Ps- SAC file

Director

उच्च प्रौद्योगिकी केन्द्र
(पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय)

सी एच टी

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

CHT/AKA/SAC

Date: 28th May 2008

To,

1. All Members and permanent invitees of the Scientific Advisory Committee on Hydrocarbons of Ministry of Petroleum & Natural Gas
2. Chief Executives of PSU Oil Companies – IOC, BPCL, HPCL, EIL, GAIL, ONGC
3. MD – BRPL, MRPL, NRL, CPCL

Dear Sir,

Sub: **Minutes of the 63rd Meeting of the Scientific Advisory Committee on Hydrocarbons of Ministry of Petroleum & Natural Gas held on 4th April 2008 at Indian Institute of Science, C.V.Raman Avenue, Bangalore**

Enclosed please find a copy of the Minutes of the 63rd Meeting of the Scientific Advisory Committee on Hydrocarbons of Ministry of Petroleum & Natural Gas held on 4th April 2008 at Indian Institute of Science, C.V.Raman Avenue, Bangalore, for your kind information and necessary action.

Thanking you,

Yours faithfully,

K S Balaraman

(Dr.K.S.Balaraman)
Executive Director

Encl. As above.

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CHT/AKA

Date: 28th May 2008

Minutes of the 63rd Meeting of Scientific Advisory Committee (SAC) on Hydrocarbons of MOP&NG held on 4th April 2008 (Friday) at Indian Institute of Science, Council Chamber, C.V.Raman Avenue, Bangalore-560012:

63.1 **INAUGURAL SESSION**

63.1.1 First, Prof.Biswas of the IISc welcomed the participants and informed that the IISc. Bangalore has completed 100 years of existence and is currently preparing a Strategic Plan for the next 100 years.

63.1.2 Dr.K.S.Balaraman, ED, CHT briefed about the Agenda items and informed that a new Agenda Item with a brief presentation by OIL on direct liquefaction of coal has been included. He also welcomed Chairman SAC, Members and other invitees to the 63rd Meeting of the SAC.

63.1.3 Shri Mahesh B. Lal, Chairman SAC, conveyed greetings to the IISc. on successful completion of its 100 years and emphasized strengthening of the relationship between academia and industry. He specifically mentioned that more collaboration and less competition between the R&D organizations, especially of oil PSUs would go a major way in developing technical know-how of strategic national importance and generate world-class indigenous technology. He also was happy to see Senior-level participation in this SACincluding the presence of the Secretary, OIDB, which should give a positive signal to all the R&D organizations and scientists.

63.1.4 He stated that the days of cheap oil are over and we have to find ways to increase efficiencies in the refineries as well as look for ways to maximize value addition. He stressed the need to have a comprehensive and coordinated Action Plan for Hydrogen on a national basis. The future is with hydrogen as an energy medium and we need to develop technologies for reliable and efficient production of hydrogen.

63.2 **PRESENTATION ON THREE PROJECT PROPOSALS:**

63.2.1 **"Hydrogen Generation by Thermo Chemical Process" by Dr.Anil Bhardwaj, Chief Chemist, ONGC:**

63.2.1.1 Ms.N.J.Thomas, GM (R&D), ONGC gave outlines of the project and said that ONGC proposed to study both iodine-sulfur (I-S process, which operates at 850° C) and Copper-chloride (Cu-Cl process that operates at 530° C) for hydrogen production using thermo-chemical process. ONGC has entered into an MOU with BARC under which ONGC through ONGC Energy Centre (OEC) will establish, laboratory facilities for study of iodine-sulfur (I-S) and other thermo chemical processes for hydrogen generation from water. Likewise, OEC has also entered into an agreement with the University Institute of Chemical Technology (UICT), Mumbai to undertake work on the Copper-chloride (Cu-Cl) process. Negotiations with IIT-Delhi are in an

advanced stage to undertake research on various aspects of I-S process. CECRI, Karaikudi will also be one of the collaborators for Cu-CL process.

63.2.1.2 I-S process is a high temperature and high efficiency process, whereas Cu-Cl is a low temperature low efficiency process.

63.2.1.3 In I-S process, excess water and excess iodine is required for Bunsen reaction. The 'excess' amount of water is very important as it is to be removed and recycled to Bunsen reactor before the decomposition steps, which are the energy intensive operations. Challenges in the I-S process are the efficiency, thermodynamic and kinetic data, separation, reactor design and flow optimisation.

