

Pre-Feasibility Report

1. Introduction

India's demand for petroleum products is growing at a very rapid rate, With a view to meet this growing demand, the new Hydrocarbon policy aims at encouraging investment in oil & gas exploration and production.

India is dependent on Imports to meet the rapidly growing demand for petroleum products. Current demand and supply projections indicate that the level of self-sufficiency is likely to decline to about less than 30% over the next few years. Substantial efforts are therefore, necessary to boost the level of exploration activity in the country, so that, new discoveries can be made and the quantum of crude oil and gas production increases significantly in the years to come.

It is also evident that vast amount of capital investments are necessary, if exploration efforts are to be substantially augmented. Therefore, there is need to attract both the National as well as Private sector oil companies to invest in this critical area.

As a part of the overall development plan for augmenting the production of oil and gas and to reduce the import of national natural gas, ONGC intends to develop the shallow water NELP block KG-OSN2004/1 & adjacent PML block GS-49-2 off the east coast of India. The project is expected to realize aggregate Natural Gas peak Production to the tune of 5.36 MMSCMD.

2. The Project

A comprehensive Field Development Plan has been developed for integrated Development of Block KG-OSN-2004/1 & GS-49-2, with onshore facilities at Odalarevu. The development of KG-OSN-2004/1 block along with GS-49 has a total production potential of 5.55 MMm³/d of gas with eleven producer wells (9 wells for KG-OSN2004/1 & 2 for GS-49-2) to deliver a cumulative gas production of around 13.16 (10.36+2.80) BCM over a period of 12 years.

The salient features of this concept are described below:

- a. Integrated Development of block KG-OSN-2004/1 and GS-49-2 field in KG Offshore with new onshore processing facilities at Odalarevu.
- b. Drilling and completion of 9 new development wells in KG-OSN-2004/1 and 2 new wells in GS-49-2 prospect.
- c. Subsea pipeline and umbilical from offshore to new onshore terminal at Odalarevu.
- d. Completion of 5 wells with mudline completion, 3 wells with subsea completion and 1 dry tree completion in KG-OSN2004/1 and 2 dry tree completion at GS-49-2.
- e. Installation of one monopod at GS-49-2 well location and one 4-legged platform at CN-B location. All wells of KG-OSN2004/1 & GS-49-2 to be tied

back to CN-B platform. The well fluids to be gathered and commingled at centrally located WHP CN-B and evacuated to onshore terminal at Odalarevu 44 km away. However, upon receipt of comingled gas, equivalent amount of GS-49-2 gas will be diverted to Contractor's existing onshore facilities (PML fields G1/S1 VA Project) for processing & evacuation to existing network.

- f. Installation of new onshore terminal at Odalarevu to process the well fluid production with a capacity of 4.60 MMSCMD from KG-OSN2004/1 wells.

3. Project Justification

The project is expected to augment the production of hydrocarbons which will cater to the growing demand for energy and contribute to the overall economic development of the region.

4. Details of KG-OSN2004/1 & GS-49-2 wells:

KG-OSN2004/1

Shallow water Block KG-OSN-2004/1 covering an area of 1131 SKM in KG Offshore, was awarded to JV consortium of ONGC (PI 55%) and BGEPII (PI 45%), with ONGC as Operator, under NELP VI round of bidding effective from 25.05.2007. Currently, ONGC is the Operator with 100% PI, w.e.f. 13.03.2013.

The block KG-OSN-2004/1 is located off the Narsapur Coast and falls south of GS-49 PML close to the river mouth of the Vashishta Godavari. The bathymetry within the block varies from 0-350m. The block extends from coast to farthest point by 28kms. The nearest facility of GS-15 is about 32kms and Vashishta – S1 is about 52 kms.

