

OIL & GAS DEVELOPMENT COMPANY LIMITED



TENDER ENQUIRY NO. PROC-SERVICES/CB/RMD-5200/2021

INTEGRATED SEDIMENTOLOGICAL, PETROGRAPHIC, DIAGENETIC AND RESERVOIR CHARACTERIZATION STUDY

Note:

Bid bond of **USD 40,000/- (US Dollar Forty Thousand Only)** must be submitted with the technical bid. Please see tender documents for further detail.

The master set of tender documents (services) uploaded on OGDCL website (www.ogdcl.com) is the integral part of this TOR.

TERMS OF REFERENCE (TOR)

"INTEGRATED SEDIMENTOLOGICAL, PETROGRAPHIC, DIAGENETIC AND RESERVOIR CHARACTERIZATION STUDY OF TAY, TAY NORTH, TAY SOUTH WEST, DARS, DARS WEST, DARS DEEP, KUNNAR SOUTH, KUNNAR EAST, PASAHKI EAST, UNNAR, CHANDIO, SHAH, NIM, NIM WEST, NORAI JAGIR, GOPANG, PAKHRO, JARWAR, SAAND, CHHUTTO, MANGRIO, BHULAN SHAH, KUNNAR , KUNNAR DEEP, KUNNAR WEST, PASAHKI, PASAHKI DEEP, PASAHKI NORTH, PASAHKI NORTH EAST, PASAHKI WEST DEEP, THORA, THORA EAST, THORA NORTH, THORA DEEP, SONO, SONO DEEP, LASHARI, LASHARI CENTER, LASHARI EAST, LASHARI SOUTH, MOOLAN, MOOLAN NORTH, MISSAN , DARU, BUZDAR, BUZDAR NORTH, DHACHRAPUR AND TANDO ALAM FIELDS."

CHAPTER – 1

"INTRODUCTION"

Integrated sedimentology, petrographic, diagenetic and reservoir characterization study of Tay, Tay North, Tay South West, Dars, Dars West, Dars Deep, Kunnar South, Pasahki East, Kunnar East, Unnar, Chandio, Shah, Nim, Nim West, Norai Jagir, Gopang, Pakhro, Jarwar, Saand, Chhutto, Mangrio, Bhulan Shah, Kunnar, Kunnar Deep, Kunnar West, Pasahki, Pasahki Deep, Pasahki North, Pasahki North East, Pasahki West Deep, Thora, Thora East, Thora North, Thora Deep, Sono, Sono Deep, Lashari, Lashari Center, Lashari East, Lashari South, Moolan, Moolan North, Missan, Daru, Buzdar, Buzdar North, Dhachrapur and Tando Alam Fields. is planned to be carried out for the detailed descriptive as well as analytical evaluation and modeling for the reservoir facies distribution throughout the area under study for deep understanding of geological events which will ultimately help in planning of further development scenarios accordingly. Below is the brief introduction of all E.L.s, D & PLs and fields to be evaluated, analyzed and studied.

The study includes a total of 47 Fields (22 operated JV fields and 25 operated 100% OGDCL own fields). Total number of wells which will be the part of this study is 178 including a number of D & A wells in the above mentioned fields or their respective D & PLs.

1. TANDO ALLAH YAR E.L

- 1.1. **Tando Allah Yar** E.L lies in District Tando Allah Yar, Sindh, Pakistan.
- 1.2. 31 Wells have been drilled to date in this E.L. Twelve (12) discoveries, and 16 wells declared as D & A. OGDCL is operating this E.L with Working interest of 77.5% and 22.5% JV partner GHPL.
- 1.3. The name of these Discoveries/fields are Tando Allah Yar, Tando Allah Yar North, Dars, Dars West, Dars Deep, Kunnar South, Pasahki East, Unnar, Chandio, Shah, Sial and Tando Allah Yar South West. All discoveries have been granted separate D & PLs by the regulator except Sial (Under EWT).
- 1.4. The 16 D & A wells in TAY E.L are Mir-01, Abri-01, Khokhar-01, Miranabad-01, Jumman Shah-01, Lado-01, Tando Jam-01, Tando Qaisar-01, Manna-01, Hanif-01, Tando Allah Yar East-01. Sohro-01, Babar-01, Rais-01, Khokhar South-01 and Bukerani-01.
- 1.5. The 14 wells of this E.L. are on production (Dars-01, Dars Deep-01, Dars West-01, Kunnar South-01, Pasahki East-01, Unnar-01, Chandio-01, Shah-01, Tando Allah Yar North-01, Tando Allah Yar-01, Tando Allah Yar-02, Tando Allah Yar-03, Tando Allah Yar-04 and Tando Allah Yar South West-01. The fields/wells are producing under KPD-TAY integrated project at KPD Plant.

The all discoveries are made in structural plays and the structures of all fields were delineated as a result of extensive seismic survey and interpretations carried out by OGDCL in Tando Allah Yar E.L.Block. The most of the structures are fault blocks/

Horst & Grabben /faulted anticlines. Most of the structures are bounded by eastern and western major faults running North-South & dipping east-west way respectively.

