



उच्च प्रौद्योगिकी केन्द्र

(पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय, भारत सरकार)
Centre for High Technology
(Ministry of Petroleum & Natural Gas, Govt. of India)

सीएचटी/एसएसी-76/1059
CHT/SAC-76/1059

दिनांक: 30 अप्रैल 2015
Date: 30th April 2015

सेवा में/ To,

पेट्रोलियम और प्राकृतिक गैस मंत्रालय की हाइड्रोकार्बन पर वैज्ञानिक सलाहकार समिति के अध्यक्ष, सदस्यगण, स्थायी व विशेष आमंत्रित अतिथिगण।

(संलग्न सूची के अनुसार)

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

विषय:- पेट्रोलियम और प्राकृतिक गैस मंत्रालय की हाइड्रोकार्बन पर वैज्ञानिक सलाहकार समिति (SAC) की 76वीं बैठक का कार्यवृत्त।

Sub: Minutes of the 76th Meeting of the Scientific Advisory Committee (SAC) on Hydrocarbons of Ministry of Petroleum & Natural Gas

प्रिय महोदय / Dear Sir,

आपकी सूचना एवं आवश्यक कार्रवाई हेतु दिनांक 3 व 4 अप्रैल 2015 को बीपीसीएल रिफाइनरी मुंबई में पेट्रोलियम और प्राकृतिक गैस मंत्रालय की हाइड्रोकार्बन पर आयोजित 76वीं बैठक के कार्यवृत्त की प्रतिलिपि संलग्न की जा रही है।

Enclosed please find a copy of the Minutes of 76th Meeting of the SAC on Hydrocarbons of Ministry of Petroleum & Natural Gas held 3-4th April 2015 at BPCL Refinery, Mumbai, for your kind information and necessary action.

सादर,

With kind regards,

भवदीय,

Yours sincerely,

बी.डी. घोष

(बी.डी. घोष)

कार्यकारी निदेशक

(B.D.Ghosh)

Executive Director

संलग्न यथोक्त

Encl: As Above

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

1.	Dr. Anil Kakodkar, Bhabha Atomic Research Centre, 7 th Floor, Central Complex, Trombay, <u>Mumbai</u> – 400 085	Chairman
2.	Dr. R. Kumar, Professor Emeritus, Department of Chemical Engineering, Indian Institute of Science, Bangalore, <u>Bengaluru</u> – 560 012 (Karnataka)	Member
3.	Dr. M.O.Garg, Director, CSIR – Indian Institute of Petroleum, P.O.IIP, Mohkampur, <u>Dehradun</u> – 248 005 (Uttarakhand)	Member
4.	Dr. B.D. Kulkarni, Distinguished Scientist, CSIR – National Chemical Laboratory, Dr. Homi Bhabha Road, <u>Pune</u> – 411 008 (Maharashtra)	Member
5.	Dr. D.V. Khakhar, Director, Indian Institute of Technology-Mumbai, Powai, <u>Mumbai</u> – 400 076	Member
6.	Dr. (Ms) M. Lakshmi Kantam, Director, CSIR – Indian Institute of Chemical Technology, Uppal Road, Tarnaka, <u>Hyderabad</u> – 500 007	Member
7.	Prof. Shantanu Roy, Department of Chemical Engineering, Indian Institute of Technology-Delhi, Hauz Khas, <u>New Delhi</u> – 110 016	Member
8.	Dr. Ajit Sapre, President - Refining Technology Group Reliance Industries Ltd. Reliance Corporate Park, Bldg. No. 7A, Thane-Belapur Road, Ghansoli <u>Navi Mumbai</u> – 400 701	Member
9.	Shri R.K. Ghosh, Ex-Director (R), IOCL, AH-708, Amrapali Village, Indira Puram, <u>Ghaziabad</u> – 201 014	Member
10.	Dr. R.K. Malhotra, Ex-Director (R&D), IOCL, House no. 303, AGCR Enclave, Opp. Karkardooma Court, <u>Delhi</u> – 110 092	Member