63.2.1.4 Maximum cycle temperature of 530° C in Cu-Cl process allows the use of wider range of heat sources. Intermediate chemicals are relatively safe, inexpensive and abundant. This process needs reduced demand on material of construction, inexpensive chemical agents, electrochemical step of hybrid cycle can be performed at low voltages and has less environmental issues.

63.2.1.5 While clarifying various issues raised during the last (62nd SAC meeting), ONGC said that as per literature, cost of hydrogen production is Euro 4.2 / kg for 17 MT / day plant through I-S route. The uncertainties in hydrogen production cost estimates are very large and inter-comparison is very difficult. As per DOE, cost of hydrogen generation can range from US $ 3.0 - 3.95 / kg depending on the sensitivity tested.

63.2.1.6 ONGC said that BARC has taken up the challenge and wants to develop the I-S reactor in next 5-6 years. ONGC clarified that as suggested in the last SAC meeting, open loop is part of the close loop S-I process, though it is not mentioned here.

63.2.1.7 Shri B.N.Bankapur, Director (R), IOC said that R&D on hydrogen should have long-term viability as it is an important area. Since ONGC proposal is a basic research work and not a applied research work, time period indicated by ONGC seems to be short. Manpower also seems to be less.

63.2.1.8 Dr.M.O.Garg, Director, IIP said that ONGC has already signed MOU with various agencies for the subject project. The project being a multi-disciplinary work, he suggested forming a small technical committee to monitor the project. CH agreed to the suggestion and formed a small committee constituting Director, IOC (R&D); ED, BPCL (R&D), Professor S.K.Biswas, IISc. and Professor S.Pushpavanam, IIT Madras for monitoring the project.

63.2.1.9 CH-SAC appreciated ONGC's efforts for the hydrogen project proposal, which is futuristic on carbon footprint and aims to use an alternative to fossil fuels. Keeping this in mind, CH was of the view that the project needs to be pursued, but further work needs to be done to establish pre-feasibility. Therefore, some initial work can be started by ONGC with the objective of gathering more detailed inputs for a comprehensive project scope and action plan, including resources required.

63.2.1.10 This being a project of national importance, SAC decided to recommend sanctioning of 25% of the funding of the subject project (Rs.16.34 Crores x 25% = Rs.4.08 Crores, say Rs.4.0 Crores) to ONGC from the Hydrogen Corpus Fund (HCF). ONGC will spend the amount in next 1-2 year on the

project, generate the detailed programme based on the experiments conducted, review the progress of the work and then decide the future course of action.

63.2.1.11 **SAC's Recommendation on the Project:** ***In view of the above, a note will be sent to the Steering Committee on Hydrogen headed by Secretary, P&NG for sanctioning Rs.4.0 Crores i.e. 25% of the project cost for funding from Hydrogen Corpus Fund (HCF), with a proviso that a comprehensive proposal will be put up to SAC by December 2009. Based on this, further funding will be reviewed.***

63.2.2 **Setting-up of Hydrogen Dispensing station and Demonstration of Hydrogen Vehicles during Commonwealth Games by IOC-R&D:**

63.2.2.1 The objective of this project is to gain experience with on-site solar hydrogen production, supply infrastructure and utilisation of hydrogen in automotive vehicles. It will also help in improving the efficiency of indigenously developed electrolyser under actual field conditions. The project will also help in studying performance, reliability and safety aspects of hydrogen vehicles besides demonstrating public awareness regarding hydrogen powered vehicles during Commonwealth Games.

IOC (R&D) clarified that this is not a research project and in fact is a demonstration project. This project falls under various projects identified by MOP&NG for hydrogen production, storage and transportation as a part of roadmap for hydrogen.

63.2.2.2 This project will involve three parts viz. sourcing of solar photovoltaic system from one of the reputed Indian supplier, electrolyser from BARC and hydrogen powered vehicles from any one of the leading Indian OEMs viz. M&M, Tata, Maruti, GM or Honda etc. The capacity of solar photovoltaic system will be 25 kw with peak load of 50 kw. It will require 700 solar panels wired in seven series with 100 parallel configurations. Other infrastructure will be hydrogen compressor, storage facilities, H_2-CNG blender and dispenser.

63.2.2.3 IOC-R&D said that presently, hydrogen powered vehicles are not available in India and therefore there is a need to develop these vehicles by OEMs. Hydrogen powered vehicles will be developed indigenously and tested for performance and emission on all weather chassis dynamometer at IOC (R&D). Field-testing and demonstration for durability, reliability and safety aspects will be carried out in Faridabad, Delhi and Noida.