2. Fields/D& PLS WITHIN TANDO ALLAH YAR (TAY) E.L

2.1. Tando Allah Yar :

Tando Allah Yar field lies in Tando Allah Yar E.L having separate D & PL (Tando Allah Yar D & PL) with an area of 3.35 Sq.Kms in District Tando Allah Yar, Sindh, Pakistan. This D & PL was initially granted in 2005 was after Gas-condensate discovery by the drilling of an exploratory well Tando Allah Yar-1 in 1997. Tando Allah Yar-1 well discovered commercial quantities of Gas-Condensate in the upper sands of Cretaceous Lower Goru Formation. Tando Allah Yar-2 well was drilled in 1998, followed by wells TAY-03 and TAY-04 in 1999.

2.2. Tando Allah Yar North:

Tando Allah Yar North field lies in Tando Allah Yar North D & PL covering an area of 1.43Km² in District Tando Allah Yar, Sindh, Pakistan. This field was discovered by the drilling of an exploratory well Tando Allah Yar North-01 in 2005. This well discovered commercial quantities of Gas-Condensate in the upper sands of Cretaceous Lower Goru Formation.

2.3. Pasahki East:

Pasahki East Development and Production Lease covers an area of 4.16 km² and lies in Hyderabad district, Sindh Province, Pakistan. The field was discovered by OGDCL in 2008 with the drilling of Pasahki East-01 well. This well discovered commercial quantities of Gas-Condensate in the Massive sand of Cretaceous Lower Goru Formation.

2.4. Kunnar South:

Kunnar South Development and Production Lease covers an area of 6.9 km² and lies in Hyderabad district, Sindh Province, Pakistan. The field was discovered by OGDCL in 2008 with the drilling of Kunnar South-01 well. This well discovered commercial quantities of Gas-Condensate in the Massive sand of Cretaceous Lower Goru Formation.

2.5. Unnar:

Unnar Development and Production Lease covers an area of 1.18 Km². This D & PL lies in Hyderabad district, Sindh Province, Pakistan. The field was discovered with drilling of Unnar-01 well in 2006. This well discovered commercial quantities of Gas-Condensate in the Massive sand of Cretaceous Lower Goru Formation.

2.6. Chandio:

Chandio Development and Production Lease lies in Tando Allah Yar District, Sindh Province, Pakistan and covers an area of 8.11 km². The field was discovered in 2006,

with the drilling of Chandio-01 well. This well discovered commercial quantities of Gas-Condensate in the Massive sand of Cretaceous Lower Goru Formation.

2.7. **Shah:**

Shah Development and Production Lease covers an area of 2.37 km² and lies in Hyderabad District, Sindh Province, Pakistan. The field was discovered in 2010 with drilling Shah-01 well. This well discovered commercial quantities of Gas-Condensate in the Massive sand of Cretaceous Lower Goru Formation.

2.8. **Dars:**

Dars Development and Production Lease covers an area of 6.02 km² and lies in Hyderabad District, Sindh Province, Pakistan . The field was discovered in 2003 by drilling of Dars-01 well. This well discovered commercial quantities of Gas-Condensate in the upper sands of Cretaceous Lower Goru Formation.

2.9. **Dars Deep:**

Dars Deep Development and Production Lease lies in district Tando Allah Yar in Sindh Province, Pakistan covering an area of 6.02 Km². The field was discovered in 2006 with drilling of Dars Deep-01 well. This well discovered commercial quantities of Gas-Condensate in the basal and middle sands of Cretaceous Lower Goru Formation.

2.10. **Dars West:**

Dars West Development and Production Lease covers an area of 5.199 km² and This well discovered commercial quantities of Gas-Condensate in the Massive sand of Cretaceous Lower Goru Formation.. The field was discovered in 2004 with the Dars West-01 well. This well discovered commercial quantities of Gas-Condensate in the upper sands of Cretaceous Lower Goru Formation.

2.11. **Tando Allah Yar South West:**

Tando Allah Yar South West lies in Tando Allah Yar E.L. The field was discovered in 2017 by the drilling and testing of Tando Allah Yar South West-01. This well discovered commercial quantities of Gas-Condensate in the Massive sand of Cretaceous Lower Goru Formation. . The lease covers an area of 1.58 Km², which was granted in 2019.

2.12. **Sial:**

Sial field also lies in same Tando Allah Yar E.L. This field discovered by the drilling of well Sial-1 in 2020 and tested commercial quantity of gas-condensate from Upper sands of Lower Goru Formation. No D & PL has been applied yet as the well is producing on Extended well testing (EWT) arrangements.

3. NIM E.L.

3.1. NIM E.L is operated by Oil and Gas Development Company Limited (OGDCL) in JV Partnership with Government Holdings (Pvt.) Limited (GHPL).The pre commercial working interest of OGDCL and GHPL in the above concessions is 95% and 5% respectively, whereas the post commercial working interest of OGDCL and GHPL is 77.5% and 22.5% respectively. Nim structures are located at about 5 Kms from Tando Alam Complex and 25 km from Hyderabad city in Sindh province, Pakistan.

