

सीएचटी/एसएसी-96/3555

CHT/SAC-96/3555

सेवा में/ To,

2 जून 2023

2<sup>nd</sup> June 2023

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 96वीं बैठक का कार्यवृत्त**

**Sub: Minutes of 96<sup>th</sup> Meeting of the Scientific Advisory Committee (SAC) on Hydrocarbons of Ministry of Petroleum & Natural Gas**

प्रिय महोदय/महोदया / Dear Sir/Madam,

दिनांक 24 मई, 2023 को वीडियो कॉन्फ्रेंसिंग मोड द्वारा सम्पन्न, पेट्रोलियम और प्राकृतिक गैस मंत्रालय की हाइड्रोकार्बन पर वैज्ञानिक सलाहकार समिति की 96वीं बैठक के कार्यवृत्त की प्रतिलिपि आपकी सूचना एवं आवश्यक कार्यवाही हेतु संलग्न की जा रही है।

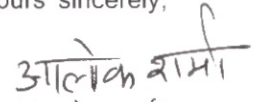
Enclosed please find a copy of the Minutes of 96<sup>th</sup> Meeting of the SAC on Hydrocarbons of Ministry of Petroleum & Natural Gas held on 24<sup>th</sup> May, 2023 through video conferencing mode, for your kind information and necessary action.

सादर,

With kind regards,

भवदीय,

Yours sincerely,



(आलोक शर्मा)

कार्यकारी निदेशक

(Alok Sharma)

Executive Director

## Minutes of 96<sup>th</sup> Meeting of Scientific Advisory Committee (SAC) on Hydrocarbons of MoPNG

The 96<sup>th</sup> meeting of SAC was held on 24<sup>th</sup> May 2023 through VC mode. The meeting was chaired by Dr Anil Kakodkar, Chairman, SAC. The list of participants is enclosed as **Annexure-I**.

ED-CHT welcomed the Chair, other esteemed Members of SAC and Special Invitees. ED-CHT briefed the SAC about the agenda. The agenda points of the meeting included the enzyme testing, high ash coal gasification, 2G ethanol projects under PM JI-VAN Yojana and R&D/Demo projects, New Projects received at CHT. Chairman stressed that in order to prepare the country for the impending Energy transition, selected R&D projects should be aligned with the vision of GoI in making the country self-reliant with respect to its energy needs and also achieve Net Zero target.

Following points were discussed in the meeting:

### A. Status by Sub Committee formed for testing of Enzymes

**Background:** SAC in its 94<sup>th</sup> meeting on 3<sup>rd</sup> Aug 2022 had advised CHT to form a “sub-committee on testing of enzymes” for comparative analysis lead by Dr. D K Tuli and complete the task within 3 months. Nominations were received from various organizations.

Enzymes developed by Indian companies / research institutes (ICGEB, HPCL, IOCL, BPCL, DBT) were to be analysed, and also carry out inter-lab comparison using the standard protocol/s. CHT was to be the nodal agency.

Following was recommended in the last 95<sup>th</sup> meeting of SAC

- To have round robin tests regularly amongst labs so as to keep a check on variations.
- Accordingly, round robin tests were done and the reported FPU levels by respective organization are as follows:

Organization	FPU level (approx.)
ICGEB	9-9.5
IOCL	12
HPCL	7-8
BPCL	5

- The final testing of enzyme suitability is biomass hydrolysis. Labs may consider to get sample of biomass pretreated at pilot scale or from Panipat plant from M/s PRAJ. Biomass hydrolysis at lower recommended dose would indicate enzyme suitability.
- To conduct similar Round Robin exercise/cross testing on a regular basis every 6 months. Preparations for commercial offerings may be evaluated. SAC proposed that the exercise should be open to all players who wish to participate.

Dr Tuli, presented the current status and outcome of the round robin testing as summarized below:

1. Development of cost competitive indigenous enzyme is absolutely essential for the economic success of upcoming several large 2G ethanol plants in the country. With a focused approach, cost effective and commercially competitive enzymes can be developed in the country.
2. For the next round-robin, M/s. Praj was requested to send the pretreated biomass to the involved organizations (1 kg packaging to each) which were sent to various R&D on 16<sup>th</sup> May'23. All the labs have been advised to follow the same protocol for testing the effectiveness of the enzyme using the treated biomass from PRAJ.
3. FPU of min 20 is required to match the commercially available enzyme from Novozyme.
4. Cross validation of production and hydrolysis results between labs before scaling up is mandatory to achieve success.
5. HPCL 1.5 KL reactor can be considered as the starting point, ICGEB agreed to do the scaleup with HPCL. ICGEB indicated NDA would be required with DBT/HPCL.

**SAC complimented the work being done by sub-committee as it shall pave the path for making the indigenous enzyme in a cost effective manner. SAC has agreed that ICGEB should carry out changes in genetics of enzyme to improve its effectiveness. Existing DBT network of IITs/ other Institutes can be included in the enzyme development exercise.**

**Action- CHT/IOCL/BPCL/HPCL**

## **B. High Ash Coal Gasification**

**Background:** CHT organized a one-day workshop on Gasification of High Ash Coal on 4<sup>th</sup> Jan, 2023 in which the industry experts from **BHEL, EIL, CIMFR, L&T & Thermax, JSPL** gave their presentation. The workshop also attended by participants from Oil Companies like IOCL, BPCL, HPCL, MRPL & NRL.

