mohkampur,
   Dehradun – 248 005 (Uttarakhand)

4. Dr. R. Kumar, — Member
   Professor Emeritus,
   Department of Chemical Engineering,
   Indian Institute of Science, Bangalore,
   Bengaluru – 560 012 (Karnataka)

5. Prof. Shantanu Roy, — Member
   Department of Chemical Engineering,
   Indian Institute of Technology-Delhi,
   Hauz Khas,
   New Delhi – 110 016

6. Prof. G. D. Yadav, — Member
   Director,
   Institute of Chemical Technology,
   Nathalal Parekh Marg,
   Matunga (East),
   Mumbai – 400 019

7. Shri Ajay N. Deshpande, — Member
   Director (Technical),
   EI Bhawan,
   Engineers India Limited,
   1, Bhikaiji Cama Place,
   New Delhi – 110 066

8. Shri R. N. Choubey, — Member
   Director General,
   Directorate General of Hydrocarbons,
   OIDB Bhawan, Tower A, Sector 73,
   NOIDA – 201 307 (U.P.)

9.	Shri R. K. Ghosh, Director (Refineries), Indian Oil Corporation Ltd., SCOPE Complex, 5th Floor, Core-2, Lodhi Road, **New Delhi** – 110 003	Member
10.	Shri B. K. Datta, Director (Refineries), Bharat Petroleum Corporation Ltd., Bharat Bhawan, 4&5 Currimbhoy Road, Ballard Estate, P.B. No. 688, **Mumbai** – 400 001	Member
11.	Shri B. K. Namdeo, Director (Refineries), Hindustan Petroleum Corporation Ltd., 17, Jamshedji Tata Road, P.O. Box No. 11041, **Mumbai** – 400 020	Member
12.	Dr. R. K. Malhotra, Director (R&D), Indian Oil Corporation Ltd., R&D Centre, Sector-13, **Faridabad** – 121 007	Member
13.	Shri L.N. Gupta, Secretary, Oil Industry Development Board, OIDB Bhawan, Plot No. 2, Sector – 73, **NOIDA** – 201 301 (U.P.)	Member
14.	Shri B. D. Ghosh, Executive Director, Centre for High Technology, OIDB Bhawan, Tower 'A', 9th Floor, Plot No.2, Sector-73, **NOIDA** – 201 301 (U.P.)	Member- Secretary
15.	Shri Vivek Rae, Secretary, Ministry of Petroleum & Natural Gas, Shastri Bhawan, **New Delhi** – 110 001	Permanent Invitee
16.	Shri Rajive Kumar, Additional Secretary, Ministry of Petroleum & Natural Gas, Shastri Bhawan, **New Delhi** – 110 001	Permanent Invitee

17.	Shri R. K. Singh, Joint Secretary (Refineries), Ministry Of Petroleum & Natural Gas, Shastri Bhawan, **New Delhi** – 110 001	Permanent Invitee
18.	Shri Mohan Lal, Dy. Secretary (R&A), Ministry Of Petroleum & Natural Gas, Shastri Bhawan, **New Delhi** – 110 001	Permanent Invitee
19.	Shri P. S. Viswanathan, Head (R&D), Bharat Petroleum Corporation Ltd., Corporate R&D Centre, Plot no. 2 A, Udyog Kendra (Behind Yamaha Motors), Surajpur Industrial Area, **Greater Noida** – 201 306 (U.P)	Permanent Invitee
20.	Shri G. Sri Ganesh, Executive Director (Corporate R&D), Hindustan Petroleum Corporation Ltd., Corporate R&D Centre, 176, Adarsh Eco Place, 1st Floor, EPIP Zone-II, Whitefield, **Bangalore** – 560 066	Permanent Invitee
21.	Shri Ganesh Prasad, General Manager (R&D), Engineers India Limited, Sector-16, **Gurgaon** – 122 001	Permanent Invitee
22.	Shri A. S. Basu, Managing Director, Chennai Petroleum Corporation Limited, 536, Anna Salai, Teynampet, **Chennai** – 600 018	Special Invitee
23.	Dr. B. Bhargava, Director General, ONGC Energy Centre, 15th Floor, South Tower, Core-4, SCOPE Minar Complex, Luxmi Nagar, **New Delhi**-110 092	Special Invitee