3.2. Total 24 wells have been drilled in this E.L. Which proved 10 Discoveries in the concession. The name of these Discoveries are Nim, Nim West, Norai Jagir, Gopang, Pakhro, Jarwar, Saand, Chhutto, Mangrio and Bhulan Shah. Most of these discoveries has separate D & PLs carved from Nim E.L.

3.3. A number of other exploratory wells have also been drilled in Nim E.L which were declared as P&A/D &A. These wells include Norai Jagir East-1, Bahadur-1, Began-1, Kathar-1, Rind Baloch-1, Satiari-1, Aulia-1, Bachani-1, Ganjo Takkar-1, Kambir-01 Musa Goth-1 and Katiar-01.

4. Fields/ D& PLs within Nim E.L

4.1. Nim:

Nim Development and Production Lease lies in Hyderabad District, Sindh Province, Pakistan covers an area of 2.14 km². The field was discovered in 2006 by the drilling of Nim-1 well. Nim-1 well discovered commercial quantity of Gas.

4.2. Nim West:

Nim West D & PL was a carved part of Nim E.L. Lease covering an area of 3.25 km² is located lies in Hyderabad District, Sindh Province, Pakistan. The field was discovered by OGDCL in 2006 with the drilling of Nim West-1 Exploratory well.

4.3. Norai jagir:

Norai Jagir Field was discovered by OGDCL in 2002 with the drilling of Norai Jagir-1 as Exploratory well. Norai Jagir D & PL covers an area of 2.43 km². An exploratory well Norai Jagir East-1 was also drilled in 2006 within Norai Jagir D & PL. This well was tested through DST and declared as P & A due to no flow during DST.

4.4. Bhulan Shah:

Bhulan Shah Field falls in Nim E.L. Bhulan Shah is located in District Hyderabad. The field was discovered in 2002. Only one well Bhulan shah-1 was drilled in it.

4.5. Gopang:

Gopang Field was discovered gas in 2010 by the drilling and testing of Gopang-1 (exploratory well). The D & PL area of Gopang is 2.88 km² lies in Hyderabad district,

Sindh province, pakistan

4.6. **Pakhro:**

Pakhro Field is 100% Owned and Operated by OGDCL. The field was discovered in 2008, Pakhro-1 was an exploratory well and tested dry Gas in Basal sand of Lower Goru formation. The well pakhro -1 has also been tested in Massive sand of Lower Goru formation which flows only about 1.0 MMSCFD gas (low pressure) during testing. Pakhro D & PL has an area of 1.41km² lies in Hyderabad district, Sindh province, Pakistan.

4.7. **Jarwar:**

Jarwar oil Field is Part of Nim E.L and located in Tando Allah Yar district. The field was discovered in 2014 by drilling and testing of exploratory well Jarwar-1. Jarwar D & PL covers an area of 1.64 km².

4.8. **Saand:**

Saand Field/D & PL falls in the Nim E.L. The D & PL area covers 1.61 km². The Saand field was discovered by Saand-1 Exploratory well drilled in 2011 and tested commercial quantity of Gas Condensate. An appraisal well Saand-2 was also drilled in 2014.

4.9. **Chhutto – Mangrio:**

Chhutto Field was discovered in 2016 by drilling and testing of upper sand “A” of Lower Goru formation in well Chhutto-01. The well Chhutto-1 well was tested gas-condensate. Another well named **Mangrio-01** (exploratory well) was also drilled in the structurally updip area of Chhutto field which discovered hydrocarbon from Upper sand “B” of Lower Goru formation. which was found wet in Chhutto-01 well. A single D & PL for both fields has been granted by regulator named as Chhutto-Mangrio D & PL covering an area of 11.21 Km² located in districts Tando Muhammad Khan and Hyderabad. Further to Mangrio-1 a development well **Mangrio-02** (Slant) was also drilled to test the updip potential of “A” sand of Lower Goru formation in Chhutto-Mangrio D&PL. The well has been tested a reasonable amount of gas in “A” Sand of Lower Goru formation

5. **KUNNAR, KUNNAR DEEP AND KUNNAR WEST FIELDS
(KUNNAR M.L)**

The above mentioned all three fields (**Kunnar oil field, Kunnar Deep gas condensate field and Kunnar West** gas condensate field) fall in **Kunnar Mining Lease** lies in Hyderabad District of Sindh Province, Pakistan covering an area of 13.21 Sq. Miles. OGDCL is operating this M.L with 100 % working Interest. 26 wells have been drilled in this M.L including 01 water disposal well. Out of these 26 wells, 13 wells in Kunnar oil field, 11 wells in Kunnar Deep field and 02 wells in Kunnar West field. Most of the wells in Kunnar Field is producing Oil through Jet Pumps. The wells of Kunnar Deep and Kunnar West fields are producing Gas Condensate through KPD Plant.