Exploratory activities in the block commenced in May 2007 with acquisition of high quality 3D seismic data. Exploratory drilling in the block commenced in April, 2011 through drilling of well KGOSN041NACS#1(Chandrika South) which resulted in discovery of NANG in the hitherto untested Tertiary Pliocene channel play. The second well KGOSN041NAAL#1 (Alankari#1) also led to NANG discovery from Late Miocene-Lower Pliocene sub unconformity play. Subsequently, three more new NANG discoveries of Saveri#1, NANL#2 and NANL#1 were made.

As on date, a total of twelve(12) wells have been drilled in the block, out of which seven were discovery wells viz. Chandrika South (CS#1), Alankari (AL#1), Saveri (SA#1), NANL#2, and NANL#1, Saranagi (SG#1) and Malhar(ML#1) One well NANL#3 established extension of CS-1 pay to the north and one well Marwah (NAMA#1) had gas indications. Three wells NARV#1(Minor gas in MDT) NANL#4 & NASA-B were dry.

Declaration of Commerciality (DoC) was submitted to DGH on 19th Aug, 2014 with a cluster development plan as the discoveries are non-economical on standalone basis. DoC was reviewed on **28/03/2015**.

First FDP was submitted to DGH on 26.05.2016 as integrated development of KG-OSN 2004/1 field and GS-49-2 field and also seek dispensation from the Government on freedom for Pricing & Marketing of gas from such fields under "Marginal Fields" category i.e. in line

with Govt. of India's Marginal Field Policy (MFP). Subsequently a revised FDP was submitted to DGH on 29.08.2016. FDP was approved by MC on 31st March 2017.

Field Development was not commenced immediately as it was unviable due low gas price prevailing at that point of time.

A revised FDP with revised development plan, updated project schedule and inclusion of one more subsea well Sarangi was submitted on 28th December 2019. A total in-place GIIP of **15.296 BCM** has been established within the contract area of the block with GP of **11.24 BCM** and ultimate reserves of **10.36 BCM**.

An integrated study, including static and dynamic modelling of all the discoveries together and economic viability based on the discovered volumes was carried out. The analysis indicates that the Chandrika South channel extends southward into the open acreage and the total GIIP and ultimate recoverable reserves, including the volumes in the open acreage are 16.566 BCM and 11.294 BCM respectively.

As per the revised FDP, total gas production potential from Alankari, Saveri, Chandrika South, NANL-3 and NANL-2, Sarangi & Malhar fields of KG-OSN-2004/1 Block including open acreage reserve of CS-1, with a total of Nine producers from these seven fields can together deliver a peak gas rate of 4.55 MMSCMD with a production life of 12 years.

GS-49-2:

The GS-49 field is located in the shallow waters of Krishna Godavari Basin at the river mouth of Vashishta Godavari in GS-49 PML block. The field has two culminations and is considered to be the south-western extension of the onshore field Kasavadasupalem in to the offshore.

The first well GS-49-1 drilled on the north-eastern culmination from on-land went dry as it encountered the sands at a structurally unfavourable position. The well GS-49-2 was the second well drilled on the structure on the south-western culmination at a structurally favourable position and encountered multi-stack reservoirs within Matsyapuri/Ravva. The total GIIP estimated is 3.94 BCM of NANG. The ultimate recoverable reserves are 2.80 BCM with a peak rate of 1.0 MMSCMD.

5. Infield Architecture

The discoveries in the blocks of KG-OSN-2004/1 are proposed to be completed with 01 platform well, 5 mud line completions (MLC) and 3 subsea completions. The well fluids are planned to be gathered and comingled at centrally located WHP CN-B and evacuated to proposed new shore handling facility near Odalarevu 44 km away. The processed gas after metering will be dispatched to customers.