The agenda for the workshop was to discuss **Status of Gasification Technologies and CCUS and finalise the way forward**. The workshop was chaired by Dr Anil Kakodkar. As advised by the Chairman, a draft approach paper was prepared and shared with experts to get their inputs.

**CHT presented the approach paper and it was deliberated in detail. CHT has been advised to refine the approach paper based on discussion and circulate the same with all stakeholders including various research institutions like IITs and CSIR Institutes working in the area of gasification. Taking into account various initiatives being pursued, one could pursue gap areas if they still exist and take steps to take up demonstration scale work depending on the interests shown by PSUs.**

**Action- CHT**

### C. OIDB funded LanzaTech Ethanol project for IOC PR

#### Background:

- Project: PSA Off-gas to Ethanol Project at Panipat Refinery
- Investment Approval date: 10.10.2018
- Approved Cost: Rs 753 Cr gross of ITC (Rs 647 Cr Net of ITC).
- First of its kind in India and in Indian Oil. The project envisages conversion of Hydrogen Generation Unit (HGU) PSA Off-Gas to Ethanol using LanzaTech Gas Fermentation Technology at Panipat Refinery. It is designed to produce 33.5 KTPA of Ethanol

IOCL made a presentation on the current status of the project and informed that the plant has been commissioned and is under stabilisation.

SAC noted the same.

Action- CHT/IOCL

### D. PM JI-VAN Yojana:

CHT presented the implementation status of RFS-I projects for review and information as follows:

PSU	Location	Capacity (KLPD)	Feed- stock	Project Cost (₹ crore)±	Expected Commissioning
IOC	Panipat	100	Rice Straw	909.00	Commissioned
ABRPL	Numaligarh	185	Bamboo	3250.00	Dec, 2023
HPC	Bathinda	100	Rice Straw/Cotton Stalk	1421.46	Feb, 2024
BPC	Bargarh	100	Rice Straw	1397.00	Mar, 2024

#### Project Milestone wise (Commercial-PD wise)

	ABRPL	BPCL	HPCL	IOCL (Commercial)
Mechanical Completion date	Dec 23	Mar 24	Feb 24	Completed (Mar 23)
25% annual Production Capacity	Mar 24	Mar 25	Nov 24	Sep 2023
75% annual production capacity	June 24	Mar 26	Feb 25	June 2024

#### Project Milestone wise (Demonstration-PD wise)

	IOCL (Demo)
Mechanical erection of the project Completion date	Nov 23
Upon achieving ethanol capacity of 50% of rated capacity for 3 months and completion of experiments	July 24
After 15 months of (Continuous or cumulative operation at minimum 50% capacity or 3 years of plant whichever is later	Oct 25

IOCL, vide letter dated 6<sup>th</sup> Mar'23 (received by CHT on 13<sup>th</sup> Mar'23) has requested for the release of 2<sup>nd</sup> instalment of 25% of financial assistance of Rs 150 Crore) i.e. Rs 37.50 crore on completion of mechanical erection of the project.

However, in compliance to Clause no. 5 (viii) of MoA, ***a three-year (with a renewable option of two years) contract/agreement/MoU for supply of Biomass and Cellulosic material is required.***

IOCL via letter dated 18.04.2023 has informed the following:

- a. Biomass for the plant will now be sourced in collaboration with the Haryana Government. The letter from Director, Agriculture and Farmers welfare department Haryana dated 28.03.2023 is attached for detailed plan of biomass aggregation.
- b. IOCL has requested to waive off the requirement of submission of three-year agreement for supply of Biomass and Cellulosic material along with 2<sup>nd</sup> installment of Biomass due to change in philosophy of Biomass aggregation for the plant. IOCL committed that all the documents regarding supply of Biomass will be submitted before release of 3<sup>rd</sup> Installment of VGF grant.

As per clause no 15 of MOA, "No amendment or modification or waiver of any provision of this MOA shall be valid unless made in writing and signed by an authorised officer of each of the Parties and is also recommended by SAC specially stating the same to be an amendment of this MOA. Any waiver or consent shall be effective only in the specific instance and for the specific purpose for which it is given. The modifications/changes shall be effective from the date on which they are made / executed unless otherwise agreed to".