Minutes of the 73rd Meeting of the Scientific Advisory Committee (SAC) on Hydrocarbons of MOP&NG held on 7th October, 2013 at Hotel The Park, Hyderabad

1.0 Shri Arun Balakrishnan, Chairman, SAC chaired the Meeting. List of participants is enclosed as Annexure-1.

2.0 Shri G. Sriganesh, ED (Corporate R&D), HPCL welcomed the SAC members and participants to the 73rd SAC meeting and presented bouquet to Shri Arun Balakrishnan and Shri B.D. Ghosh, ED, CHT and Member Secretary of SAC.

3.0 Shri B.D. Ghosh, ED, CHT in his welcome address talked about the salient achievements of the present SAC and contribution made by various members.

4.0 Chairman in his opening remarks observed that six meetings of the Committee were held during the period and suggested that SAC meetings should be held at least thrice a year for expediting the project review/approving mechanism. He expressed that this will also allow regular review of the progress of the on-going projects for mid-term correction, if any.

5.0 Shri A.S. Pathak, Addl. Director, CHT presented the ATR of the Minutes of the 72nd Meeting including the current status of the various projects and other pending issues.

4.0 The status of the following projects proposals was presented to the SAC. SAC took note of the same and approved.

4.1 "Experimental and Simulation Studies on Coke Mitigation in Petroleum Refinery Systems" of BPCL-R&D and BITS, Pilani, Goa Campus

The technical part of the project proposal was approved in-principle in the 72nd meeting of SAC and the final cost approval referred to the sub-committee.

It was informed that the sub-committee comprising Shri S. Rajagopal, ED, IOCL-R&D, Shri G. Sriganesh, ED, HPCL and Prof. S. Roy, IITD reviewed the details/clarifications submitted by BITS/BPCL-R&D and has recommended approval for funding the project at a cost of Rs.132.97 lakh with completion schedule of 36 months.

SAC took note of the same and approved the project at a cost of Rs.132.97 lakh, with completion schedule of 36 months, as per the recommendations.

4.2 **Development of process know-how for indigenous production of Biphenyl for thermic fluid and other application – by BPCL-R&D**

The project proposal was approved in-principle at a cost of Rs.260 lakh and completion schedule of 36 months in the 72nd meeting of SAC, subject to submission of note addressing the commercialization aspects by BPCL-R&D. It was informed that BPCL-R&D has since submitted the details addressing the commercialization issues which will be covered in the MoU.

SAC took note of the same and concurred for taking up project at a cost of Rs.260 lakh and completion schedule of 36 months.

4.3 **Hydroprocessing of Residues – by IIP, Dehradun & HPCL-R&D**

CHT informed that a one day workshop, as advised by the SAC, was organized by IOC-R&D on 5th August 2013 to discuss the modalities for undertaking this project in mission mode. The details of the deliberations were presented by CSIR-IIP and are covered separately under Presentations on New project proposals.

4.4 **"An Integrated Approach for Bio-hydrogen production through combined dark and photo fermentative process" of HPCL and TERI under Hydrogen Corpus Fund**

CHT informed that in line with the recommendation of 72nd meeting of the SAC, Steering Committee of Hydrogen Corpus Fung (HCF) of MoP&NG has approved for continuing the project with 100 litre photo bio-reactor instead of 1000 litre bio-reactor. The Scope of work for the project has also been incorporated through an amendment of the project MoU. HPCL/TERI expressed concern regarding execution of the project as per the scheduled work plan due to delay in receiving payments from CHT/OIDB. **Chairman, SAC agreed to discuss the issue separately with Secretary, OIDB as CHT informed that the matter is pending with OIDB.**

5.0 **Discussion on Mission R&D project "Hydroprocessing of Residues" – by IIP, Dehradun & HPCL-R&D**

The subject proposal was earlier presented in 71st and 72nd Meeting of the SAC. As suggested in the earlier SAC meeting, a workshop was organized at IOC-R&D on 5th August 2013 to finalise the methodology for initiating the work in the area. The objective of the project is to develop catalyst for hydroprocessing of heavy oil and residues, catalyst preparation for hydro demetalization (HDM), Hydro desulphurization (HDS) and slurry phase hydrocracking.