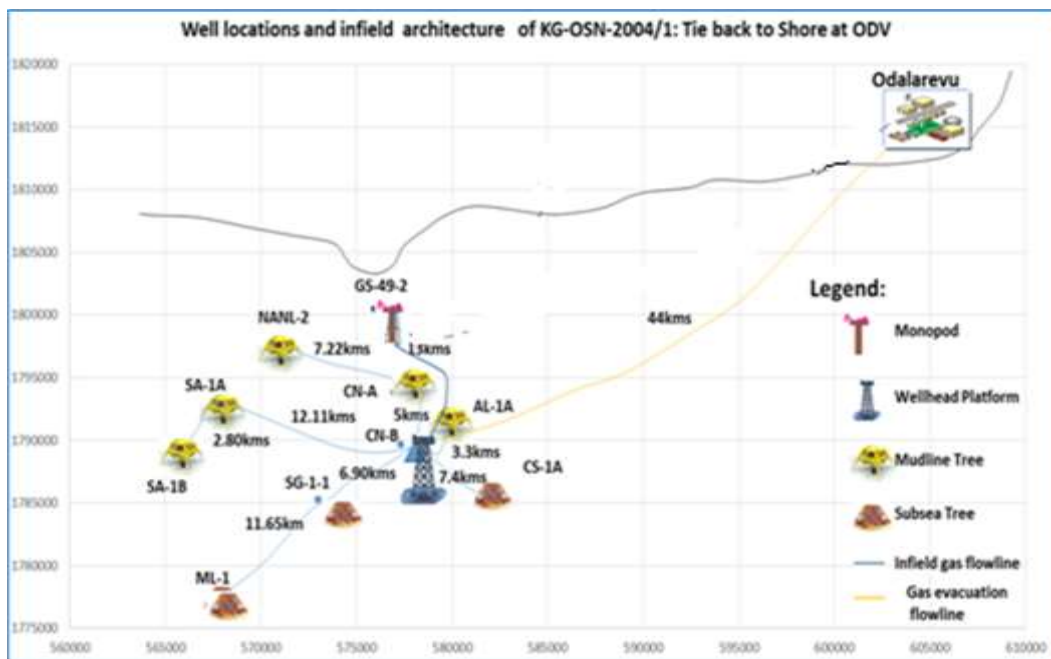
GS-49, a marginal field located in the GS-49 PML block north of KG-OSN-2004/1 is proposed to be developed with drilling of 2 development wells and one monopod at GS-49-2 location. Gas from GS-49 will be metered at monopod platform & proposed to be transported to CN-B WHP (centralised location) before final transportation to Onshore Terminal, Odalarevu along with gas from NELP block utilizing 20"X 44 km trunk line.

Proposed infield architecture is as under:

- Well NL-2 and CN-A: daisy chained flow line for well fluid gathering at CN-B WHP.
- Well SA-1B and SA-1A: daisy chained for well fluid gathering at CNB platform.
- Well AL-1: independent flow line for well fluid gathering at CN-B WHP
- Subsea well CS-1A: independent flow line for well fluid gathering at CN-B WHP.
- Subsea wells ML-1 and SG-1: daisy chained for well fluid gathering at CN-B WHP.

At well Malhar-1, flow line end manifold is proposed for tie-in of future discoveries.

Schematic depicting infield architecture for well fluid gathering at CN-B WHP (central location) is shown in the figure below. Well fluids from various locations (7 infield flowline segments with a cum. length of ~58 km) are comingled at the inlet manifold on CN-B WHP and evacuated to shore facilities at Odalarevu through 20" x 44kms flow line.



➤ The broad Field Development Plan is as under:

➤ **Drilling of 8 wells & completion of 9 Wells:**

- ✓ 2 wells in Saveri : SA-1-A (WD : 15.5 mtrs) & SA-1-B(WD :18 mtrs)
- ✓ 1 well in NL-2 field: NANL-2A(WD :11.5 mtrs)
- ✓ 1 well in Alankari field: AL-1-A (WD :20.5 mtrs)
- ✓ 3 wells in Chandrika field: CN-A (WD:14.5 mtrs),CN-B (WD:22 mtrs) & CS-1-A(WD:138 mtrs)
- ✓ 1 well in Malhar field: ML-1A (WD:320 mtrs)

✓ 1 Re-entry well in Saranagi Field : SG-1 (WD:70 mtrs)

