OIL & NATURAL GAS CORPORATION LIMITED
WESTERN OFFSHORE BASIN
MUMBAI REGION

Geology Operations Group
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Eastern Express Highway
Sion, Mumbai-400 022
File No. : MR/WOB/GOG/Tech/2015
Date : 13.02.2018

From: GM (Geol)- Head Geology Operations Group, WOB, Mumbai
To : ED-HOI, KDMIPE & Chief COIN, ONGC, Dehradun

Sub: ONGC-Pan-IIT Collaborative Research Program

With reference to letter # KDMIPE/COIN/Pan-IIT/Phase-IV/2018, titled ONGC-Pan-IIT Collaborative Research Program, project proposals and issues requiring solutions from various IITs were to be identified and submitted by the end of February.

We are herein submitting a project proposal, "to identify hydrocarbon source kitchens of the Mumbai Offshore Basin or any specific field, eg. Ratnagiri, Murud Depression, Tapti-Daman, by creating iso-source rock potential maps (TOC%, VRo, Tmax, S2 and HI), and subsequently to establish the time of hydrocarbon expulsion from these kitchens, to achieve oil-source, oil-oil correlation, to trace their migration pathways and utilizing Dept. of Earth Sciences, IIT Bombay's expertise and analytical facilities dedicated to a research in organic geochemistry, for this purpose."

Additional details like scope of work, deliverables, time frame and financial implication are also mentioned in the proposal. (Enclosed)

Regards,

Regards

13/02/2018
(D.Ghosh)
GM-HGOG

कार्यालय–संस्थान प्रमुख कंडीएमआईपीई, देहरादून
Office of HOI - KDMIPE, Dehradun
प्राप्ति सं./DTS No. 1023
प्राप्ति दि. 15.2.18 प्रेषण दि. 15.2.18

**Copy to;**

1. EA to -ED Basin Manager, WOFF,Mumbai

I/c R&D & Tech.
Attn. Vijay Singh. 15.2.18

OIL AND NATURAL GAS CORPORATION

# Project Proposal

Prepared for: ONGC-Pan IIT Collaborative Research Program
Prepared by: Shreyas Vichare, Senior Geologist

Western Offshore Basin, ONGC, Mumbai
February 2018

## Preferred IIT

Department of Earth Sciences
Indian Institute of Technology, Bombay
Powai, Mumbai- 400076

Vichare

Prepared by: Shreyas Vichare
CPF: 122205

OIL AND NATURAL GAS CORPORATION

# SCOPE OF WORK

In a petroleum industry, organic geochemistry is utilised for number of purposes, the primary purpose being evaluating the source rock potential of a petroliferous basin. Having a broad regional idea of potential hydrocarbon source kitchens becomes an integral part of exploration, as a single source rock pod can contribute to one or more hydrocarbon reservoirs. Source rock evaluation parameters generated from the well samples can be plotted on the base maps to generate iso-TOC%, VRo, Tmax, S2 and HI maps *(please refer to the adjoining figure)*. These maps can later be integrated with the tectonic history of the western coast basin and biomarker studies to determine the time of hydrocarbon expulsion, to establish oil-source correlation and to trace hydrocarbon migration pathways. **The output from this geochemical studies can later be integrated with seismic studies for generating 3D petroleum system models.** With re-procurement of Ratnagiri field in Western Offshore Basin, issues like, low TOC% and hydrocarbon generation potential of Palaeocene-early Eocene sequences of Ratnagiri field needs to be re-looked and comprehended.

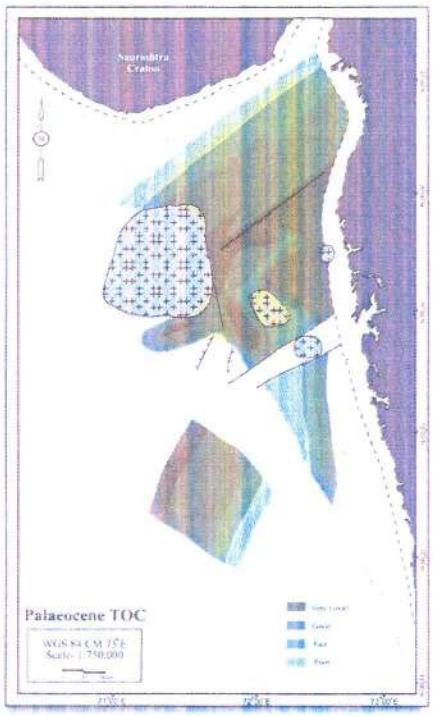


Figure 1: Example of a draft iso-TOC% map of Mumbai Offshore Basin

The Earth Science Department of Indian Institute of Technology, Bombay possesses the faculty and research scholars, with an expertise dedicated to a research in organic geochemistry. Along with the routine instruments like RockEval Pyrolysis and GC-MS, the department also possesses the advanced GCXGC-TOF-MS which facilitates finer analysis of biomarkers as compared to conventional GC-MS.