The role of various participants (IIP, IOCL, BPCL, HPCL and EIL) was presented. The members deliberated on the scope of study and it was agreed that while IIP, IOCL and HPCL would be primarily focus on catalyst development, EIL and BPCL may work independently or jointly for hydrodynamics, modeling & process simulation studies. Subsequently design of demo unit will be handled by EIL in consultation with other participants.

The project is proposed to be carried out in two phases with Catalyst development, hydrodynamics, modeling & process simulation studies and design of demo unit in Phase-1 and Phase-2 covering scale up of catalyst manufacture and pilot plant for the process.

The estimated cost of Phase-I activities is Rs. 632.9 lakh with project completion schedule of 36 months.

SAC deliberated on the merits of the project and suggested that the results of the projects should be utilized for the oil refineries. It was also suggested to have an appropriate monitoring mechanism in view of the larger participation and co-ordination involved in addressing the project objectives and deliverables.

SAC concurred for in-principle approval of the project. However, as IIP had presented only their cost requirement for the project, it was advised to interact with other participants and furnish a consolidated estimated cost to CHT for consideration and approval by the SAC.

6.0 Presentation and discussion on New/Revised Project Proposals

6.1 Parametric Study and Technology Development for Desalter Design – by EIL-R&D and BPCL-R&D

Mr. Sheo Raj Singh presented the details of the project proposal to be undertaken jointly by EIL and BPCL. Desalter is critical equipment for any refinery or oil processing offshore/onshore fields. Designing a desalter/dehydrator is a very complex issue as it depends on many parameters and involves a unique combination of process technology and electrical interface.

Based on the feedback being shared by the refineries in the Activity Committee Meeting on Distillation organized by CHT, majority of the desalters in refineries have the operational problems/issues regularly. This leads to corrosion and failure of critical equipment in primary and secondary processes.

Under the proposed project, a skid mounted Proto-type Desalter unit shall be set up for parametric study and Desalter design development. While a skid mounted proto type Desalter shall be assembled at BPCL-R&D and relocated in a refinery subsequently, EIL shall look into the development of Desalter technology based on in-house data base and the knowledge assimilated over the years.

EIL also informed that in the present scenario, M/s Cameron is the only supplier of Desalter Systems in India and performance of the Desalter systems supplied by M/s Mackenzie Hydrocarbons has not been found to meet the design requirements. An indigenous efforts in this direction are therefore beneficial to all the refineries.

It was informed that the overall approximate cost of the project would be about Rs. 10.0 crore with a completion schedule of 36 months.

SAC deliberated the advantageous and considering the scope for its indigenization and commercialization agreed for in-principle approval of the project at a total cost not exceeding Rs.10.0 crore with part of the project cost shared by the participating organisations. The completion schedule of the project is 36 months. SAC advised EIL to submit a detailed break-up of the cost estimates and cost sharing details to CHT for further consideration, concurrence and final approval of the project cost.

6.2 Development of Improved 3-phase reactor configuration for hydroprocessing applications – BPCL-R&D and EIL-R&D

Conventionally hydroprocessing of refinery hydrocarbon feedstocks is carried out in co-current flow trickle bed reactors, in the presence of large excess hydrogen causing higher feed vaporization and higher pressure drop across the reactor. Also due to accumulation of reaction products i.e. H_2S and ammonia, reaction rate is inhibited. To overcome these deficiencies, BPCL-R&D & EIL-R&D had a proposed radial flow type reactor configuration. In the proposed reactor configuration, hydrogen is fed from a central pipe and flows towards the outer annular conduit after contacting liquid flowing downwards over the catalyst bed.

SAC in its 72nd meeting had advised that an expert committee may be formed to study the proposal in detail. Accordingly, an expert committee, comprising Shri S Rajagopal, Shri G Sriganesh and Dr. Shantanu Roy, formed by CHT studied the BPCL proposal and submitted its recommendation to CHT.