➤ **Offshore Facilities:**

- ✓ Well Head Platform : 1 four legged Platform (CN-B)
- ✓ Mud-Line Completions : 5 nos. (NANL-2A, AL-1A, CN-A, SA-1A & SA-1B)
- ✓ Sub Sea completion : 3 nos.(SG-1, CS-1A & ML-1A)
- ✓ Infield Pipelines : 58.70 kms
- ✓ Umbilicals : 45 kms. for MLC wells & 26 Kms. For subsea wells

➤ **SPS Package:**

- ✓ X-Mas tree: 03 nos
- ✓ Sub-sea Control system (Electro-hydraulic Control from WHP CN-B)
- ✓ Subsea Electrical Cable (44 kms)

➤ **Onshore Facilities:**

- ✓ Gas Dehydration
- ✓ Process System
- ✓ Gas Compression
- ✓ Gas Metering
- ✓ Produced Water Treatment

Facilities on Well Platform (CN-B)

• **Topside facilities**

- Cellar Deck and Main deck cum Helideck.
- Production manifold consisting of production header to hook up the present wells plus the incoming well fluid risers and will also have tapings for future wells
- Flow arms for all the present wells
- Orifice meter for continuous measurement of gas in the well Platforms.
- CN-B platform will act as centralised gathering well platform, accordingly the manifold is to be sized for connecting well fluids from all attached platforms and subsea wells with the provision of additional spare tapping for connection of future well fluid risers.
- One test header will also to be provided at CN-B for testing well streams from mudline completed wells individually/ commingled. One wet gas meter is to be provided for this purpose.
- Also, one Wet Gas flow meter shall be provided at CN-B well head platform for measurement of total gas being despatched through Trunkline to shore

- Individual Well Fluid line Launcher/Receivers have not been considered. However, Pig Launcher for 20" P/L at CN-B pipeline has been considered for pigging CN-B-Odalarevu main trunk line.
- Instrument & Gas system (IUG) with backup of Nitrogen. IUG system will comprise of pipe separator, pressure reduction system, filter separator, instrument air storage tank & Double Pipe Heat exchanger etc.
- Hydro pneumatic shutdown panel for safe shutdown of wells and Pipelines
- Pneumatic fire detection loop and hydrocarbon gas detection system with integration to Platform Shutdown system.
- GCI injection system has not been envisaged as there is no H₂S and very low content of CO₂ (about 0.7%)
- Vent Header to collect low pressure hydrocarbon gas will be diverted to crude condensate drum before disposal through to Vent boom
- CO₂ snuffing system to protect accidental flare of Vent boom.
- Open & Close Hydrocarbon Drain Headers connected to crude condensate drum for collection of effluents hydrocarbon and its disposal into the export pipe line by gas driven pump.
- Open water drain for draining out storm water to sea
- 5 Ton Capacity Jib Crane meeting the requirement of API-2C placed between main deck & Cellar Deck.
- Hook mounted chain pulley block of 2 ton Capacity on Cellar Deck for material handling.
- Diesel storage will be provided in separate tank of 1.5 M³ capacity. Transfer of diesel from barrel to day tank of crane will be done by manually operated rotary gear pump.
- Solar system consisting of high efficiency solar Panel, solar power controller, and battery banks to cater to the requirements of Remote telemetry system, instrumentation (including control of sub-sea wells) & lighting system, Fire & Gas detection system and Navigational Aid system.
- Building Module to consist of Battery Room, Electrical/Telemetry room and 2 bedded shelter in Telemetry room
- Fire fighting equipment viz. DCP skid (one no. on Cellar Deck and two nos. on main cum Heli Deck each of 350 Lb capacity), Life raft with Scramble net one on each of Cellar Deck & Main cum Heli deck, Life ring Buoy on each side of Cellar Deck.
- Hydraulic Power units on CN-B Platform to control the subsea wells – CS-1A, ML-1 and 5 nos mudline completed wells (SA-1A,SA-1B, CN-A, NANL-2 & AL-1A)
- Cathodic Protection system for Jackets
- Lay down area for material handling and muster area for safe egress to escape route

- High Pressure Protection system on SA-1A & SA-1B to limit the Pipeline Design pressure within 230 Kg/cm²g.
- To & fro data communication between well head Platform & onshore Terminal through SCADA
- **Substructure**
 - 4 legged Jackets for CN-B
 - Sub Structure will accommodate 3 stage boat landing

In addition to accommodating the risers of incoming and outgoing pipelines, Substructure of CN-B Platform will also accommodate I/J tubes for accommodating umbilical for subsea and mudline completed wells. Further, CN-B Platform will be designed to accommodate 2 nos. of 12" future risers.