**Accordingly, CHT has proposed for approval for modification of payment clause for IOC 2G commercial plant for release of 2<sup>nd</sup> Instalment of Financial Assistance.**

**SAC advised CHT to form a committee with approval of SAC chairman for due diligence of the case and get their recommendations.**

CHT also presented the implementation status of RFS-III projects as under;

PSU	Location	Capacity (KLPD)	Feed- stock	Project Cost (₹ crore)/ Financial Assistance Approved	Current Status
MRPL (Comm)	Karnataka	60	Corn Cob	950/100	Proposed JV formation with M/s Mitsui by June 23. Upon the JV formation, Financing arrangements for the Project shall be made. <b>MRPL has requested for 2G ethanol pricing for JV concurrence.</b>
SIMPL (Comm)	Karnataka	150	Bagasse	960/150	<b>Financial tie-up is awaited</b>

<b>HPCL (Demo)</b>	Bihar	3	Rice Straw/ Bagasse	150/15	<b>Internal Financing, Draft MoA prepared. Land agreement is awaited.</b>
<b>CIPL (Demo)</b>	Punjab	1.2	Wheat straw /Rice straw/ Bagasse	195/15	Withdrawn

### CHT also presented the Status of RFS-IV projects

CHT Floated RFS-IV to provide financial assistance for balance 6 New Commercial & 7 Demo Proposals. Following proposals have been received against RFS-IV;

<b>Project Developer</b>	<b>Plant Location</b>	<b>Feedstock / Capacity (KLPD)</b>	<b>Technology</b>	<b>Capex / FA (Cr. INR)</b>
<b>Spray Engineering Devices Ltd. (Comm)</b>	Bihar	Bagasse / 65	Lanzatech	750/100
<b>Rice Cellulose Pvt. Ltd. (Comm)</b>	Andhra Pradesh	Rice straw / 100	Praj	1000/150
<b>Khaitan Bio Energy Pvt. Ltd. (Comm)</b>	Rajpura Phase-1 Punjab	Rice straw/ 100	In-House	1035/150
<b>Khaitan Bio Energy Pvt. Ltd. (Comm)</b>	Rajpura Phase-2 Punjab	Rice straw/ 100	In-House	991/150
<b>Khaitan Bio Energy Pvt. Ltd. (Comm)</b>	Saharanpur, Uttar Pradesh	Rice straw/ 100	In-House	1019/150
<b>Khaitan Bio Energy Pvt. Ltd. (Comm)</b>	Lucknow, Uttar Pradesh	Rice straw/ 100	In-House	1019/150
<b>GPS Renewables Pvt Ltd (Comm)</b>	Bairabi Aijwal	Bamboo/ 100	LanzaTech	1000/150
<b>Jindal Steel &amp; Power Ltd (Comm)</b>	Angul, Odisha	Off gases /175	Lanzatech	1040/150
<b>Lignopura Agrotech Pvt. Ltd. (Demo)</b>	Maharashtra	Bagasse/ 1.27	In-house	16.4/15
<b>Godavari biorefineries ltd. (Demo)</b>	Karnataka	Bagasse/3	In-house	36/15
<b>Chhattisgarh Bio Fuels Authority (Demo)</b>	Chhattisgarh	Rice Straw / 1.2	DBT-ICT	20/15

Meeting of the Select Committee of SAC is scheduled to be held on 29<sup>th</sup> May'23 at CHT, Noida. Select Committee will be constituted for evaluation of proposal under RFS-IV of PM JI-VAN Yojana with due approval of Chairman SAC.

**SAC noted the above.**

**Action- CHT/PDs**

## **E. New R&D Project Proposals:**

### **1. Hydrogen Management in refinery - ALGO8AI: IITK/IOCL**

**Background:** Generating, recovering, and purchasing of hydrogen have significant impact on refinery operating costs. More importantly, overall refinery operations may be constrained by the availability of hydrogen.

R&D proposal from IIT Kanpur on 'Hydrogen Management in refinery' was deliberated. The proposal envisages AI / ML based modelling for Hydrogen Network Management in Refineries and designed to meet the following key objectives

- Real time visibility of whole hydrogen network showing generation, recovery and consumption.
- Accounting of each Hydrogen stream and doing accurate supply demand balance on daily and cumulatively basis.
- Suggestive report on daily basis identifying inefficient hydrogen recovery and utilization, if any and corrective actions.
- Meeting all hydrogen consumption as per the designed parameters.
- Real time advisory for minimization of hydrogen downgrade to fuel gas network.
- Minimization of hydrogen consumption and use it efficiently.
- Optimization of hydrogen production sources to minimize hydrogen production cost Carbon-footprints
- The AI/ML solution has in-built tools for dedicated data reporting and visualization that will help in real time monitoring of all key parameters.

**SAC observed that this proposal is commercial in nature and does not contain innovative development component. SAC advised that IOC can directly engage ALGO-8 for the development. Hence the proposal was not recommended.**

### **2. Nature based solution for the valorization of technical lignin to sequester biogenic carbon in a sustainable circular bio-economy model: TERI/IOCL**

**Objective:** To valorize the technical lignin obtained from an operational commercial second generation (2G) bioethanol production plant as such, to produce value added product for

Biobased Smart delivery high Precision Fertilizers (BioSPF)”, having high-volume applications in a circular bio-economy model.

- Project Cost: Rs 126.7745 Lakhs
- Fund required from CHT: Rs 63.3872 Lakhs (50%) & 50% PI/Industrial partner
- Project Duration: 30 Months
- **Industry partner: IOCL**

PI presented the summary of proposal. SAC deliberated and observed that valorization of technical lignin shall help in making the 2G process economically viable and attractive and shall ensure circular bioeconomy. SAC found it essential to study the effect on soil health while using BioSPF. SAC suggested to put up revised proposal covering soil health study jointly with agriculture institutes of ICAR/ agricultural universities.