Dr Ravikumar, BPCL-R&D presented the details of the project proposal covering the recommendations of the expert committee. The highlights of the proposal includes –

- Carrying out the project in two phases
  - Phase-I : Feasibility study of cross flow hydroprocessing reactor through cold flow studies
  - Phase-II : Hot unit demonstration of cross flow hydroprocessing reactor
- Low pressure cold flow studies at BPCL R&D
- Moderate pressure studies using existing facilities at EIL R&D
- CFD model development and validation using experimental data

The total estimated cost of the project is Rs. 12.50 crore (Rs. 810 lakh for Phase-1 and Rs. 440 lakh for Phase-2) with a time schedule of 36 months for Phase-1. Phase-2 activities will be initiated after successful completion of Phase-1. Activities to be carried out by BPCL-R&D and EIL-R&D were also presented.

During deliberation on the proposal some members expressed apprehension regarding the outcome and tangible benefits of the project, in view of the high project cost. It was informed that HPCL-R&D and IIT Delhi are also interested in collaborating for development studies in this project. Detailed discussions were held regarding the scope of work presented by BPCL and it was suggested to undertake the studies/scope of work limited to establishing the proof of concept prior to taking the detailed exercise involving pilot scale hydrodynamic hot and cold experimentation studies. BPCL was also requested to revisit the cost estimates and absorb the CFD software procurement cost internally. Members suggested that funding the project to establish proof of concept can be considered by the SAC.

SAC concurred with the members and approved to fund the cost of the project limited to Rs. 100 lakh, for establishing the proof of concept and advised BPCL to submit the revised proposal highlighting the scope of work and activities for achieving the above objective.

6.3 Synthetic Aviation Lubricants – Phase II Involving Ground & In-flight Tests with Indigenously Developed SAL on TV2 Aero Engine by Indian Air Force at 3BRD, Chandigarh – IICT, Hyderabad

Dr. P. Vijayalakshmi, IICT made detailed presentation about the project proposal.

It was informed that during the Phase-1 of the project on "Development of Synthetic Aviation Lubricants" which was completed in March 2011 by IICT, Hyderabad in collaboration with 6 other agencies/R&D institutions, two potential lubricants SVS11 and SVS21 were formulated and provisional certificates for Airworthiness Approval has been granted by CEMILAC for SVS11 and SVS21.

The main objective of the present project proposal is to meet the requirements for preparation of the base oil stocks for Synthetic Aviation Lubricants and subsequent formulations of the lubricants by IOC-R&D. About 500 kg each of the base oils will be prepared for preliminary ground testing followed by in-flight testing by Indian Air Force (IAF).

CEMILAC has taken initiative and obtained the consent of AOM from Indian Air Force for undertaking the pre-testing activities. During the meeting attended by representatives from IAF, CEMILAC, DGAQA, IOC-R&D and CSIR-IICT, IAF has expressed interest to test the lubricants on TV2 engine.

Successful testing of the SVS11 and SVS21 lubricants for the in-flight test at IAF will be helpful in commercialization of these lubricants.

The estimated cost of the project proposal is Rs.250 lakh, with a completion schedule of 18 months. CSIR-IICT requested for funding the project for Rs. 97.02 lakh from CHT/OIDB and the balance shall be met from institutional funds of IOC-R&D and CSIR-IICT, Hyderabad.

Members appreciated the indigenization and commercialization efforts initiated by CSIR-IICT and expressed that the project being of national importance, providing technological competence to India for manufacturing the synthetic lubricants, should be encouraged and suggested for funding by CHT/OIDB.

SAC approved the project at a cost of Rs.250 lakh with a contribution of Rs.97.0 lakh funded by CHT/OIDB, as requested by CSIR-IICT, with a completion schedule of 18 months.

7.0 Presentation & discussion on Ongoing R&D Projects

7.1 "Coal to Liquid (CTL) Fuels Technology Project" of EIL-R&D and BPCL-R&D

Dr R.N. Maiti, EIL-R&D and Dr V. Ravikumar, BPCL-R&D presented the detailed progress on the ongoing project on behalf of EIL and BPCL which has primarily four major components :

- Gasification pilot plant
- Gas clean-up and conditioning
- FT – technology development
- Basic Design for a Demo Plant

First 2 parts are being carried out by EIL-R&D and while FT technology is by BPCL-R&D and the basic design of demo plant to be carried out jointly.