11.	Shri Sanjiv Singh, Director (Refineries), Indian Oil Corporation Ltd., SCOPE Complex, 5th Floor, Core-2, Lodhi Road, New Delhi – 110 003	Member
12.	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
13.	Shri B.K. Namdeo, Director (Refineries), Hindustan Petroleum Corporation Ltd., 17, Jamshedji Tata Road, P.O. Box No. 11041, Mumbai – 400 020	Member
14.	Shri B.P. Das, Executive Director – I/C (R&D), Indian Oil Corporation Ltd., R&D Centre, Sector-13, Faridabad – 121 007	Member
15.	Shri Ajay N. Deshpande, Director (Technical), Engineers India Limited, 1, Bhikaiji Cama Place, New Delhi – 110 066	Member
16.	Dr. B. Bhargava, Director General, ONGC Energy Centre, 15 th Floor, South Tower, Core-4, SCOPE Minar Complex, Luxmi Nagar, New Delhi – 110 092	Member
17.	Shri B.N. Talukdar, Director General, Directorate General of Hydrocarbons, OIDB Bhawan, Tower A, Sector 73, NOIDA – 201 307 (U.P.)	Member
18.	Director (BD), GAIL India Limited, 16, Bhikaiji Cama Place, R.K. Puram, New Delhi – 110 066	Member
19.	Shri L.N. Gupta, Secretary, Oil Industry Development Board, OIDB Bhawan, Plot No. 2, Sector – 73, NOIDA – 201 301 (U.P.)	Member
20.	Shri B. D. Ghosh, Executive Director, Centre for High Technology, OIDB Bhawan, Plot No.2, Sector – 73, NOIDA – 201 301 (U.P.)	Member-Secretary

21.	Shri Sandeep Poundrik, Joint Secretary (Refineries), Ministry Of Petroleum & Natural Gas, Shastri Bhawan, <u>New Delhi</u> - 110 001	Permanent Invitee
22.	Shri Sanjay Bhargava, Head (R&D), Bharat Petroleum Corporation Ltd., Corporate R&D Centre, Plot no. 2 A, Udyog Kendra, Surajpur Industrial Area, <u>Greater Noida</u> - 201 306 (U.P)	Permanent Invitee
23.	Shri N.V. Choudary, General Manager (R&D), HP Green R&D Centre, Hindustan Petroleum Corporation Ltd., KIADB Industrial Area Tarabanahalli, Devanagundi, Hoskote, <u>Bangalore</u> -- 560 067	Permanent Invitee
24.	Ms Varika Shukla, General Manager (Process and R&D), R&D Centre, Engineers India Limited, Sector-16, <u>Gurgaon</u> - 122 001	Permanent Invitee
25.	Dr. A. Meenakshisundaram Chief Manager & Head (R&D), Chennai Petroleum Corporation Limited, Manali, <u>Chennai</u> - 600 068	Permanent Invitee
26.	Shri R.K. Kashyap, Executive Director (R&D), GAIL India Limited, 8 th Floor, Jubilee Tower, B- 35-36, Sector - 1, <u>Noida</u> - 201 301	Permanent Invitee
27.	Shri Gautam Roy, Managing Director, Chennai Petroleum Corporation Ltd. 536, Anna Salai, Teynampet, <u>Chennai</u> - 600 018	Special Invitee
28.	Shri P. Padmanabhan, Managing Director, Numaligarh Refinery Limited, 6 th Floor, Tolstoy House, 15 - 17, Tolstoy Marg, <u>New Delhi</u> - 110 001	Special Invitee
29.	Shri H. Kumar, Managing Director, Mangalore Refinery & Petrochemicals Ltd., Regd. Office: Kuthethoor, P.O. Via Katipalla, <u>Mangalore</u> - 575 030	Special Invitee

**Minutes of the 76th Meeting of the Scientific Advisory Committee (SAC) on Hydrocarbons of
MOP&NG held on 3-4th April 2015 at BPCL Refinery, Mumbai**

- 1.0** Dr. Anil Kakodkar, Chairman, SAC chaired the 76th Meeting of the Scientific Advisory Committee (SAC) held at BPCL Refinery, Mumbai on 3-4th April 2015. The list of participants is enclosed as Annexure-1.
- 2.0** Shri B.K. Datta, Director(R), HPCL welcomed Chairman Dr. Anil Kakodkar and members of SAC. In his welcome address, Shri Datta stressed on the refinery performance challenges and need for exploring new opportunities/initiatives in view of the depletion of resources and availability of new sources of energy.
- 3.0** Shri B.D. Ghosh, ED, CHT in his opening remarks welcomed Dr. Anil Kakodkar, Chairman SAC; members of the SAC, academia and scientists to the 76th SAC meeting. He gave an overview of SAC agenda in his opening remarks and briefed the participants regarding the developments in respect of Hydrogen Corpus Fund and Sectoral Innovation Council (SIC). He also informed the participants that an additional role for SAC has been notified by MoP&NG for implementation the recommendations of SIC.
- 4.0** Shri Sandeep Poundrik, Joint Secretary (Refineries), MoP&NG in his opening address made the observation that there is definite and urgent need to improve the refinery performance necessitated due to de-regulation for which focused approach is required towards energy conservation and higher complexity for margin improvement of Indian refineries. He expressed that there is significant move on Auto Fuel Policy of the Indian Government to directly move from BS-IV to BS-VI fuel specification by 2020. He informed that the Government is also seriously looking at bio-fuels as alternative energy source to meet the energy needs of the country which is evident from number of Cabinet notes generated featuring bio-fuels.
- 5.0** Chairman in his inaugural address made the observation that consistent with the new mandate of the SAC charter, it is important to look at the important developments in the Hydrocarbon sector in a pro-active manner and hoped to have these addressed and deliberated during the presentation by EIL on 'Position Paper'. He stressed that in view of the additional activity of Sectoral Innovation Council (SIC) assigned by MoP&NG for the entire hydrocarbon sector, the scope and domain of SAC needs to be re-looked for systemic functioning of the Committee vis-à-vis SAC Charter addressing issues of the hydrocarbon industry excluding upstream sector.