**SAC recommended the proposal subject to revision of scope on study related to effect on soil health jointly with agriculture institutes of ICAR/agricultural universities and confirmation from IOCL to partner financially in the proposal.**

**Action- CHT/IOCL/TERI**

### **3. Experimental and Simulation studies on CO<sub>2</sub> utilization and storage in mature Indian fields: IPE/IOCL**

**Background:** Development of a ML Model based on the experimental results for formulated foam system in order to predict the ultimate hydrocarbon recovery. Profile modification during CO<sub>2</sub> miscible flooding by in-situ generation of CO<sub>2</sub> foam for enhanced production with simultaneous sequestration of CO<sub>2</sub> in formation. The proposed model will be useful to analyse CO<sub>2</sub> foam behaviour and its effectiveness in HC recovery and CO<sub>2</sub> storage potential in different geological formations.

- Project Cost: Rs 44.022 Lakhs
- Fund required from CHT: Rs 22.011 Lakhs
- Project Duration: 36 Months
- Industry partner: IOCL

PI presented the proposal. SAC deliberated and observed that such study requires actual oil/ gas field to generate the data but the proposal is limited to only lab study which may not be much useful. Also, IOCL didn't agree to support the proposal. It was also advised to PI to approach upstream companies OIL/ONGC.

**Hence the proposal was not recommended by SAC.**

### **4. Biocatalytic CO<sub>2</sub> fixation for continuous manufacturing of industrial chemicals and pharmaceuticals: IITB/ IOCL**

**Objective:** To design and construction of streptavidin based artificial metalloenzymes for utilizing CO<sub>2</sub> to synthesize drugs and industrially relevant compounds. Tuning of the constructed ArMs will be performed via chemical and genetic optimization to mimic nature's proficiency.



- Project Cost: Rs 148.68 Lakhs incl GST
- Fund required from CHT: Rs 74.34 Lakhs
- Project Duration: 36 Months
- Industry partner: IOCL, scope revision is advised by IOCL

**After deliberation SAC recommended the proposal subject to confirmation of financial support from IOCL with change in the scope as per IOCL.**

**Action- CHT/IOCL/IITB**

#### **5. Development of ICCU-BRM (Bi-Reforming) and ICCU-TRM (Tri-Reforming): ICTM/IOCL**

**Objective:** To develop new DFMs for ICCU-BRM and ICCU-TRM. It also include developing novel Ni-based dual-function materials (DFMs) for ICCU-BRM and ICCU-TRM and test performance in a continuous vapour-phase reactor on the bench-scale and optimize DFMs in terms of the synthesis method, temperature for CO<sub>2</sub> capture and conversion, duration of the reforming step, material stability, inhibition of coking, composition of the feed, and the method for material regeneration. The project envisages to perform pilot-scale trials using the best-performing material (industry partner).

- Project Cost: Rs 218.41 Lakhs
- Fund required from CHT: Rs 109.205 Lakhs
- Project Duration: 48 Months
- **Industrial Partner:** IOCL R&D.

The proposal was deliberated in 95<sup>th</sup> SAC meeting wherein IOCL R&D indicated 50% financial support in the proposal, however, financial support could not be confirmed.

**CHT indicated that IOCL R&D has not shared the financial support letter. IOCL R&D indicated that they are currently not in line with the scope of the proposal and hence could not extend support to this proposal.**

**SAC did not recommend the proposal.**

#### **6. Inline Inspection Tool for Oil & Gas Pipelines: VDT Pipelines / GAIL**

**Objective:** To develop Inline Inspection Technology to the extent of Ultrasonic and Crack Detection Tool to improve e safety monitoring and health inspection of Oil and Gas Pipelines to ensure safe and efficient operations of Oil and Natural gas pipelines.

- Project Cost: Rs 5.08
- Fund required from CHT: Rs 2.54 Cr
- Project Duration: 12 Months
- Industry partner: GAIL (subject to SAC recommendation of the proposal)

SAC deliberated and observed that the proposal lacks the technical information to enable taking decision.

The PI was suggested to put up revised proposal with technical details such as functionality of sensors, sensitivity of detection, defined targets of detection etc. The role of Industrial partner, GAIL to be defined. SAC further suggested that GAIL shall be the equal custodian of the technology developed by PI.

SAC will review the revised proposal.

Action- VDT/GAIL/CHT

#### F. Review of on-going R&D Projects (ATR)

##### 1. Prototype Development of Ultra-Efficient Green Gasoline Fueled Compression Ignition (GCI) Engine for Decarbonization of Transport Sector: ERL, IIT Kanpur/ CSIR-IIP/IOCL/Tata Motors

**Objectives:** To develop an ultra-efficient green gasoline fuelled GCI Engine prototype for heavy transport application and Engine tuning via open ECU & calibration maps to achieve stable GCI combustion, fuelled with 60 RON green gasoline.