5.1. **Kunnar:**

Kunnar Oil Field was discovered in 1987 by Kunnar-01 exploratory well, which discovered commercial quantities of oil in the upper sands (A & B) of Cretaceous Lower Goru Formation. The reservoir was also found to contain a gas cap, which provides the main reservoir drive. The field has been on production since December 1991 and has a total of 13 wells, 07 of which are still on production, naturally or on jet pumps, 03 wells are shut-in, 01 gas injection well, 01 P &A and 01 water disposal well. The **Kunnar field** is located in a NNW-SSE oriented horst block.

5.2. **Kunnar Deep:**

Kunnar Deep field lies in the same Kunnar Mining Lease. Kunnar Deep Gas Condensate Field was discovered by OGDCL in 2005 by well Kunnar Deep-01 (exploratory well). The well discovered commercial quantities of Gas-Condensate from the Massive sands of Lower Goru formation. Further to Kunnar Deep-01 well 06 appraisal wells (Kunnar Deep-2, 3,4,5,6, and 7) were drilled to delineate/ appraise the field. Four more development wells (Kunnar Deep -8, 9, 10 and 11) has also been drilled and tested successfully till date. The field was put on commercial production in 2012 under KPD-TAY (Kunnar-Pasahki Deep –Tando Allah Yar) integrated project through KPD Plant. Currently 10 wells are producing in Kunnar Deep field. The field is producing gas, condensate and LPG in commercial quantities.

5.3. **Kunnar West:**

Kunnar West Field also lies in the Kunnar Mining Lease, which discovered by drilling of exploratory well Kunnar West -01A and tested as Gas –Condensate producer in 2006. Another well development well Kunnar West-02 (slant) has been Drilled and successfully tested in 2018. Currently, Kunnar West-1 is producing from the KPD plant.

6. **PASAHKI, PASAHKI NORTH, PASAHKI NORTH EAST, PASAHKI DEEP & PASAHKI WEST DEEP (PASAHKI & PASAHKI NORTH D & PL)**

All 05 fields (Pasahki, Pasahki North, Pasahki North East, Pasahki Deep & Pasahki West Deep) fall in Pasahki & Pasahki North D&PL covering an area of 27.95 km² lies in District Hyderabad, Sindh Province, Pakistan. OGDCL is operating the all these D & PLs with 100% working interest. Total 26 wells have been drilled in Pasahki & Pasahki North D & PL. Out of these 26 wells, 13 wells drilled in Pasahki field including 01 water injection well, 02 wells drilled in Pasahki North field, 02 wells drilled in Pasahki North East field, 07 wells drilled in Pasahki Deep field and 02 wells drilled in Pasahki West Deep field.

Upper sands of the **Lower Goru** Formation of Cretaceous age are the main producing reservoirs in Pasahki, Pasahki North and Pasahki North East fields.

The Massive sands of Lower goru formation is the producer of Gas-Condensate in Pasahki Deep and Pasahki West Deep fields.

6.1. Pasahki:

Pasahki oil field was discovered in 1989 by the drilling and testing of exploratory well Pasahki-01. Pasahki-01 was drilled and completed in August 1989, which discovered commercial quantities of oil in the Upper sands of Cretaceous (Lower Goru Formation). The well was brought on regular production in 1989. Total 13 wells have been drilled to date in Pasahki Field including 01 water injection well. 07 wells out of which are on production through Jet Pump.

6.2. Pasahki North:

Pasahki North Oil Field was discovered by drilling and testing of Pasahki North-01 well, which was drilled in 1989 and discovered oil in the Upper sands of Cretaceous (Lower Goru Formation). Another Development well named Pasahki North-03 (Slant) has also been drilled and successfully tested oil in 2018. Pasahki North -03 (slant) well is currently producing hydrocarbon through Jet Pump Completion.

6.3. Pasahki North East:

Pasahki North East-01 was drilled in November 2006 in a structural extension of the main Pasahki structure. It discovered hydrocarbons (Oil) and was put on production in 2006. The Pasahki North East-02 (Slant) was drilled in October 2018 as a development well in the structural extension of the main Pasahki NE structure. It was tested hydrocarbons and was put on production in the same year. Currently both wells of Pasahki North East field are on production using jet pump completion.

6.4. Pasahki Deep:

Pasahki Deep Gas Condensate Field (Pasahki Deep field area of 18.08 km²) lies within Pasahki & Pasahki North D & PL was discovered by OGDCL in 2004, with the drilling and testing of first exploratory well Pasahki Deep-01. The well Pasahki deep-1 was drilled targeted the Massive sands (reservoir) of Lower Goru formation. The Massive sand was successfully tested as Gas – condensate producer. Afterward Pasahki Deep-02 was drilled as an appraisal well in 2008 followed by drilling of 05 Development wells named Pasahki Deep-3, 4, 5, 6 and 7. The field was put on production in January 2012 under KPD-TAY integrated Project through KPD Plant. Currently, 06 wells of Pasahki deep field are on production.