63.2.2.4 Key benefits of the project will be to gain hands on operating experience with on-site renewable H_2 production, distribution and supply to automotive vehicles, capacity building for indigenous development of efficient electrolyser, solar photovoltaic system and H_2 powered vehicles, inputs for developing safety codes and standards for H_2 as transport fuel and creation of public awareness.

63.2.2.5 Total cost of the project will be Rs.12.5 Crores including the cost of the hydrogen vehicles and the duration of the project will be 30 months.

63.2.2.6 On a query from CH it was clarified that auto industry will produce and make available neat H2 IC Engine vehicles for trials under this project. IOC also mentioned that cost of hydrogen production on per unit basis would be more

through solar route (renewable source). CH observed that the cost indicated for the solar power generation system seemed much higher than expected.

63.2.2.7 **SAC's Recommendation on the Project:** ***It was observed that there is very little research component in this project and that, as mentioned in the proposal itself, it is more in the nature of a demonstration project. However, it was also stated that the project is part of the various projects identified by MOP&NG for hydrogen production, storage and transportation as a part of roadmap for hydrogen, for which funding can be made available from the hydrogen corpus fund.***

Accordingly, a note highlighting the above can be sent to the Steering Committee on Hydrogen headed by Secretary, P&NG for funding it from the Hydrogen Corpus Fund (HCF).

63.2.3 **Hydrogen Production from Natural Gas (Methane) by Catalytic Decomposition by HPCL and IIT-Delhi:**

63.2.3.1 Before start of the presentation, IOC (R&D) raised a procedural point that as per the procedure for funding the project from Hydrogen Corpus Fund, the subject proposal should first have been routed through the Technical Committee and then to the SAC, for which CH agreed. IIT-Delhi, however, made the technical presentation of the project.

63.2.3.2 Professor K.K.Pant said that catalytic decomposition of natural gas is basically dissociation of CH_4 to C and hydrogen. In this process, pure carbon and hydrogen is produced unlike CO_2 and hydrogen through reforming route.

As per the available literature, energy requirement through this route is 37.8 kJ/mole vs. 63 kJ/mole through reforming route. In this process no air is required to be added to the reaction and more than 80% conversion is possible.

63.2.3.3 Director, IIP said that IIP had taken similar project under NIMITLI projects in 2002 and worked for 4 years, but the conversion was very low at 8% only. He suggested using carbon as the catalyst if we want to succeed. IIT-D reiterated that thermodynamically more than 80% conversion is possible.

63.2.3.4 The various challenges for the project are catalyst development, kinetic modelling and type of the reactor to be used for this purpose. Total cost of the project is Rs.51 Lakhs with completion schedule of 36 months.

63.2.3.5 **SAC's Recommendation on the Project:** ***CH-SAC suggested that since lot of work has already been done by IIP in similar project, the project proposal should be routed through the Technical Committee to review the proposal.***

63.2.4 **Coal to Liquid (CTL) Technology" by Dr.S.Banik, GM, EIL-R&D:**

63.2.4.1 EIL (R&D) mentioned that the objective of this project is syn gas cleaning and development of FT process. Development of gasification technology, however, is not part of the project. Gasifier is required only for syn gas generation for cleaning purposes. EIL said that they are considering a gasifier of 60 kg / hour capacity.

EIL said that Shell and SASOL are the two process licensors who have the technology for FT synthesis.

63.2.4.2 Total cost of the project is Rs.33 Crores to be equally shared by OIDB on one hand and BPCL & EIL on the other hand and the completion schedule of the project is 45 months.

63.2.4.3 IOC (R&D) said that they are taking up gasification study on its own. For basic research in this field, help of academia will be taken.

63.2.4.4 Chairman advised EIL / BPCL (R&D) to collect some more information on gasification, hydrogen & power generation and gas cleaning efficiency (both high and low) for CTL route. CH was of the opinion that for long-term benefit, development of technology for gasification seems to be advantageous. RIL is also going for 2000 MW gasification power plant.

However, considerably more technical inputs are required detailing the scope and objectives of the proposal.

63.2.4.5 Subsequently after discussions with CH-SAC on 22nd April 2008, EIL and BPCL submitted the detailed project schedule and work plan in respect of the project.

63.2.4.6 **SAC's Recommendation on the Project:** ***Coal to Liquid (CTL) being an important project, SAC decided to recommend initial sanctioning of 20% of the funding of the subject project (Rs.16.5 Crores x 20% = Rs.3.3 Crores).***

EIL and BPCL will also contribute an equivalent amount of Rs.3.3 Crores, spend the amount, generate the detailed programme based on the experiments conducted, review the progress of the work and then put up a comprehensive proposal to SAC by December 2009. Based on this, further funding will be reviewed.