FACILITIES ON MONOPOD WELL PLATFORM (GS-49)

Topside facilities

- Cellar Deck and Main deck cum Helideck.
- Production manifold consisting of production & test headers to hook up the present wells plus the incoming well fluid risers and will also have tapings for future wells
- Flow arms for all the present wells
- Multi-phase flow meter for continuous measurement of gas in both the well.
- Well Fluid risers & Launcher/Receivers.
- Instrument & Gas system (IUG) with backup of Nitrogen. IUG system will comprise of pipe separator, pressure reduction system, filter separator, instrument air storage tank & Double Pipe Heat exchanger etc.
- Hydro pneumatic shutdown panel for safe shutdown of wells and Pipelines.
- Pneumatic fire detection loop and hydrocarbon gas detection system with integration to Platform Shutdown system.
- Vent Header to collect low pressure hydrocarbon gas and their disposal through Glycol Seal pot to Vent boom
- CO₂ snuffing system to protect accidental flare of Vent boom.
- Open & Close Hydrocarbon Drain Headers connected to Crude condensate drum for collection of effluents hydrocarbon and its disposal into the export pipe line by utility gas driven pump.
- Open water drain for draining out storm water to sea
- 5 Ton Capacity pneumatic Jib Crane meeting the requirement of API-2C placed between main deck & Cellar Deck.
- Hook mounted chain pulley block of 2 ton Capacity on Cellar Deck for material handling.
- Solar system consisting of high efficiency solar Panel, solar power controller, and battery banks to cater to the requirements of instrumentation & lighting system, Fire & Gas detection system and Navigational Aid system.

- Firefighting equipment viz. DCP skid (one no. on Cellar Deck and two nos. on main cum Heli Deck each of 350 Lb capacity), Life raft with Scramble net one on each of Cellar Deck & Main cum Heli deck, Life ring Buoy on each side of Cellar Deck.
- Cathodic Protection system for Jackets
- Lay down area for material handling and muster area for safe egress to escape route

Substructure

- Suitable Jacket system
- Sub Structure will accommodate 3 stage boat landing
- All conductors will be within the confinement of Jacket structure

Description of Pipelines

Following pipelines are envisaged

S/N	Pipeline Segment	Nom. Dia	Approx. length, km	No. of Risers	Service	Material of Construction.
1	SA-1B to SA-1A	8"	2.80 km	Nil Sub-sea	Gas Well Fluid	X-60 CS NACE
2	SA-1A to CN-B	10"	12.11km	1	Gas Well Fluid	X-60 CS NACE
3	NANL-2A to CN-A	8"	7.22km	Nil Sub-sea	Gas Well Fluid	X-60 CS NACE
4	CN-A to CN-B	10"	5 km	1	Gas Well Fluid	X-60 CS NACE
5	AL-1A to CN-B	8"	3.3 km	1	Gas Well Fluid	X-60 CS NACE
6	CS-1A# TO CN-B	8"	7.4 km	1	Gas Well Fluid	X-60 CS NACE
7	ML-1A# to SG-1	10"	11.65 km	Nil Sub-sea	Gas Well Fluid	X-60 CS NACE
8	SG-1# to CN-B	10"	6.89 km	1	Gas Well Fluid	X-60 CS NACE
9	CN-B to Odalarevu*	20"	44 km	1**	Gas Well Fluid	X-60 CS NACE

* One size higher than the optimum hydraulic calculated size has been considered

Umbilicals -For three sub-sea wells

** **Connected** to Onshore terminal at Odalarevu

Note:

1. 20" Pipeline from CN-B Well head Platform to Odalarevu onshore Terminal will have approximately 44.0 Km offshore & 3.5 Km onshore portion.