He emphasized on the need to look for technologies for hydrocarbon beyond conventional resources like biomass and hydrogen and stressed on utilizing the pool of intellectual resources available at IITs, NITs and research institutions and integrate

innovations & capabilities available at these places with technology gaps with the industry to foster indigenization. He strongly favored a monitoring mechanism for all the research projects undertaken / funded by SAC to assess the progress and proposed for remodeling & strategizing the same in structured manner, for achieving the targeted project deliverables and higher conversion / success to commercialization.

- 6.0 Dr. R. Kumar agreed with the views of the Chairman regarding project monitoring and expressed serious need to follow the project deliverables. He recalled that at the last meeting the Committee had started the process by asking questions with a wider scope. He again highlighted the unique role and composition of CHT with its basket of expertise in one place but stressed that it is not being utilized to its potential and suggested to utilize its role in hydrocarbon industry to translate higher conversion of academic research as well as research projects to commercialization.
- 7.0 Dr. M.O. Garg, DG-CSIR while agreeing with the views of Dr. R. Kumar, hailed the significant contribution made by SAC for development in the areas of process technology, catalyst, internals / equipment. In keeping with the Make-in-India focus of the Government, and the target of 20% import substitution by 2022 set at the recent Urja Sangam, SAC should serve as a strong engine to ensure the R&D labs of the Industry as well as National Labs try and develop technology, catalysts, chemicals and internals/equipment instead of relying on imports. He suggested that SAC may follow DBT, DSIR to be more industry oriented.
- 8.0 Shri A.S. Pathak, Director, CHT presented the ATR of the Minutes of the 75th meeting, the current status of the various on-going / approved projects and unresolved issues.
- 8.1 Chairman suggested CHT to include the Minutes of the Meeting as a part of the Agenda folder for adoption by the SAC in the subsequent meeting. Since there were no comments/observations, the house ratified the minutes of the 75th meeting of SAC.
- 8.2 CHT informed that in respect of the project on "Synthetic Aviation Lubricants – Phase II" approved for funding in the 73rd SAC Meeting at a cost of ₹ 250.00 lakh (including CHT contribution of ₹ 97.00 lakh), the MOU signing could not progress pending inputs from IOC-R&D.

During the deliberations, HPCL confirmed its willingness to collaborate on this project with CSIR-IICT, Hyderabad and CEMILAC for initiating the project. IOC-R&D also agreed to share all the pertinent details of Phase-1 of the project (completed earlier) with CSIR-IICT and HPCL.

SAC agreed to the above proposal and accorded approval for collaboration of HPCL with CSIR-IICT & CEMILAC and suggested IOC-R&D to share relevant inputs in National

interest without further delay. CSIR-IICT and HPCL were advised to expedite MOU signing with CHT for initiating the project activities. A technical committee under DG-CSIR will resolve the transfer of know-how / information by IOC to CSIR-IICT and HPCL.

8.3 CHT presented the status MOUs in respect of the following project/s.

(i) "Parametric Study and Technology Development for Desalter Design" – by EIL-R&D and BPCL-R&D (Total Project cost – ₹ 14.511 crore; CHT/OIDB: ₹ 8.53 crore, BPCL: ₹ 3.481 crore and EIL: ₹ 2.5 crore with 36 months completion schedule) – **MOU signed in February 2015. The Zero date for the project is 14th March 2015.**

(ii) "Development of Improved 3-phase reactor configuration for hydroprocessing applications" – by BPCL-R&D, EIL-R&D and IIT Delhi (Total Project cost – ₹ 115.00 lakh; CHT/OIDB: ₹ 115.00 lakh with 18 months completion schedule) – **MOU finalized for signing. Signing will be completed by 10th April 2015.**

(iii) "Hydroprocessing of Residues" – by consortium of CSIR-IIP, IOCL, HPCL, BPCL & EIL (Total Project cost – ₹ 22.35 crore; CHT/OIDB: ₹ 13.66 crore, HPCL: ₹ 7.76 crore and IIP: ₹ 0.93 crore with 36 months with 36 months completion schedule) – **MOU finalized but could not be signed as IOC-R&D had communicated its decision to withdraw from the Consortium.**

Dr. M.O. garg expressed that even after several meetings and exclusive meeting during 74th SAC, the project could not take-off. IOC-R&D informed that they have already made substantial progress in this area and hence have finalized to go all alone, independently. The SAC expressed its reservations on the decision of IOC-R&D and suggested it to continue to be part of the consortium. IOC-R&D, however, still desired to handle the project on its own and requested SAC accordingly.