The project was earlier deliberated in 93<sup>rd</sup>, 94<sup>th</sup> and 95<sup>th</sup> SAC meeting and due to non-availability of auto OEM as partner, the project was not considered. **PI submitted revised proposal in May'23, with Tata Motors as OEM and IOCL as Industry partner.**

- Total Project Cost (Rs. Lakh): Rs.1082.76
- Fund required by CHT/OIDB (Rs. Lakh): 541.38 & remaining by IITK/IIP/IOCL/TML
- Project Duration: 36 months
- Industry partner: IOCL
- OEM Partner: TATA Motors
- In Kind contribution IIP: Rs 99 Lakhs
- In Kind contribution IOCL: Rs 254.8 Lakhs
- In Kind contribution IITK: Rs 157.58 Lakhs
- In Kind contribution TML: Rs. 30 Lakhs

CHT informed SAC that PI has collaborated with auto OEM (Tata Motors Ltd), and hence 25% of financial contribution of IOCL is confirmed (as committed in 94<sup>th</sup> SAC). SAC recommended the proposal subject to submission of letter from industrial partner IOCL.

Action- ERL, IITK/ CSIR-IIP/Tata Motors/IOCL/CHT

##### 2. Methanol (M85) Fuelled Car Prototype Development and Field-Trials: ERL, IITK/ CSIR-IIP/IOCL

**Objective:** To develop an M85-fuelled SI-engine powered car prototype with performance parameters comparable to existing gasoline-fuelled SI engine powered cars. It aims to conduct field trials of M85 fuelled car prototypes on the road. It also includes comparative

benchmarking of M85 fuelled car prototypes with corresponding standard gasoline BS-VI compliant vehicle operating with E10 fuel, including on-board emission measurements.

**Background:** Earlier the project was put up with M15 proposal and was deliberated in 95<sup>th</sup> SAC. JS (R) mentioned that ethanol blending in gasoline (E10) has already been achieved and all efforts are being made towards achieving the target of 20% blending (E20) through PM JI-VAN Yojana. He further mentioned that Govt. is currently not supporting Methanol blending in gasoline. However, methanol as alternate fuel (M100/M85) may be considered.

**Based on above PI submitted revised proposal**

- Project Cost: Rs 1487.088 Lakhs
- Fund required from CHT: Rs 743.544 Lakhs
- Project Duration: 36 Months
- Industry partner: IOCL

**SAC deliberated and recommended the proposal.**

**Action- ERL, IITK/IOCL/CHT**

**3. Intelligent Leak Detection System (I-LDS) for Oil Pipelines: Bharat Flow Analytics/IOCL**

**Objective:** To develop an Intelligent Leak Detection System for Oil Pipelines using Artificial Intelligence (AI) and Internet of Things (IoT) based sensor systems. The developed system shall provide improved sensitivity up to 0.5% of flow rate by using AI-based model and also improved localization (100 metres) by acquiring data at high-speed using IoT sensors on the pipeline.

**Background:** The project was earlier deliberated in 95th SAC meeting. The project was not recommended as TRL-3 was not achieved. SAC further advised PI to either approach DST or seek start-up funding from Oil PSU's like HPCL, BPCL, IOCL & ONGC.

**PI indicated in May'23 that they have reached TRL-3.**

- Project Cost: Rs 45.97 Lakhs
- Fund required from CHT: Rs 22.98 Lakhs
- Project Duration: 12 Months
- Industry partner: IOCL

**SAC deliberated and recommended the proposal subject to IOCL's satisfaction on the results shared by PI.**

**Action- BFA/IOCL/CHT**

**4. Process technology for the catalytic dehydration of methanol to dimethyl ether (DME)- Demonstration of 2.5 TPD pilot plant: CSIR-NCL/IOCL**

**Objective:** To set up, commission and demonstrate stable operation of a pilot/demonstration plant of 2.5 TPD capacity of DME that is produced from catalytic dehydration of methanol using CSIR-NCL's indigenously developed technology.

**Background:** The proposal was deliberated in 95<sup>th</sup> SAC meeting. IOCL shown interest in the proposal and agreed to review the project cost & proposal with NCL and NCL will put up the revised proposal adhering to OADB funding guidelines of 50 % max of total project cost.

The PI submitted the revised proposal.

- Project Cost: Rs 7032.80 Lakhs
- Fund required from CHT: Rs 3516.40 Lakhs
- Project Duration: 36 Months

**SAC recommended the proposal subject to due diligence and financial contribution by PSU partner (IOCL).**

**Action- CSIR-NCL/IOCL**

**5. Light weight novel Multicomponent High entropy alloy for hydrogen storage application: CSIR-IIP/IIT-T/IIT-D/Midhani, Hyderabad/3Wi Technologies, Vadodara/IOCL**

**Objective:** To develop Novel HEAs with a hydrogen storage capacity of  $\geq 3$  wt.% at ambient temperature and pressure < 10 bar and HEA with cyclic stability of more than 10000 cycles

- Project Cost: Rs 167.29 Lakhs
- Fund required from CHT: Rs 83.64 Lakhs
- Project Duration: 36 Months
- Industry Partner: IOCL
- Project Approval: Approved in 93rd SAC (Mar'22) & Approved in 33rd EC (May'22)

CHT sent MoA to IOCL/IIP in Aug'22, Internal approval of IOC awaited.