## Objective

To identify hydrocarbon source kitchens of the Mumbai Offshore Basin or any specific field, eg. Ratnagiri, Murud Deppression, Tapti-Daman, by creating iso-source rock potential maps (TOC%, VRo, Tmax, S2 and HI, refer *figure: 1 for an example*), and subsequently to establish the time of hydrocarbon expulsion from these kitchens, to achieve oil-source, oil-oil correlation, to trace their migration pathways and utilizing Dept. of Earth Sciences, IIT Bombay's expertise and analytical facilities dedicated to a research in organic geochemistry, for this purpose.

## Deliverables

The project will be executed to yield following outcomes:

1. Generation of the iso-source rock potential maps i.e. TOC%, S2, Tmax, VRo and Kerogene Type of Mumbai Offshore Basin.
2. Identification of the hydrocarbon source kitchens of Mumbai Offshore Basin by integrating source rock potential maps with the tectonic history of the western coast of India.

Vichare

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3. Establishment of the time of expulsion of hydrocarbons from the source rock pods.
4. Oil to Source and *vice versa* correlation and hence construction of hydrocarbon migration pathways at a regional scale.
5. Carrying out source rock kinetic studies to understand and reconstruct the evolution of the basin.
6. Addressing certain issues as to why certain fields are gas bearing while certain are oil bearing while others are dry.

### Project Timeframe

- Identification of wells and gathering well data (~200 wells): 4 months
- Extraction and preparation of rock samples from cores or dry cuttings: 5 months
- Analysis of samples and integration of results: 5 months
- Plotting of data and preparation of "source rock potential maps" of Mumbai Offshore Basin and their integration with the tectonic history: 5 months
- Interpretation of Data: 7 months
- Preparation and submission of the project report: 4 months

Total duration: 30 months

# BUDGET

Given below is total estimated budget for the collaborative project having a duration of three years. The estimated budget, along with the man-power salary, also includes contingency funds, travel allowance, instrument maintenance, etc:

Salary (Research Scholar): INR 40,000/month Salary (Post Doctoral Scholar): INR 60,000/month

Travel allowance: INR 4,00,000/- (3 years)

Contingency: INR 12,00,000/- (3 years)

Instrument maintenance and other expenses: INR 25,00,000/- (3 years)

| Description | Duration | Total Estimated Cost |
|---|---|---|
| If a PhD Scholar is employed | 3 Years | ~INR 60,00,000/- |
| If a Post-Doctoral Scholar is employed | 3 Years | ~INR 75,00,000/- |

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**PROJECT I: "Design and development of a low toxicity synthetic oil based drilling fluid system for HPHT environment weighing upto 2.5 SG that can operate in the pressure range 10,000 to 15,000 psi and temperature range of 400ºF to 500ºF".**

SCOPE OF WORK:

To design, develop and test in laboratory a Low Toxicity Synthetic Oil based Drilling Fluid(LTSOBM) with suitable additives to maintain optimum Rhoelogical and other drilling fluid parameters, for successful drilling of HPHT wells (BHP from 10000 psi to 15000 psi) requiring drilling fluids weights in the range 2.0 to 2.5 SG at temperatures range of 400°F to 500°F.

DELIVERABLES:

1. Develop LTSOBM with weights from 2 SG to 2.5 SG with increments of 0.1 SG
2. Test above drilling fluids at pressures from 10000 psi to 15000 psi in increments of 250 psi and temperatures from 400°F to 500°F in increments of 25°F.

PROJECT DURATION: 12 months

INSTITUTE ASSOCIATION: IDT

RGL, Mumbai
*QHSE Certified*

**OIL & NATURAL GAS CORPORATION LTD**
**WESTERN OFFSHORE BASIN, MUMBAI REGION,**
**REGIONAL GEOSCIENCE LABORATORY**

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***Date 21.2.18***

File no. MR/WOB/RGL/COIN/Pan-IIT/2017-18

From- GGM-Head RGL, WOB, Panvel

To- ED-HOI, KDMIPE & Chief COIN, ONGC, Dehradun

Subject: **Submission of Project Idea / concept note for Pan IIT collaborative Research Program (Ph IV)**

Please find herewith concept note of the proposed collaborative project of RGL Panvel and IIT-B w.r.t. the low temperature demulsification of crude oil emulsion of Heera platform, Mumbai off-shore. The concept note has been prepared in consultation with IIT-B professors.

Crude oil emulsion of Heera platform is very tough to demulsify that too at lower process temperatures of ~45°C. Low demulsification efficiency at process platform generates high water content in processed crude oil which creates problems at receiving end. ONGC is struggling as only very rare proprietary chemical additives (demulsifiers) are in market to put to use.

The project can give a deeper understanding of the mechanism of demulsification and selection rules for demulsifiers leading to an effective generic demulsifier.