After detailed deliberations, SAC allowed IOC-R&D to withdraw from the Consortium and advised CHT to modify the MOU in consultation with CSIR-IIP for signing by other participating members at the earliest.

8.4 SAC debated the process of MOU signing which is often delayed due to reasons beyond control of CHT. These delays are due to inadequacy in the proposals, various steps and time taken, Standard Clauses, opinion of legal cells of Companies, inadequate clarity/synergy between partners, etc. It was suggested to look at the possibility of standardizing the elements of MOUs that are of a generic nature as a potential means of avoiding delays in finalizing and signing of MoUs once the technical details are agreed between the parties.

Chairman advised CHT to bring out a paper on delays and deviations, to standardize the MOU for signing.

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- 8.5** CHT informed the members that nominations for the Innovation awards, in line with the approval accorded by Governing Council of CHT, were invited and have been received from various PSU & Private R&D institutions and these are required to be scrutinized for finalization of the award by the Innovation Awards Committee.

Innovation Awards Committee was constituted and approved by the SAC comprising Chairman-SAC, ED-CHT and 2 members each from oil industry, CSIR/IITs/National Institute & SAC nominated members/experts. Based on the discussions held in the 75th meeting, the awards committee has been finalized with the approval given by Chairman to CHT proposal.

SAC advised CHT to intimate the members and forward the applications received to the Innovation Awards Committee members to enable them to evaluate the same. CHT to follow-up evaluation and finalization of nominations for respective awards with the Committee.

8.6 Presentation and discussion on Ongoing Projects and New/revised Project Proposals

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

Shri Ajay Deshpande, Director(T), EIL presented the update and highlights of the progress achieved so far. Dr R.N. Maiti, EIL-R&D subsequently briefed on the current status on the ongoing project on behalf of EIL and BPCL.

The project zero date is July 2009 and revised scheduled completion is June 2015, as approved in the 74th SAC meeting. Total cost of the project is ₹ 33.0 crore with contribution by each of the participating members, EIL, BPCL, Thermax and CHT/OIDB.

The summary of the current status is as under:

1. Activities under FT technology development have been completed
 - Reactor model , Catalyst and kinetic studies, cold flow hydrodynamic & CFD studies
2. Activities under gasification studies:
 - HPTGA procured, Commissioned in Jan, 2013
 - Gasifier has been commissioned in combustion mode
 - Syngas pilot plant has been installed and commissioned with air-water system.
 - Data generated with coal (two sources)/petcoke/lignite-CO₂.
 - Data analyzed for reactivity and kinetics with CO₂
 - Data generation with Steam under progress & and planned to be completed by 2nd week of April,15
 - Further Data generation with coal (to be tested in pilot plant) to continue

3. Activities under Demonstration package

- PFD, Mass & Energy balance prepared, P&ID under progress
- BDEP for demo plant (1700 TPD coal) being prepared for costing

Although gasifier system is in place/ tested, combustion trial done, gasification run will start from May end /June 1st week. So it needs 3 months to complete the gasification run and three more months to complete the subsequent activities including preparation of BDEP for demo plant.

EIL indicated that further extension by another 6 months i.e. up to December 2015 may be required for the project completion.

Chairman constituted a sub-committee, comprising Dr. M.O. Garg, DG-CSIR, Director(T), EIL and Director(R), BPCL, to look into integration of all elements (gasifier, gas clean-up, FT reactor), benchmarking with the global technologies to bring it to a logical end and propose viable commercial option.

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

Dr. S.M. Nanoti, IIP briefed on the current status of the project. The total cost of the project is ₹ 116.7 lakhs and its revised completion schedule is March 2015.

It was observed that the targeted reduction in the S content < 1% could not be achieved with the solvent extraction route alone and oxidative route is required to be integrated with the extraction route for handling various feed streams and integration with refineries. The results of the study to explore the effect of microwaves and ultrasound as external fields did not yield any improvements in reducing the Sulphur content. The Sulphur content in the desulphurised streams even through a combination of oxidation & extraction schemes was found to be of the order of 1.5-1.9 wt% as against the targeted S content of 1% or lower. CSIR-IIP requested for extending the project completion schedule by further 3 months to allow completion of analysis and report writing.

In view of the observations made by the members on microwave and ultrasound methods and their utility for oxidative extraction, SAC advised that the project be reviewed by a smaller group (IIP, CPCL and EIL) to bring in proper closure in the final report by making a small note on end use. SAC consented for extending the project by another 3 months. The revised project completion schedule will be June 2015.