During the last 95<sup>th</sup> SAC, IOCL indicated that study conducted by IIP have not yielded desired results. SAC advised participating agencies to resolve the issue and take the project forward at the earliest. **Now, IOCL indicated internal approval is in progress.**

**SAC noted the same.**

**Action - CSIR-IIP/IIT-T/IIT-D/Midhani, Hyd/3Wi Technologies, /IOCL /CHT**

**6. Integration of parabolic trough solar collectors with multi effect evaporator for reducing the dependency of energy-intensive industries over fossil fuels: IIT Roorkee / IOCL**

**Objective:** To develop an improved analytical model of parabolic trough solar collectors (PTSC) for better prediction of its thermal efficiency and examine its performance on varying different associated parameters.

**Expected outcome:** Achieving higher efficiency than reported (75-78% versus <70% reported under given process conditions at 150 Deg C temperature) through appropriate process optimization and material modifications.

- Project Cost: Rs 42.24 Lakhs
- Fund required from CHT: Rs 21.12 Lakhs
- Project Duration: 21 Months

- Industry Partner: IOCL

**Project Approval:** Approved in 93<sup>rd</sup> SAC (Mar'22) & Approved in 33<sup>rd</sup> EC (May'22)

CHT sent MoA to IOCL/IITR in Aug'22, Internal approval of IOC awaited. Draft MoA approved by CHT/IITR, currently under vetting of IOCL legal team.

**SAC noted the same.**

**Action - IITR/IOCL/CHT**

**7. Catalytic Pyrolysis of multilayer plastic waste (MLP) to value added products A Circular Economy Approach: IITM/VIT Vellore/CPCL/ Samudhyog Waste Chakra/ITC**

**Objective:** To simultaneously address the issues of waste management and alternative revenue generation through converting multi-layer plastic waste to value added products like diesel and carbon black.

- Project Cost: Rs 65.36 Lakhs
- Fund required from CHT: Rs 32.68 Lakhs
- Project Duration: 24 Months
- Industry Partner: CPCL

Based on suggestion in the last 95<sup>th</sup> SAC, PI submitted revised proposal with Samudhyog Waste Chakra indicated as commercialisation partner.

**SAC deliberated and recommended the proposal.**

**Action - IITM/VIT Vellore/CPCL/ Samudhyog Waste Chakra/ITC**

**8. 2G ethanol, 20 KLPD brown field Project at cost of 50 Cr: Committee report for ASN Fuels Pvt Ltd, IIT Tirupati**

- Project Cost: Rs 50 Cr
- Fund required from CHT: Rs 15 Cr
- Project Duration: 21 Months
- Industry Partner: None

SAC deliberated on the proposal in **95<sup>th</sup> SAC** and instructed PI to resubmit the proposal in collaboration with Oil PSU as a partner. It was also advised by SAC that a Committee led by Dr D K Tuli may do the due diligence and submit the report.

It was deliberated that ASN's submission of 20 KLPD commercial plant proposal to the last 95<sup>th</sup> SAC could not be considered, as the current set-up does not meet the following RFS criteria:

- Demo plant data at 1/50th capacity: Not Meeting
- Project should not be a brown field: Not Meeting
- Revenue of Rs 250 Cr: Not Meeting

### **Recommendations by committee:**

The pre-treatment step is mostly conventional. The saccharification step has / may offer advantages in terms of lower energy and much shorter reaction time. It may have lower capex as number of saccharification reactors are eliminated.

The process has novelty that it used indigenous commercial enzyme cocktail which they claimed has been finalised after very extensive trials. Though the quantity was more but they claim three time recycle (Not seen in this visit) This will reduce OPEX.

Some suggestions regarding avoiding base – acid on same substrate were happily accepted. Similarly, fatty acid removal/ collection can be dropped as it makes no commercial sense.

However, committee feel that the process must be validated on Demo level at about 1000 lit of ethanol per day. This will resolve some of the process uncertainties and we may have a good working technology on a slightly different platform. The flow type saccharification and fermentation reactors need to be validated and may provide alternate technology platform

Committee recommend to Ms ASN Fuels to submit a complete proposal on setting up a demo plant as per provisions of PM JI-VAN Yojana. PI must submit a sort of pre DFR along with equipment sizing, analytical facilities, land requirement and arrangement for the same complete process flow diagrams of each section and time lines. SAC thereafter may consider to support this demo plant under RFS-IV.

**ASN fuels on 12<sup>th</sup> May'23 has informed CHT that due to insufficient funds, they have withdrawn from putting up bid for 2G Demo plant in RFS-IV of PM JI-VAN Yojana.**

**SAC noted the above.**

## **G. Review of on-going R&D Projects**

### **1. Development of kinetic as well as 3D CFD Model for Gasifier: EIL/BPCL**

**Objective:** To develop an integrated model for complete fluidized bed coal gasification system using a combination of phenomenological models and state-of-the-art CFD modelling for (a) Credible scale-up of CTL technology; (b) Enabling design of a demonstration unit and subsequently designing / offering commercial unit; (c) Identifying problem areas in CTL technology development which shall help in overcoming problems in CTL pilot plant running.