The project zero date is July 2009 and revised scheduled completion of 57 months, i.e., April 2014. Total cost of the project is Rs. 33.0 crore with contribution by each of the participating members, EIL, BPCL, Thermax and CHT/OIDB.

EIL informed the members that the foundation work for gasifier installation at EIL R&D centre has been completed and refractory lining work for the gasifier is in progress as also the cyclone system. On the gas clean-up system, the PO has been placed on M/s Texol and the skid mounted unit is expected to be ready by February 2014.

BPCL briefed about the various activities of the project under BPCL's scope of work and informed that the work on FT reactor model development, Catalyst development and kinetic studies, cold flow hydrodynamic studies (pilot plant & CFD studies) have been completed within schedule time and final reports have been submitted.

During the discussions members expressed apprehensions in EIL-R&D completing the project in the revised schedule and requested EIL to expedite the project. EIL highlighted the problems being faced with regard to development of gasifier and gas cleaning system. EIL further requested for re-allocation/re-adjustment of funds under various budget heads to accommodate the increased cost of the gasification system. EIL submitted that the total cost of gasifier has further increased by about Rs.352 lakh from existing Rs.1122 lakh and as per the agreement, 25% of the increased cost (i.e. 88 lakh) is being borne by M/s Thermax. Of the remaining 75% cost increase, 50% cost (i.e. Rs.1.32 crore) is to be shared by CHT/OIDB and 50% by EIL/BPCL.

In this connection, EIL informed that BPCL-R&D has consented to share and part fund the escalated cost amounting to Rs.32 lakh from its portion of the un-utilised funds in this project, in order to meet the funds requirement of Rs.132 lakh by EIL and BPCL. The balance differential amount of Rs.100 lakh shall be met by EIL utilizing its original budgeted cost of Rs.1090 lakh.

SAC reviewed the progress made by EIL and allowed re-adjustment of funds proposed by EIL, as per the MOU, with the consent/concurrence of OIDB/CHT and within the overall project cost of Rs.3300 lakh approved by the SAC earlier. SAC advised EIL to submit the details of actual increased cost and justification to CHT/OIDB for effecting the appropriation of funds.

7.2 "Desulphurization of Fuel Oil using Solvent Extraction Route" – CPCL & CSIR-IIP

Dr A. Meenakshisundaram, CPCL presented the detailed status on progress of the project. The total cost of the project is Rs.116.7 lakhs and schedule of 30 months i.e. Sept. 2014.

CPCL informed that batch extraction runs with external field have been taken up as per the project schedule. Batch LLE extractions runs have been performed using gas oil and Vistar (RFO component) in jacketed reaction vessel without external field. IIP informed procurement of ultrasonicator has been initiated and order placed. IIP indicated the project progress is as per schedule.

SAC took note of the progress in the project.

8.0 Presentation & discussion on Completed Projects under Hydrogen Corpus Fund (HCF)

8.1 "Hydrogen Production from Natural Gas (Methane) by Catalytic Decomposition" – HPCL & IIT-Delhi

Prof. K.K. Pant, IIT-Delhi gave a detailed technical presentation on the above project being funded under Hydrogen Corpus Fund (HCF). The objective of the project is to develop a novel catalytic process for Cox free Hydrogen production by methane / natural gas decomposition.

As a part of the project, preparation and characterization of modified Ni/Fe/Co/Cu/Zn based catalysts on different supports (Al_2O_3/SiO_2 and MCM-22) for CO_x free hydrogen production from methane were undertaken to identify most suitable / potential catalyst for methane decomposition. The effect of various process variables (temperature, residence time and hydrocarbon partial pressure) on hydrogen production has been studied/investigated for decomposition reaction mechanism and stability & performance of the catalyst.