6.5. Pasahki West Deep:

Pasahki West Deep field was discovered by drilling and successful testing of exploratory well Pasahki West Deep-01 targeting the “Massive Sands” of Lower Goru Formation in 2009. The well was tested Gas-Condensate producer. Another development well **Pasahki West Deep-02** (Slant) was drilled in 2019 in a structural extension of the main Pasahki west deep structure. The testing of the well-produced hydrocarbons (Gas-condensate) from Massive sands of Lower Goru formation. This well is currently on production through KPD Plant.

7. Thora & Thora East Mining Lease

The **Thora oil field, Thora East oil field, Thora North & Thora Deep Gas-Condensate field** are the part of Thora & Thora East Mining Lease in Hyderabad District, Sindh Province, Pakistan. OGDCL has 100 % working Interest. Thora & Thora East mining Lease covers an area of 5.87 Sq. Miles. Total 13 wells have been drilled in Thora & Thora East Mining Lease. Out of these 13 wells, 08 wells drilled in Thora field, 01 well drilled in Thora East field, 01 well drilled in Thora North field and 03 wells drilled in Thora Deep field.

7.1. Thora:

Thora Oil Field was discovered in 1987 by Thora-01 exploratory well, which discovered commercial quantities of oil in the upper sands of Cretaceous Lower Goru Formation. The field has been on production since December 1987 and has a total of 9 wells including 01 water disposal well, 1 of which are still on production on jet pump. 04 wells are shut-in and waiting for jet pump units to revive the production from them. Other 03 wells are P & A.

7.2. Thora East:

Thora East Oil Field was discovered in 1988 by Thora East-01 exploratory well, which discovered commercial quantities of oil in the upper sands of Cretaceous Lower Goru Formation. This well is now P & A.

7.3. Thora North:

Thora North-1 well was drilled in Thora & Thora East Mining Lease as an Exploratory well and abundant due to water bearing reservoir.

7.4. Thora Deep:

Thora Deep Gas Condensate Field was discovered by OGDCL in 2006, with the Thora Deep-01 well. This well has been tested Massive sand of Lower Goru formation and flow commercial quantity of Hydrocarbons (Gas-condensate). Afterward, Thora Deep-02 was drilled as an appraisal well in 2008 and tested successfully for hydrocarbons. The field was put on production in January 2017 under KPD Project through Kunnar-Pasahki Deep (KPD) Plant. Currently, only one well (Thora Deep-02) is producing. Thora deep-1 well is currently shut in due to water load up. Another, Development well **Thora Deep-03** (Slant) have been successfully drilled and tested in year 2019 for gas-condensate but not on production yet.

8. Sono, Sono Deep & Sono South (Sono D & PL)

The **Sono & Sono Deep** fields are the part of Sono D&PL in the Hyderabad District, Sindh Province, Pakistan. Sono D & PL covers an area of 25.08 km². OGDCL has 100 % working Interest. Total 10 wells have been drilled in sono D & PL. out of these 10 wells, 08 wells in Sono, 01 well in Sono Deep and 01 well in Sono South.

8.1. Sono:

Sono Oil Field was discovered in 1988 by drilling Sono-01 exploratory well, which discovered commercial quantities of oil in the upper sands of Cretaceous Lower Goru Formation. The field has a total of 8 wells. Currently 3 wells are producing, 4 wells are P&A and 1 well is shut-in.

8.2. Sono Deep:

Sono Deep Gas Condensate Field was discovered in 2007 by drilling of Sono Deep-01 exploratory well which discovered commercial quantities of Gas Condensate from Massive sand of Lower Goru Formation. This well is now P & A.

8.3. Sono South:

Another exploratory well **Sono South-1** in southern structural region of Sono D & PL has also been drilled to target the upper sands of lower Goru formation, which was declared as D & A due to water wet reservoir.

9. Lashari Center and South D & PL

Lashari, Lashari Center, Lashari East & Lashari South Fields fall in Lashari Center & South D&PL in the Hyderabad District, Sindh Province, Pakistan. OGDCL has 100% working interest. Lashari Center and South D & PL covers an area of 23.15 km². Total 12 wells have been drilled in Lashari Center and South D & PL. out of these 12 wells, 01 well in Lashari, 06 wells in Lashari Center, 02 well in Lashari South, 01 well in Lashari East, 01 well in Lashari Deep & 01 well in Lashari South West.

9.1. Lashari:

First exploratory well "**Lashari-1**", which was drilled in 1986 targeting the upper sands of lower Goru Formation. Unfortunately, the well was declared D & A after RFT.

9.2. Lashari Center:

Lashari Center Oil Field was discovered in 1988 by drilling of an exploratory well Lashari Center-01 in April 1988 which discovered commercial quantity of Oil and Gas from Upper Sands of Lower Goru formation of Cretaceous age. Total 06 wells have been drilled in this field. 01 well is currently producing in Lashari center field.

9.3. Lashari East:

Lashari East Oil/Gas Field was discovered in 1990 by drilling of an exploratory well Lashari East-01 (Side track) which was completed in April 1990 and discovered commercial quantities of Oil and Gas from Upper Sands of Lower Goru formation of Cretaceous age. Now the well was P & A.