**Background:** Extension of the proposal for 3 months up to Mar'23 was approved in the last 95<sup>th</sup> SAC meeting. EIL submitted project closure report.

**EIL presented future plan and way forward. Looking into the national importance of coal gasification, SAC advised EIL to continue working on coal gasification covering design of large gasifier, prediction of plant performance, addressing the operating issues etc. EIL should move project proposal for further study on gasification and can join hands with public/private players in this technology domain.**

**SAC approved closure of the project with the above comments.**

## 2. Synthetic Aviation Lubricants (SAL) - Phase 2: CSIR-IICT, HPCL & CEMILAC

**Objective:** To prepare 500 kg each of the base oils for SVS-11 and SVS-21 lubricants at CSIR-IICT and carryout preliminary testing.

**Background:** The testing was planned in TV-2 aero engine of MI-8 helicopter supplied by 3BRD. Subsequently, due to phasing out of TV-2 aero engine, it was decided to try these lubricants in TV-3 aero engine of MI-17 helicopter. Only SVS-11 found compatible while carrying out rubber seal compatibility study & tribology testing. Therefore, its testing in TV-3 aero engine & also in-flight tests (MI-17 helicopter) is to be done.

### Physical Progress:

MOU Date	Start Date	End Date	Extension	Physical Progress
Mar 2016	Apr 2016	Sept 2017	Dec 2023	90%

### **Following activities were completed by December 2022:**

- Completed Ground Testing of TV3-117MT Aero Engine with proven OX-27 Oil
- Completed Ground Testing of TV3-117MT Aero Engine with SVS-11 Oil

### **On request of CSIR-IICT, extension was approved for SAL Phase-II project from January to December 2023 to complete the following activities:**

- In-flight test schedule finalization with Air HQ to facilitate flight trials after getting clearance from CEMILAC for SVS-11 oil TV3 aero engine ground test report (Jan 2023)
- In-flight testing with SVS-11 oil at 3BRD, IAF (Feb – Sept 2023)
- Compilation of the data from participating organizations & submission of final report by CSIR-IICT (Nov-Dec 2023)

**CHT informed that IICT is still waiting for IAF response for arranging a meeting to discuss about the way forward for inflight testing with SVS-11 Lubricant oil. HPCL has agreed to support and interact with IAF to facilitate flight trials.**

**SAC noted the above.**

**Action - IICT/HPCL/CEMILAC/CHT**

## H. Review of ongoing Projects under HCF

1. **Development & Demonstration of commercially viable Fuel Cell buses based on Hydrogen produced from Multiple Pathways: IOCL/IISc/OEM**

**Objective:**

- A comprehensive pilot study to develop and demonstrate clean transportation solutions through hydrogen fuel cell technology based on various indigenously designed hydrogen production pathways / indigenously available resources.
- To indigenously develop and commercialize fuel cell stack / system for heavy-duty buses.
- Understanding the performance and durability of fuel cell buses under Indian operating conditions
- To develop and scale up / explore commercially viable hydrogen production pathways from 4 different routes (namely: Biomass gasification, bio-methanation to H<sub>2</sub>, solar electrolysis based on three different electrolyzer technologies, and natural gas reforming)
- Evaluate the technology by executing the field trials on 15 fuel cell buses in Delhi NCR region for a running distance of 20,000 kms and undertaking the techno-commercial evaluation for providing end to end solution for heavy duty buses including cost effective and environmentally friendly production pathways.
- Developing an understanding of the complexities of hydrogen refueling station especially in terms of addressing the requirements of heavy-duty fleet.

**Project cost break-up (Rs, in Crore)**

	Description	Cost
1	GRANT / GRANT-IN-AID from HCF to IOCL	25.00
2	GRANT / GRANT-IN-AID from HCF to IISc	22.01
3	GRANT / GRANT-IN-AID from HCF to OEM	50.51
4	<b>Total GRANT-IN-AID from HCF (1+2+3)</b>	<b>*97.52</b>
5	Internal funding / contribution by IOCL	128.14
6	Internal funding / contribution by OEM	71.00
	<b>Total Project cost (4+5+6)</b>	<b>296.66</b>

\*Funds will be released to IOCL only for IOCL, IISc and OEM.

OEM shall mean the party selected by IOCL through competitive bidding for development of Fuel cell Stack and procurement of fuel cell buses.

**Physical Progress:**

MOU Date	Start Date	End Date	Physical Progress
Dec 2020	Dec 2020	Dec 2023	60%

During the last 95<sup>th</sup> SAC, IOC indicated delay of 2-3 months on account of delay from OEM in supply of the Hydrogen Infrastructure.

IOCL R&D made a presentation on the development of the project and indicated the delay of 6-8 months in project execution.

SAC noted the same.

**Action - IOCL/IISc/OEM /CHT**



**2. Design development and demonstration of 1KW PEM Fuel cell technology: High energy batteries (HEB)/IOCL/GAIL**

CHT informed that MoA for the project has been signed on 24<sup>th</sup> Apr'23.