2. SS-ML-1A,SG-1 & SS-CS1A are subsea wells located approximately at 320 mtrs,70 mtrs & 138 mtrs Water Depth respectively. Subsea umbilical will be laid between these three subsea wells to the Well Platform CN-B
3. Subsea wells will be connected to the topside of CN-B WHP with interconnecting Pipeline. Similarly, Mudline completed wells will be connected to the topside of CN-B WHP with interconnecting Pipeline.
4. I/J tube of appropriate size shall be provided on CN-B platform to support umbilical of the Subsea wells SS-ML-1A & SS-CS1A. Similarly, I/J tube of appropriate size shall be provided to support the master umbilical to cater all the mudline completed wells after getting distributed in sub-sea umbilical distribution unit.
5. Cathodic protection system will be provided for Pipelines
6. All offshore Pipelines and umbilicals will be buried minimum 2m from the top of pipe to original undisturbed sea bed

6. Process Facilities

The well fluids from the Offshore WHP at CN-B are received at the onshore facilities through 20" x 44 km flowline.

A dedicated onshore terminal is planned at Odalarevu to handle well fluid production with capacity of 4.60 MMSCMD from Saveri (1A & 1B), NANL-2, AL-1A, CN-A&B, Chandrika South (CS1A), & Malhar (ML-1) from NELP block KG-OSN-2004/1 .

The received well fluid is separated in slug catchers into gas and liquid with the removal of water droplets more than 150 microns from outgoing gas. The outgoing gas from slug catchers is further treated in gas scrubbers for the removal of droplets more than 10 microns. After conditioning of the gas in gas scrubbers, the gas is compressed from the slug catcher operating pressure depending on the life of field, is compressed to a pressure of 65 kg/cm² through Gas engine/Turbine driven gas compressors. The compressed gas is dehydrated to water dew point of 0 Deg C at line operating conditions.

As the methane content is more than 95%, HC dew point depression unit is not warranted to maintain HC dew point at 0 Deg C as per PNGRB Guidelines as per the available gas compositions. However if fluid compositions during production require HC dew pointing, facilities are proposed to be installed (on owned / lease basis as per trade off analysis) to meet the quality of supply gas.

The condensate from the knocked out liquid is separated and sent to storage tank. Produced water is diverted to effluent treatment/ handling facilities before final disposal complying applicable pollution control standards.

Telemetric control and monitoring systems for control of subsea wells and WHP are to be located at the onshore facilities apart from the gas processing, Also dedicated composite power cable (OFC +Power) from onshore terminal to CN-B WHP of 44 km is envisaged.

Gas processing facilities will be designed to cater following feed parameters :

- Qgas : 4.60 MMSCMD
- Qliq. : 300 m3/day
- GDU : 4.60 MMSCMD

7. Project cost

Details	KG-OSN 2004/1 (NELP)	GS-49-2 (PEL/ML)
No. of wells	9 (6 +3 subsea wells)	2
Total reserve GIIP (BCM)	15.29	3.94
Recoverable reserves (BCM)	10.36	2.80
Peak production (MMSCMD)	4.55	1.0
CAPEX (M US\$)	507.98 (As per revised FDP)	51.53 (IOGPT Estimate)