Dave 21.2.18

Dr. Alok Dave
GGM-Head RGL

# Pan-IIT collaborative research program (Ph- IV)

## Concept note of proposed project by RGL Panvel and IIT-B

**Title**
**Development of selection rules for low temperature demulsifiers leading to identification of effective generic demulsifier(s) for Heera emulsion**

**Researchers from IIT-B** Rochish M. Thaokar, Jyoti R. Seth, Vinay A. Juvekar
Department of Chemical Engineering, IIT Bombay

**Background**
Water in crude oil emulsions is difficult to demulsify due to the presence of a layer of asphaltenes stacked at the oil-water interface. Asphaltenes are known to increase the interfacial viscosity and elasticity. In order to demulsify the crude, these asphaltenes have to be displaced using more active surfactants which also should reduce the interfacial viscosity and elasticity, so that drainage of oil film between droplets is enhanced, thereby facilitating rapid coalescence of water droplets.

Demulsification in oil industry is usually carried out at higher temperatures since the viscosity of crude oil as well as interfacial viscosities decrease with increase in temperature. So higher temperatures aid faster drainage of crude oil films between coalescing water droplets thus promoting coalescence and demulsification. For high water-cut crudes, however, available capacity of the existing heating system is limited. Hence the temperature in the settlers/ separators is reduced with consequent reduction in rate of demulsification. Additional capacity usually cannot be installed due to paucity of space at off-shore platforms. It is therefore desired to select additives that may promote demulsification at lower temperatures of around 40- 45° C. The phenomenon is very much applicable to ONGC's Heera platform where heating capacity has been limited due to high volume of produced liquid which has to be processed for water separation.

To achieve this, the demulsifiers should have high surface activity even at low temperatures so as to displace asphaltenes stacked at the crude oil-water interface. The demulsifier molecules must not self-aggregate so that they can remain mobile and thereby exhibit low interfacial elasticity and interfacial viscosity. Molecular architectures, such as branched, comb, dendrimer, etc. and chemical constituents, such as siloxanes, perflurocarbons, polyethers, etc. also determine how surfactant behaves at the oil-water interface. Moreover, a single surfactant may not be able to fulfil all the above criteria. Therefore, a combination of two or more surfactants might be needed to achieve this goal.

**Proposal**
In this project, it is proposed to
- Understand the mechanism and dynamics of demulsification in high water-cut crude oils

- Establish the rules for selection of surfactant type and architecture
- Suggest rules for synergistic combinations of two or more surfactants

- Study the effect of parameters such as temperature, salinity, API of crude oil and interfacial properties of neat crude oil – water interface.

**Methodology**

- Characterisation of the crude oil – water (brine) interfacial properties such as dynamic interfacial tension, interfacial shear and dilatational viscosity and elasticity
- Dynamics of adsorption and displacement of asphaltenes /naphthenates etc. by demulsifiers and effect on interfacial properties over time.
- Preparation of high water content emulsions using high shear mixer and its characterisation for size and distribution of water droplets
- Actual tests for emulsion dewatering such as bottle tests for evaluating time of dynamics of demulsification
- Effect of parameters such as temperature, salinity, API of crude oil, on interfacial properties
- Modelling of the process of demulsification as a function of interfacial properties, and other process parameters
- Based on these studies, rules for selection of surfactant type, molecular architecture and their combinations will be evolved.

For this study, mainly commercially available surfactants from known suppliers and with reasonably well known chemical constituents and molecular architectures will be focused.
As we gain understanding of the mechanism of demulsification, possible combinations of known surfactants would be proposed and evaluated.

The above approach / methodology will give the most effective generic demulsifier for Heera emulsion containing one or more generic chemicals along with deep understanding of mechanism of demulsification with respect to the specific emulsion.

**Benefits**

Heera platform in Mumbai off-shore produces around 1 lakh barrels of emulsion per day. Around 65% of this is water which needs to be separated with in short residence time- the problem ONGC is grappling with. The project would be of immense value to ONGC in composing the right combination of surfactants for effective demulsification of oil emulsion at Heera platform at lower temperatures.

**PROJECT II: "Identify suitable weighting material to make and maintain Drilling Fluid to drill normal temperatures wells requiring weights upto 2.9 SG"**

SCOPE OF WORK:

To design, develop and test in laboratory a Drilling Fluid with suitable additives to maintain optimum Rhoelogical and other drilling fluid parameters, for successful drilling of normal temperature wells requiring drilling fluids weights in the range 2.0 to 2.9 SG to target depth of ~2500m.

DELIVERABLES:

1. Develop Drilling Fluid with weights from 2.0 to 2.9 SG in increments of 0.1 SG with suitable rheology
1. Test above drilling fluids from 5000 psi to 10000 psi in increments of 250 psi and at temperatures from 150 to 200°F in the increments of 25°F.

DURATION: 12 months

INSTITUTE ASSOCIATION: IDT