**SAC noted the same.**

**Action - HEB/IOCL/GAIL/CHT**

**3. Effective hydrogen Production through membrane less electrolyser and storage: High energy Batteries /OEC**

CHT informed that MoA for the project has been signed in March 2023 and work has been initiated by M/s HEB.

**SAC noted the same.**

**Action - HEB/OEC/CHT**

**4. Development and Scale-up of Indigenous Next Generation Solid Oxide Fuel Cell Technology and Demonstration of Process Line (10 kW) for Prototype Production: HPCL/ARCI/CGCRI**

CHT informed that MoA on the project signed on 3<sup>rd</sup> May'23.

**SAC noted the same.**

**Action – HPCL/ARCI/CGCRI/CHT**

## I. PCRA merger with CHT

CHT informed that the following R&D projects of PCRA are being transferred to CHT for Execution/ Implementation after the dissolution of PCRA;

Sl.No	Project Name	Project duration (months)	Project Start Date	Scheduled Project Completion date	PCRA's contribution (in Lakhs)	Total amount released (in Lakhs)
1	Design and development of a micro turbine combustor working on biogas- IIT Jodhpur & IIP Dehradun	24	23.08.2021	22.08.2023	24.98	10.88
2	Design and development of Inline Bio methane Enrichment and CO2 separation system- CSIR-CMERI Ludhiana	18+3	16.07.2021	15.01.2023 revised as 14.04.23	19.96	13.48
3	Interventions to improve Performance of Combustion Systems in MSMEs- IIT Delhi	24	16.07.2021	15.07.2023	24.93	10.80
4	Performance Evaluation of a floating Bio-gas plant by Integrated photo- voltaic Thermal (SPVT) collectors (Bi-SPVT) during harsh winter Indian climate conditions- RGIPT Amethi	24	16.07.2021	15.07.2023	25.00	20.23
5	Development of Encapsulated Asphalt- Rubber Pavement (EARPAVE) Product for Road Applications- IIT Tirupati	24	16.07.2021	15.07.2023	42.54	10.00
6	Development of New Energy Efficient porous burner (Stove) for domestic cooking with Pipe Natural Gas (PNG) as fuel- IIT Kharagpur	24	22.12.2022	21.12.2024	24.91	6.20
7	Design and development of a fuel-flexible burner for domestic and community cooking applications- IIT Hyderabad	24	16.06.2022	15.06.2024	24.93	6.20
8	Design and Development of Integrated Spouted Bed Roaster- CSIR-CFTRI Mysore	24	16.06.2022	15.06.2024	24.13	6.00
9	Identification of the most critical locations having the highest impact on traffic in case of vehicular breakdown- CSIR CRRRI Delhi	18	16.06.2022	15.06.2024	24.00	6.00

SAC noted the above.

Action - CHT

## J. BARC's Hydrogen production technologies for implementation in Refinery, Copper and zinc industry

BARC made a presentation on production of green hydrogen using IS cycle. SAC pointed out that there should be collaboration between BARC and Oil PSUs on hydrogen production processes considering the expected lower cost of green hydrogen production. SAC also advised EIL to explore opportunity to leverage the technology in the context of Copper and Zinc industries as well. CHT was advised to communicate to Oil PSUs on the technology with a suggestion that interested PSUs may directly get in touch with BARC to explore the matter further.

**List of members for 96<sup>th</sup> meeting of SAC**

	<b>Name</b>	<b>Designation</b>	<b>Organization</b>
<b>CHAIRMAN</b>			
1	Dr. Anil Kakodkar	Former Chairman, AEC	BARC
<b>MEMBERS</b>			
2	Prof. Sanjay M. Mahajani	Professor	IIT, Mumbai
3	Dr. T. N. Rao	Additional Director	ARCI, Hyderabad
4	Prof. Vijayamohan K. Pillai	Professor	Indian Institute of Science Education & Research, Tirupati
5	Dr. R. K. Malhotra	Former Director General	FIPI
6	Sh. R. Ramachandran	Former Director (Refineries)	BPCL
<b>MEMBER SECRETARY</b>			
7	Sh. Alok Sharma	ED	CHT & Convener
<b>EX-OFFICIO MEMBERS</b>			
8	Ms. Sukla Mistry	Director (R)	IOCL
9	Mr. S Bharathan	Director (R)	HPCL
10	Dr. S.S.V. Ramakumar	Director (R&D)	IOCL
11	Ms. Varsha Sinha	Secretary	OIDB
12	Mr. Rajiv Agarwal	Director (T)	EIL
13	Mr. Ravi	DG	OEC
14	Dr. S K Maity	Scientist	IIP
<b>PERMANENT INVITEE</b>			
15	Dr. Ravikumar V.	Head (R&D)	BPCL
16	Mr. V K Maheshwari	ED (R&D)	HPCL
17	Mr H Shankar	Head (R&D) (Attended by Ms Lavanya)	CPCL
18	Mr. R N Maiti	Head (R&D)	EIL
19	Mr. Sanjeev Kumar	Head (R&D)	GAIL