8.6.3 "Development of Large scale Photo-Catalytic process using Modular Reactor for Hydrogen production by Dissociation of Water utilizing Solar energy" – IOC-R&D & IIT-BHU

The project MOU was signed in September 2011 with a completion schedule of 36 months, at a cost of ₹ 70.62 lakh.

Dr. Umish Srivastava, IOC-R&D briefed on the current status of the project. IOC-R&D had communicated in February 2015 seeking Closure of the Project claiming that the deliverables under the MOU have been met.

CHT informed that the targeted objective of designing the hydrogen generator to generate hydrogen @25 litres/hr/m² Sun exposure area has not been achieved by IIT-BHU/IOC-R&D and the claims of IOC-R&D (35.5 litres/hr/m²) have been found to be solely based on the extrapolation of the Lab scale results (3ml/hr per 5 cm² area). In view of these observations, the project deliverables could not be considered to have been met.

IOC-R&D expressed apprehension in achieving the demonstratable objectives as it felt that considerable comprehensive research work on novel methods of catalyst synthesis, exploration of non-noble metal co-catalysts and development of coating techniques for reactor design is required to be carried out and it may not be feasible even during any extension granted for this project and instead a separate project with 4-5 years may be needed for the same.

Various options were deliberated and SAC agreed to consider the fore-closure of the project (short-closure) as the defined deliverables have not been achieved. CHT was advised to initiate fore-closure of the project as per the terms of the MOU.

8.6.4 "Renewable crude and liquid hydrocarbon fuels from algae and biosolids using a novel continuous scale subcritical water reactor" of CPCL and Aban Infrastructure Pvt. Ltd. (REVISED PROJECT PROPOSAL)

Based on the discussions held in the last (75th) SAC meeting, Dr. A. Meenakshisundaram, CPCL presented the details of the modified project proposal to be undertaken jointly by CPCL and Aban Infrastructure.

The aim of this multi-objective project was:

- a) To grow a consortium of marine algae continuously in seawater in 1000 m² open ponds to generate algal biomass
- b) To evaluate a novel algal harvesting system to continuously harvest algae from pond
- c) To install and test an advanced continuous scale 'sub-critical water extraction reactor' to process 100 kg algal slurry per day

- d) To convert the algal biomass into biocrude (about 3-5 kg/day)
- e) Upgrade the biocrude for production of drop-in biofuels
- f) Characterize distillate fractions from algal biocrude and petrocrude blend.

The estimated cost of this collaborative project was ₹ 1143.86 lakh with a completion schedule of 36 months

During the discussions, Dr. R. Kumar expressed that such study with algae should be taken up as it has not been done previously in India. He informed that the crucial component of the project should define how much algae/m² can be produced since typically about 10 gm/m²/day has been reported in the literature. He also sought to know whether genetically modified algae can be produced in the open tank. Dr. Malhotra raised concerns on the project viability as no serious success has been achieved world over in this area.

CPCL/Aban informed that based on their experience and the studies conducted by them so far, algae production of the order of 22-25 gm/m²/day can be expected. Members felt that the project still has not been sharply defined and it should have a target for algae production.

Chairman suggested that a group of experts be formed to review and advise CPCL to refine the project proposal. He requested Dr. R. Kumar to take the lead along with Dr. B.D. Kulkarni and two experts in this area and help CPCL in finalizing the project objectives and deliverables. Dr. R. Kumar suggested the names of Dr. V.V. Ranade of NCL, Pune and Dr. G.U. Kulkarni of JNCASR, Bangalore.

SAC constituted the monitoring group with above members under Chairmanship of Dr. R. Kumar. CPCL was advised to re-visit the proposal in consultation with Dr. Kumar and his team for preparation of revised proposal for consideration of SAC in the next meeting.

8.6.5 "Biomass Pyrolysis to produce Bio-oil and up gradation for co-processing in Refinery" of HPCL-R&D and CSIR-IIP (NEW PROJECT)

Shri Pramod Kumar, HPCL-R&D presented the details of the project proposal.

The project proposal presented by HPCL was aimed to develop an innovative approach for transformation of biomass into a clean renewable fuel through catalytic / fast pyrolysis of biomass followed by in-situ up gradation of bio-oil over suitable catalyst. The pyrolysis oil will be upgraded by co-processing in refinery secondary units to produce clean transportation fuels. The estimated cost of the project was ₹ 18.41 crore. CHT/OIDB funding of ₹ 11.365 crore has been sought. Funding to HPCL and CSIR-IIP in

the project was to be ₹ 6.365 crore and ₹ 5.00 crore, respectively and the contribution of HPCL estimated at ₹ 7.045 crore.