9.4. Lashari South:

Lashari South Oil/Gas Field was discovered in 1987 by drilling of an exploratory well Lashari South-01 which was completed in April 1987 and discovered commercial quantities of Oil and Gas from Upper Sands of Lower Goru formation of Cretaceous age. Now the well was P & A. Recently one more well named Lashari X-1 was drilled and tested successfully.

9.5. Lashari Deep:

Well **Lashari Deep-1** has also been drilled in Lashari Center and South D & PL area. This well was declared as D&A.

9.6. Lashari South West:

Well **Lashari South West-1** has also been drilled in Lashari Center and South D & PL area. This well was declared as D & A.

10. Moolan & Moolan North

Moolan & Moolan North Fields are the part of Lashari Center & South D&PL in Hyderabad District, Sindh Province, Pakistan. OGDCL has 100 % working interest. The discovery areas of Moolan and Moolan North Fields are 0.53 km² and 1.48 km² respectively.

10.1. Moolan:

Moolan Gas Condensate field was discovered in 2007 by the drilling of exploratory well Moolan-01 which was completed in November 2007 and discovered commercial quantities of Gas Condensate in the Upper sands of Cretaceous (Lower Goru Formation). The well is producing through KPD plant. Another development well Moolan-02 (Slant) was drilled in Moolan in March, 2021. The well is temporarily suspended as target sands of “A” and “B” sands were missed during drilling. Currently the well is suspended. The post well evaluation of seismic data for any updip/side track option is under evaluation.

10.2. Moolan North:

Moolan North Oil field was discovered in 2008 by drilling of an exploratory well Moolan North-01 which was completed in April 2008 and discovered commercial quantities of oil in the Upper sands of Cretaceous (Lower Goru Formation). The well is on production through TOC (Tando Alam Oil complex).

11. Missan Field

Missan Oil Field lies in Missan D&PL lies in Hyderabad District of Sindh province, Pakistan. OGDCL has 100% working interest. **Missan Oil field** was discovered in 1998 by drilling of an exploratory well Missan-01 which was completed in October 1998 and discovered commercial quantities of oil from Upper Sands of

Lower Goru formation of Cretaceous age.

12. **Daru Gas Condensate Field**

Daru, Daru Deep and Urs fields fall in Daru D&PL in the Hyderabad District of Sindh province, Pakistan. OGDCL has 100% working interest.

12.1. **Daru:**

Daru Gas Condensate field was discovered in 1989 by drilling of an exploratory well Daru-01 which was tested and completed in January 1989 and discovered commercial quantities of Gas condensate from Upper Sands of Lower Goru formation of Cretaceous age. 02 more wells Daru-2 & Daru-3 well then drilled as development wells in this area and tested successfully. Currently only one well (Daru-1) is producing hydrocarbon.

12.2. **Daru Deep:**

One deep well **Daru Deep-1** was drilled in Daru D & PL in 2016 to target the deeper reservoirs i.e. Basal and Massive sands of Lower Goru formation. The well was tested and found tight reservoir. Currently, the well was suspended for tight gas evaluation and feasibility of frac. Job in it.

12.3. **Urs:**

One deep well **Urs-1** was drilled in Daru D & PL in 2018 to target the deeper reservoirs i.e. Basal and Massive sands of Lower Goru formation. The well was tested and found tight reservoir. Currently, the well was suspended for tight gas evaluation and feasibility of frac. Job in it.

13. **Buzdar & Buzdar North**

Buzdar & Buzdar North fields fall in Buzdar D&PL in Tando Allah Yar District of Sindh province, Pakistan. OGDCL has 100% working interest.

13.1. **Buzdar:**

Buzdar Gas Condensate field was discovered in 1991 by drilling of an exploratory well Buzdar-01 which was completed in April 1991 and discovered commercial quantities of Gas condensate from Upper Sands of Lower Goru formation of Cretaceous age.

13.2. **Buzdar North:**

13.3. **Buzdar North Oil Field** was discovered in 1993 by drilling of an exploratory well Buzdar North-01 which was completed in March 1993 and discovered commercial quantities of Oil from Upper sands of Lower Goru formation of cretaceous age. Another well **Buzdar North-02** was drilled in the area in 2015 which is D & A without producing any hydrocarbon due to missing of reservoir section.