The study concluded that among the various catalysts tested 60% Ni/Al_2O_3 modified with 5 to 10% Cu and Zn promoters showed best performance. IIT-Delhi informed that one patent and few technical papers have been published / presented in various journals / conferences based on the research undertaken in this project. Further studies with fluidized bed reactor system were proposed for development of a continuous process and scale-up as a follow-up to the objectives addressed in this project. HPCL confirmed that all the deliverables under this project have been met.

SAC agreed to consider the project as completed and advised IIT-Delhi to submit a fresh proposal for initiating further studies in this area for fruitful utilization and commercialization of the developed knowhow.

8.2 **"Design and Construction of Metal Organic Framework (MOF) materials for Storgae of Hydrogen" – HPCL & Gitam University, Visakh**

Prof. M. Saratchandra Babu, Gitam University, Visakh gave a detailed technical presentation on the above project being funded under Hydrogen Corpus Fund (HCF). The objective of the project is to design and construct novel MOF materials and test the Hydrogen storage capacity of the MOF materials at variable pressures and temperatures with a target of 6.0-7.0 wt% H2 storage at non-cryogenic temperatures.

As a part of this project, MOF materials were synthesized with different metals, polycarboxylate ligands, lanthanide incorporation, structural characterization by FTIR, XRD, TGA and single crystal XRD were completed. The hydrogen sorption/uptake measurements at varying pressures from 1 bar to 60 bars at different temperatures were carried out.

Based on the sorption uptake, Two potential MOF materials that exhibited good hydrogen adsorption capacities were identified as promising candidates. The Hydrogen uptake for MOFs developed was in the range of 6.4 to 7.4 wt% at 77K. HPCL confirmed that all the deliverables and milestones under this project have been accomplished.

SAC agreed to consider the project as completed

9.0 The meeting concluded with thanks to the Chair.

Annexure-1

73rd Meeting of the Scientific Advisory Committee (SAC) on Hydrocarbons of MOP&NG held on 7th October 2013 at Hotel The Park, Hyderabad

List of participants

	Name	Designation	Organisation
1	Arun Balakrishnan	Chairman	SAC
2	Dr R. Kumar	Hon. Professor	IISc, Bangalore
3	Prof. G.D Yadav	Vice Chancellor	I.C.T. Mumbai
4	Dr Shantanu Roy	Member-SAC	IIT, Delhi
5	Dr R.K. Malhotra	Director (R&D)	IOC-R&D
6	B.K. Datta	Director (R)	BPCL
7	Dr M.O. Garg	Director	IIP
8	A.S. Basu	MD	CPCL
9	B.D. Ghosh	ED	CHT
10	Ajay N. Deshpande	Director (T)	EIL
11	Dr B. Basu	ED	IOC-R&D
12	G. Sri Ganesh	ED, R&D	HPCL
13	P. Padmanabhan	ED (Ref. Co.)	BPCL
14	Dr P.S. Viswanathan	Head, R&D	BPCL
15	Dr V. Ravikumar	Chief Manager (R&D)	BPCL
16	Dr Bharat L. Newalkar	Sr. Manager (R&D)	BPCL
17	Ganesh Prasad	GM, R&D	EIL
18	S.R. Singh	DGM,	EIL
19	Dr R.N. Maiti	AGM	EIL
20	Dr D. Parvatalu	DGM (Chem)	ONGC Energy Centre
21	Dr N.V. Choudary	GM	HPCL
22	Dr P.V.C. Rao	DGM	HPCL
23	Dr S.K. Maity	Principal Scientist	IIP
24	Dr Sanjukta Subudhi	Fellow	TERI, New Delhi
25	Prof. K.K. Pant	Professor	IIT Delhi

	Name	Designation	Organisation
26	Dr K.V. Raghavan		IICT, Hyderabad
27	Dr R.B.N. Prasad		IICT, Hyderabad
28	Dr P. Vijayalakshmi		IICT, Hyderabad
29	Dr R. Ravishankar		HPCL
30	Dr A. Meenakshisundaram		CPCL
31	Prof. M. Saratchandra Babu	Professor	Gitam University
32	N. Naga Raju		Gitam University
33	R. Krishnamurthy	Director	CHT
34	A.S. Pathak	Addl. Director	CHT