The members expressed that review of other routes/options like converting biomass to liquid using Hydrogen may also be explored. The proposed project/ process viability would much depend on the availability of the biomass locally. Hence for the project to succeed these may be developed as small units stationed locally, in proximity of the biomass sites. The other areas suggested to be addressed were biomass stability, degumming, de-metallization. Members also expressed that the approach and the deliverables are very relevant in the long run.

SAC while agreeing to consider the proposal for funding, suggested HPCL to assess the project in view of the comments and forward the proposal to Dr.R.Kumar for final technical and financial recommendations.

8.6.6 "Scale-up studies and process development for Hydrogen production by catalytic decomposition of natural gas" of HPCL-R&D and IIT Delhi (REVISED PROJECT PROPOSAL)

Shri Pramod Kumar, HPCL briefed about the background and presented the updated findings and details of the proposal. It was informed that the project is an extension of the earlier project funded under HCF and completed in collaboration with IIT Delhi wherein the details kinetics, modeling and simulation studies were carried out for fixed bed as well as fluidized bed.

1. In the Phase-1 of the project for Hydrogen Production, study was undertaken by HPCL/IIT Delhi wherein catalytic decomposition of methane (CDM) was investigated for the production of COx free H₂ and carbon nanofibers. A series of catalysts were prepared by different techniques using different metals (Ni, Co and Fe), promoters (Cu and Zn) and supports and characterized. Among the catalysts, Ni-Cu-Zn/Al₂O₃ catalyst prepared by wet impregnated method was found to be most promising, for the production of COx free hydrogen and quality carbon nanofibers. The maximum methane conversion was 93% (91% H₂ yield) at 750 °C.
2. During the presentation made by HPCL in the 75th (last) SAC meetings, the members had observed that the Methane conversion levels of 65% achieved with fluidized bed is far below 90% conversion achieved in fixed bed configuration.
3. HPCL was advised to carry out further optimization studies at lab scale before taking up the pilot scale project and take the assistance of EIL, IIT Delhi for finalizing the reactor size and configuration.
4. The estimated cost of the Project is ₹ 24.0 crore and completion schedule of 48 months. Contribution requested from CHT/OIDB is ₹ 18.0 crore.

HPCL informed the members that the studies undertaken by them by changing the catalyst size have yielded results / conversion levels > 90% in their fluidized bed set-up. Hydrodynamic studies with 100-150 mesh and 50-100 mesh size particles were found to be suitable for fluidization and achieving conversion levels of 97% on a sustained basis.

Members opined that as a part of the project, Carbon nano tubes should be viewed as valuable byproducts. Besides looking at the concentration of nano tubes, its characterization and product specifications also needs to be addressed as development objective. It was suggested to involve expert/s in nano science for addressing the above issues.

Chairman constituted a Peer group (comprising Dr. R.Kumar, Dr. B.D. Kulkarni and ED, CHT) to assess the proposal and provide their recommendation, if suitable, for acceptance on technical and financial considerations.

9.0 Presentation and discussion on "Position Paper" by EIL

SAC in its last (75th) meeting had constituted a sub-committee lead by Director (T), EIL and members from CSIR-IIP, IOCL, RIL, IIT Mumbai and IIT Delhi to draft a Position Paper to look at emerging scenario and identify new research areas / initiatives that need to be taken up to proactively address the need for technology readiness in areas likely to be of key importance to our country. The Committee was requested to cover the following aspect in its deliberations:

- a. Identify and prioritize new areas of development of technologies likely to be of high importance to India.
- b. Identify key issues to ensure national autonomy and strategies to have control on them.
- c. Identify areas of potentially serious vulnerability
- d. Synergy in national effort for translation of research and development to commercial technologies and pushing their deployment.
- e. Proactive mechanism to invite proposals in identified ideas to build national capability.
- f. Supporting fellowships for research through academia (projects of industry interest like alternatives to HC, alternative sources to HC, enhancing output from depleting wells, coal bed methane, etc) aimed at building industry academia synergy.

Ms. Vartika Shukla, EIL made a comprehensive presentation covering the background and highlighted the key R&D initiatives / areas for the Hydrocarbon sector, which are needed to be addressed / explored.

While domestic refining sector growth is 5% annually accounting for nearly 30% energy requirements, refineries are also engaged in up-gradation and capacity augmentation. The current crude basket comprises 68% sour crude and 32% sweet crude. Globally refining technologies are targeting reduced carbon foot print, efficient use of energy, energy conservation, reduced water consumption, integration of refining with bio-refining, processing of un-conventional feedstock such as tar sands / shale oils / heavy oils with continued shift towards ultra-low sulphur products and sizeable processes involve new generation catalysts.