14. Tando Alam Field

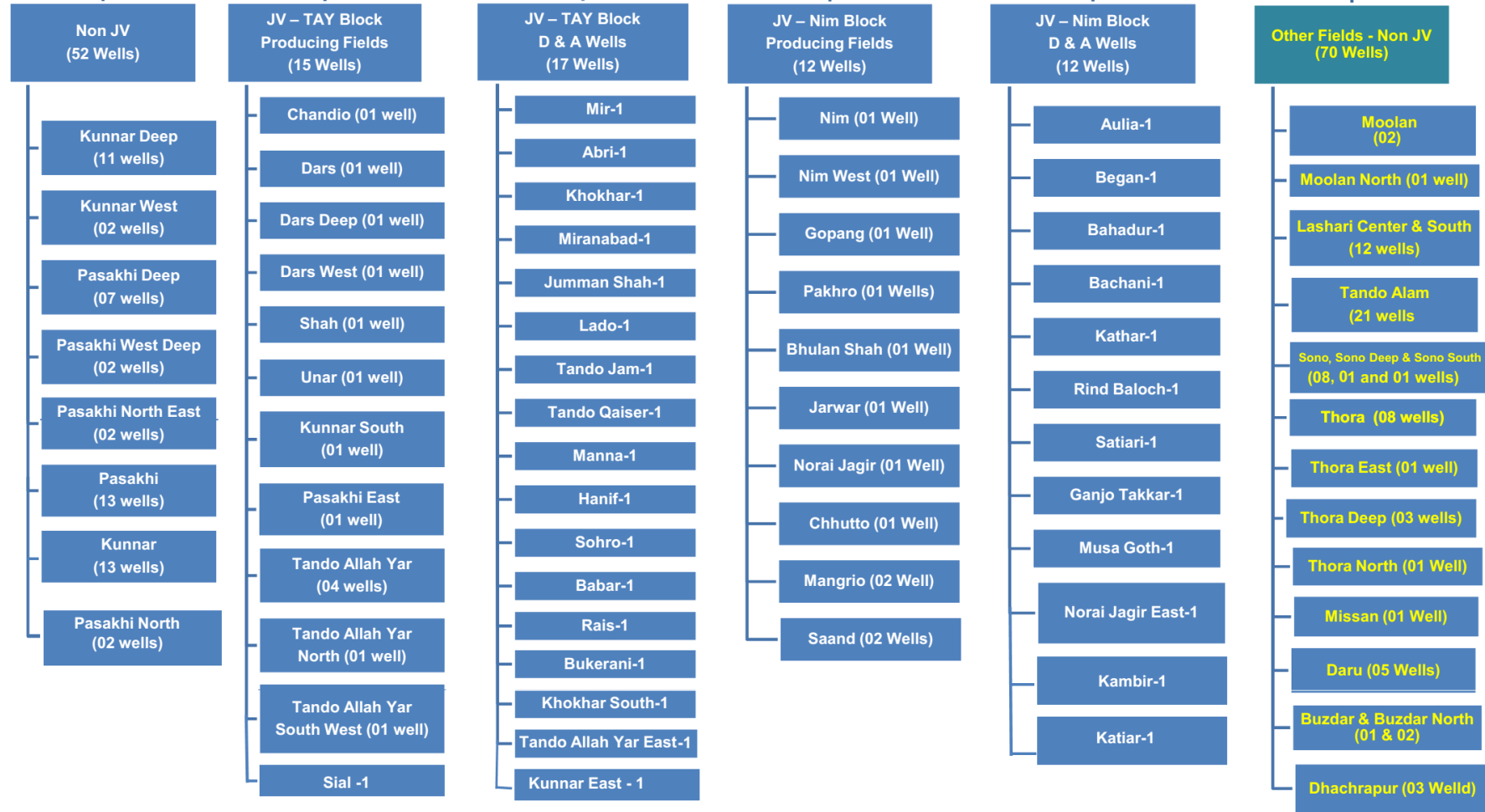
- 14.1. Tando Alam Oil Field** lies in Tando Alam Mining Lease in the Hyderabad District of Sindh province, Pakistan. OGDCL has 100% working interest.
- 14.2. Tando Alam Oil field** was discovered in 1984 by drilling of an exploratory well Tando Alam-01 which was completed in May 1984 and discovered commercial quantities of Oil from Upper Sands of Lower Goru formation of Cretaceous age.
- 14.3.** Total of 21 wells have been drilled in this Mining Lease including one well targeting deeper sands (Basal & Massive Sands) of Lower Goru formation. This well **Tando Alam Deep-01** was not proved to be a success and declared as P & A.

15. Dhachrapur

- 15.1.** Dhachrapur gas Field lies in Tando Alam ML, Hyderabad District of Sindh province in southern Pakistan. OGDCL has 100% working interest.
- 15.2.** Dhachrapur Gas field was discovered in 2007 by drilling of an exploratory well Dhachrapur-01 which was completed in Massive sands of Lower Goru formation in May 2007.

Afterward 02 more Development wells (Dhachrapur 2 & 3) were drilled in this Dachrapur field targeting deeper sands (Basal & Massive Sands) of Lower Goru formation.

Integrated Sedimentological study for KPD,TAY,Nim,Tando Alam and other Surrounding Fields



CHAPTER - 2

"OBJECTIVE OF STUDY AND SCOPE OF WORK"

OBJECTIVES OF THE STUDY

Key uncertainties to be addressed through the subject study are the erratic distribution of sands in different parasequences sets and diagenetic controls of porosity-permeability within these to be able to predict the presence of reservoir in space and its transition into non reservoir. The study should identify all the controls over reservoir diagenesis and delineate good quality sand controls (predictive reservoir depositional models) within the study area which can targeted in future wells.