Fig 1: KG-OSN2004/1 & GS-49-2 Field Location Map

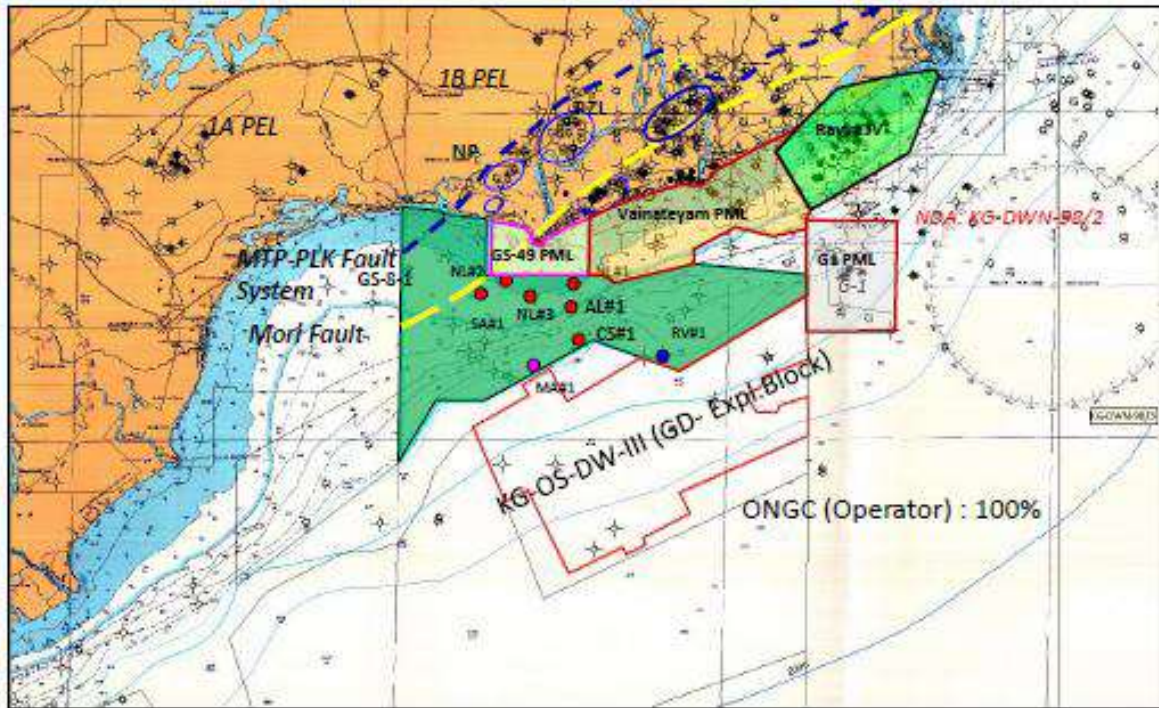


Table 1

BLOCK CO-ORDINATES OF KG-OSN2004/1 FIELD

Block Coordinates For KG-OSN 2004/1		
Point	Longitude	Latitude
A	81° 30' 0.00"	16° 21' 9.00"
B	81° 30' 0.00"	15° 58' 25.96"
C	81° 33' 32.00"	16° 03' 48.47"
D	81° 37' 16.62"	16° 03' 48.47"
E	81° 47' 36.00"	16° 09' 9.00"
F	81° 52' 00.40"	16° 07' 47.01"
G	81° 55' 27.00"	16° 06' 39.00"
H	81° 07' 0.00"	16° 13' 24.00"
I	81° 07' 0.00"	16° 14' 55.33"
J	81° 07' 0.00"	16° 15' 15.00"
K	81° 53' 15.70"	16° 15' 15.00"
L	81° 49' 26.94"	16° 14' 17.07"

M	81°48'46.28"	16°15'1.54"
N	81°48'0.00"	16°15'15.00"
O	81°39'39.00"	16°15'15.00"
P	81°37'50.00"	16°15'15.00"
Q	81°37'50.00"	16°20'16.00"
Point Q to A follows coast line		

BLOCK CO-ORDINATES OF GS-49-2 FIELD

Block Coordinates For GS-49		
Point	Longitude	Latitude
1	81°39'6.35"	16°20'5.23"
2	81°39'5.00"	16°15'14.99"
3	81°48'54.22"	16°15'14.98"
4	81°48'53.73"	16°19'15.66"
5	81°48'0.00"	16°18'58.36"
L	81°39'59.07"	16°17'55.70"