The India centric opportunities call for upgrading the refinery performance besides diversifying the domestic fuel portfolio with new process developments required for refinery residue to clean fuels, demetalisation of crude oil, processing of high TAN crude, ionic process for Hydrogen transfer and novel hydro-treatment for removal of sulphur and nitrogen. The other thrust areas needed to be addressed are alternative energy sources, non-HDS technologies, bio-refining, process intensification and fostering innovation. It was emphasized that while taking up any of these developments, key issues such as delivery time, IP protection and cost overruns are needed to be strictly monitored and controlled for its success and translation to commercialization.

The presentation highlighted mostly the refining thrust areas covering diversifying domestic fuel portfolio, upgrading refinery performance through optimizing configuration, energy efficient & environment friendly technologies, asset management tools and technologies for coal/Gas/Biomass to liquid fuels.

During the discussions, Dr. B.D. Kulkarni suggested that molecular engineering science can be utilized for improving the various equipment designs for improved efficacy. Chairman requested Dr. Kulkarni to prepare and submit a note on this approach.

It was observed that bulk of the items / design & technological aspects (particularly for rotary and control systems) installed in refineries are still being imported and no concrete & specific efforts/developments have been made or reported for its indigenization. Chairman expressed that Government of India may like to consider implementation of refinery project with 100% sourcing of indigenously developed capabilities in these areas.

Dr. R. Kumar suggested for more focused research involving larger section of academia and industry to develop hydrocarbon technologies from renewable sources such as HC from CO & Water through chemical route.

Chairman remarked that the Position paper could be split into 2 to 3 sections and explicitly define specific areas to be proactively focused, identify technologies, equipment to be pursued by seeking competitive proposals involving industry and academia.

SAC advised EIL to review & revise the Position paper taking into consideration wide spectrum of energy resources as suggested and inputs of IOC, BPCL, HPCL, GAIL, IIP circulated to all the members for superimposing their views for subsequent discussions in the next SAC meeting.

10.0 Presentation on New Project proposal & strategies

Dr.D.V. Khakhar, IIT Mumbai presented an overall approach which could be considered by the SAC while approving new project proposals. He suggested that the proposals can be categorized into mainly three categories, namely, exploratory, development and implementation with various levels of funding for limited number of projects. An insight into the broad framework for its execution was also given as a part of the presentation for inviting view of other members.

For exploratory projects of benefit to hydrocarbon industry, primarily aimed for research at academia / national labs, up to 20 projects for an amount of ₹ 1.5 crore could be funded by the SAC. Similarly, 5 no. development projects and 2 no. implementation projects costing upto ₹ 25 crore and ₹ 100 crore respectively, could be considered/explored. Members expressed their apprehensions to Dr.Khakhar's suggestion of allowing 100 % upfront release of grant for developments projects.

Chairman appreciated the views and added that these ideas for implementation could be suitably incorporated along with proactive seeking of proposals and their approval on a competitive basis into the revised Position Paper and discussed as a part of program and its implementation strategy.

11.0 Presentation and discussion on "Sectoral Innovation Council"

In his opening remarks Chairman mentioned that Innovation has become a buzz-word of late. He opined that Innovation should not be just about generating ideas but more importantly creating an eco system for taking them to their logical end. For this purpose, it was necessary to have an eco-system that facilitates and empowers people to implement ideas and take them to fruition.

Shri Rajan Kapoor, Director-CHT, made a presentation giving the overview of the Sectoral Innovation Council and the expectations of the Ministry of Petroleum & Natural Gas that the Scientific Advisory Committee (SAC) would now supervise the

implementation of the road-map framed in the Report of the Sectoral Innovation Council.

The introductory presentation by CHT was followed by detailed presentation and updates on the road-map by Shri B K Gupta, ONGC and Shri R.S. Pandey, DGH for Upstream hydrocarbon sector, Shri M.K. Biswas, GAIL (I) Ltd for Midstream, and Dr Pankaj Bhatnagar, IOC R&D for Downstream.

The presentations covered the following:

- Alignment of HR policies to create a culture of innovation.
- Establishment of a separate cadre for R&D
- Recommendation to have a body similar to the Scientific Advisory Committee for the Upstream Industry.
- Deal with challenges of upstream, e.g., assessment of unexplored and prospective areas, increase recovery factors, replace imported oil-field services with domestic capability.
- Collaborative/cooperative technology development.
- National Repository of technology induction case studies.
- National Data Repository.
- Earmarking 2% of Profit after tax for R&D.
- Web based applications for safety, security and tracking of transportation system. Automation of retail outlets.
- Benchmarking of operations.
- Creation of innovation data-base.
- Create culture of innovation.
- Create failure analysis system.
- Innovation awards
- Sharing of royalty with innovators
- Improvement in Academic deliverables.