63.3 Additional agenda point on "Further Studies Towards Setting Up of a Commercial Coal Liquefaction Plant in North East" of OIL, an OIDB approved project:

63.3.1 OIL reiterated that Assam coal is good for Direct Coal Liquefaction (DCL) technology due to special properties such as low ash content (2-10% wt.), high volatile matter (40-45% wt.) and high sulfur (1.5-6%). It is not suitable for industrial usage due to high sulfur. Further, NE has proven coal reserves of 467 MMT.

63.3.2 The objective of this project is to develop coal liquefaction capability and convert unutilised coal of NE to valuable petroleum products. The cost of the present project is Rs.14.2 Crores, which is being funded by OIL and OIDB on 50:50 basis and the completion schedule is 16 months i.e. December 2008.

63.3.3 The subject study of the project is being done at Headwaters, CTL (HCTL), USA since September 2007.

Quality of Naphtha produced through this route is good, whereas diesel is low in cetane number. Main plant will have a huge complex comprising of slurry preparation, gasification, treatment, product up-gradation, Oxygen, hydrogen etc.

63.3.4 As a part of commercialisation of the technology, OIL, EIL and NRL are reviewing setting up small size commercial plant of 2500 bpsd capacity in the refinery premises and will use all existing refinery infrastructure and utilities. DFR for full-scale commercial plant would be completed in parallel.

63.3.5 Though ICL is also a proven technology with SASOL, it requires huge coal reserves (1 billion tonnes within a radius of 50 km) for 40 years working.

63.3.6 **SAC's Recommendation on the Project:** ***Since EIL is associated with this project, CH-SAC advised EIL (R&D) to prepare reply on suitability of the DCL technology for sending to Secretary, P&NG and Chairman, OIDB.***

63.4 **Sharing of noble ideas and opportunities by BPCL with the participants:**

63.4.1 BPCL (Shri Seshadri) presented the outcome of three R&D projects taken up with UICT, Mumbai. The first project on 'S' removal by absorptive separation using Ion exchange resins gave encouraging results. The second project on up-gradation of residue using Microwave technology also gave good results. The third project on Hydrogen recovery from flare gas using membrane separation may be economically attractive as there is 4 tons / day of Hydrogen loss.

Annexure

Participants to the 63rd Meeting of the Scientific Advisory Committee on Hydrocarbons of MOP&NG held on 4th April 2008 at Indian Institute of Science, C.V.Raman Avenue, Bangalore:

S. No.	Name, S/Shri	Designation	Organisation
1.	M.B.Lal	Chairman, SAC	--
2.	Dr.M.O.Garg	Member, SAC	Director, IIP
3.	Prof. S.K.Biswas	Member, SAC	Prof., IISC, Bangalore
4.	Prof. S.Pushpavanam	Member, SAC	Prof., IIT-Madras
5.	B.N.Bankapur	Member, SAC	Director (R), IOC
6.	K.V.Seshadri	--	GM (O), BPCL
7.	Mrs. N.J.Thomas	--	GM (R&D), ONGC
8.	Dr.B.N.Prabhu	--	GM, ONGC
9.	Dr.Anil Bhardwaj	--	Chief Chemist, ONGC
10.	D.Parvatalu	--	Chief Chemist, ONGC
11.	Arun Kumar	Member, SAC	Secretary, OIDB
12.	Anand Kumar	Permanent Invitee, SAC	Director (R&D), IOC
13.	Dr.M.A.Siddiqui	Permanent Invitee, SAC	ED, BPCL-R&D
14.	Dr.N.V.Choudary	--	CM (R&D), BPCL
15.	Dr.V.Ravikumar	--	SM (R&D), BPCL
16.	Dr.R.P.Verma	--	Consultant, HPCL
17.	Dr.R.K.Malhotra	--	ED (R&D), IOC
18.	N.K.PAI	--	DM (R&D), IOC
19.	Dr.S.Banik	Permanent Invitee, SAC	GM (R&D), EIL
20.	Dr.K.K.Pant	--	Professor, IIT-Delhi
21.	U.C.Bora	--	Head CLP, OIL
22.	H.Dubey	--	GM (R&D) I/c, OIL
23.	Dr.K.S.Balaraman	Member, SAC	ED, CHT
24.	A.K.Agarwal	--	AD, CHT