Following the presentations, the house was opened for discussions, when the following opinions were voiced:

1. Ministry of Petroleum & Natural Gas needed to clarify whether SAC should take up the Innovation road-map for upstream, considering that its ambit did not extend to reviewing R&D projects for upstream.
2. For a pro-active role in nurturing an eco-system:

- a. Create joint activities between Industry and Academia.
 - b. Sub-divide the work into functions, after getting a grip on the subject.
3. Oil companies should consider indigenization as a strategy, whereby all items of repeat consumption for O&M are gradually procured from Indian manufacturers. This will build capability in the country and over the long term will encourage innovation, and bring down input costs. This is true of control systems, rotary equipment, etc., which continue to be largely imported.

A larger cross-section of active workers need to be involved for incremental improvement to facilities, whereby institutes can contribute to modeling, etc., additional sources of petroleum products can be tapped, particularly natural/renewable sources with or without genetic modification, and move to chemicals from carbon dioxide and water using solar energy through the enzymatic/chemical route.

4. To enable expenditure on demonstration units to be treated as R&D expenses, for granting tax exemption a note may be generated with inputs from DG-CSIR. EIL may co-ordinate this so that the matter can be taken up with Secretary DST. Once a demonstration unit was set up with this assistance, the developed technology must be made to stand on its own without any further assistance.

12.0 Concluding Remarks:

- 12.1 Chairman in his concluding remarks appreciated the excellent views expressed by members of the SAC and other participants to the meeting.
- 12.2 Chairman agreed with Dr. M.O. Garg's proposal to have the next meeting of the SAC at CSIR-IIP, Dehradun in June 2015.
- 12.3 Shri B.D. Ghosh, ED (CHT), thanked Chairman and other participants for a very fruitful meeting. He thanked Chairman for steering the SAC effectively and valuable views on road-map for future R&D projects. He extended special thanks to Director(R), BPCL & his team for the excellent support provided and hosting the meet.
- 13.0 The meeting concluded with thanks to the Chair.

**76th Meeting of the Scientific Advisory Committee (SAC) on Hydrocarbons of MOP&NG
held on 3-4th April 2015 at BPCL Refinery, Mumbai**

List of participants

	Name	Designation	Organisation
1	Dr. Anil Kakodkar	Chairman – SAC	BARC
2	Sandeep Poundrik	Joint Secretary (Refineries)	MoP&NG
3	B.K. Datta	Director (R)	BPCL
4	Sanjiv Singh	Director (R)	IOCL
5	Dr. R. Kumar	Hon. Professor	IISc, Bangalore
6	Dr. M.O. Garg	Director	CSIR-IIP, Dehradun
7	Dr. B.D. Kulkarni	Distinguished Scientist	NCL, Pune
8	Dr. Devang V. Khakhar	Director	IIT, Bombay
9	Dr.(Ms) M. Lakshmi Kantam	Director	IICT, Hyderabad
10	Dr. Shantanu Roy	Professor	IIT, Delhi
11	Dr. R. K. Malhotra	Ex-Director (R&D)	IOCL
12	B.P. Das	ED – I/C (R&D)	IOCL
13	Ajay N. Deshpande	Director (T)	EIL
14	Gautam Roy	MD	CPCL
15	R.S. Pandey	ED	DGH
16	Sanjay Bhargava	Head, CRDC	BPCL
17	Ms. Vartika Shukla	GM (Process and R&D)	EIL
18	N.V. Choudary	GM (R&D)	HPCL
19	Dr. A. Meenakshisundaram	DGM	CPCL-R&D
20	B.D. Ghosh	ED	CHT
21	N.S.J. Rao	ED	HPCL
22	Brijesh Kumar	DGM	IOC-R&D
23	M.K. Biswas	DGM	GAIL
24	Parivesh Chugh	DGM	GAIL
25	Dr. P.V.C. Rao	DGM	HPCL

	Name	Designation	Organisation
26	Dr. R.N. Maiti	DGM	EIL
27	Dr. Senthil Chinnasamy	CTO, Biotech Division	Aban Infra.
28	Pramod Kumar	SM	HPCL- Corp. R&D
29	Dr. D. Parvatalu	DGM	ONGC Energy Centre
30	H.S. Dayal	ED	ONGC
31	R.K. Sharma	ED	ONGC
32	B.K. Gupta	GM	ONGC
33	A.R. Tamhankar	DGM	HPCL
34	Suresh K. Rao	DGM	MRPL
35	Dr. N. V. Choudary	GM	HPCL
36	Umish Srivastava	CRM	IOC-R&D
37	Dr. Pankaj Bhatnagar	CRM	IOC-R&D
38	S. Sarkar	GM	IOC-RHQ
39	Dr. S.M. Nanoti	Scientist	CSIR-IIP
40	Dr. Ravikumar V.	DGM	BPCL
41	Rajan Kapoor	Director	CHT
42	A.S. Pathak	Director	CHT
43	R.K. Bali	Advisor	CHT
44	V.K. Suri	Jt. Director	CHT