1. KEY OBJECTIVES

- 1.1.** Detailed core description (identification of bedding, lithology, sedimentary structures, trace fossils, other macro features etc.) along with data that can be used to understand depositional environments, reservoir geometry, and reservoir quality and to be used to calibrate wireline logs
- 1.2.** To determine the nature of lithofacies utilizing cores cut, well cuttings, other available data and reports.
- 1.3.** The detailed interpretation of facies of cored intervals, their distribution/extension in non-cored area of the fields and detailed evaluation for depositional environments.
- 1.4.** To investigate the sequence of diagenesis to which sediments have been subjected for the development of diagenetic facies distribution.
- 1.5.** To determine the relative influence of lithofacies and diagenesis on the distribution of reservoir quality (porosity, permeability, thickness, grain size etc.)
- 1.6.** To prepare the maps (thickness, porosity distribution, permeability distribution, lithological variation in different layers separately , etc.).
- 1.7.** Facies distribution/extension on each layer/horizon identified on the basis of log response, core and drill cuttings.
- 1.8.** Characterization of cored intervals and their extension.
- 1.9.** Characterization of un-cored intervals based on other data sets available like Logs, master logs, cuttings etc. in correlation/integration with core data.
- 1.10.** The 3D seismic data interpretation, Structural mapping, attribute analysis, Seismic Transact preparation for seismic facies analysis using sedimentological facies framework/model.
- 1.11.** The above points may be summarized as, the objective of the study is to provide input into exploration and development activities focusing on reservoir property evaluation and architecture through application of results inferred from sedimentological core description, core testing & analysis, Petrophysical

evaluation, petrography, advanced petrographic analyses, cutting/sample testing, facies analysis, facies distribution, sequence stratigraphic, sequence stratigraphic analyses and integration of all sedimentological and seismic outputs/data sets into an integrated conceptual model.

- 1.12. The bidding companies must have considerable experience in performing sedimentological evaluations/interpretations and studies using cores and cuttings descriptions/analysis in integration with mentioned data sets especially in clastics and preferably having experience in Pakistan.

2. **DATA SET TO BE USED FOR STUDY (but not limited to):**

- 2.1. Cores.
- 2.2. 3-D Seismic Data (Cube of 1145Sq.km)
- 2.3. Petrographic analysis, evaluation and interpretation using cores and cuttings.,
- 2.4. SCAL and RCAL including core gamma, core porosity- permeability analysis and core to log depth correlation. (consultant to carry out where already not available)
- 2.5. Well Cuttings/Drill Chips.
- 2.6. Mud logs, Composite Logs, Gas Data.
- 2.7. Hotshot core analysis reports including Core Gamma.
- 2.8. End of well / completion report.
- 2.9. Depth Structure Map.
- 2.10. LAS files of wireline logs along with borehole image logs (where available).
- 2.11. Literature and Publications of the study area (as per availability).
- 2.12. Consultant to carry out any test and analysis as required (with the consent of client representative looking into the area of study) using cores & cuttings required for better understanding/approach to infer sedimentological facies, their distribution and property modeling.

3. **SCOPE OF WORK**

The scope of this study/Work is as follows:

- 3.1. The consultant will prepare a detailed analytical description of available cores and identify/characterize the litho facies in the cored intervals & their particular extension using logs, image logs, cuttings etc. in un-cored area/interval/wells.
- 3.2. Consultant will also evaluate depositional environment of sedimentary layers under study, their sedimentary structures, their grain distribution, their diagenetic sequence and imprints

using thin section conventional petrography, SEM and XRD techniques for selected samples taken from cores & cuttings.

- 3.3. Consultant to provide/prepared correlations spanning the maximum area of study to fully understand the distribution of each lithofacies and its reservoir characteristics.
- 3.4. Consultant to prepare the maps for lithofacies, porosity distribution, thickness distribution, permeability distribution, reservoir quality distribution along with a map showing depositional trend for all identified reservoir layers on agreed scales after consultation with client representative.
- 3.5. Consultant to prepare sequence stratigraphic framework model for each reservoir layer.
- 3.6. 3D seismic data available for the area is around 1145 Sq. Km. So, OGDCL proposes additional scope of work to extend Sequence Stratigraphic surfaces on regional transacts through 3D seismic data volume over study areas based upon regional sequence stratigraphic model/ frame work (mutually agreed with contractor and OGDCL) with the following **key objectives**:
 - 3.6.1. Seismic structural interpretation of 04 horizons namely Top Lower Goru, Top Basal Sand, Top Massive Sands and Chiltan Limestone will be provided to the contractor. Refinement of interpretation (Horizons and Faults) and infill interpretation will be carried out by contractors. Interpretation of Middle Sand, Intra Massive Sand Layer (within Massive Sand), Lower Massive sand and Sembar will be carried out by contractor.
 - 3.6.2. Time to Depth conversion of 08 horizons/ levels, namely Top Lower Goru, Top Middle sand, Top Basal Sand, Top Massive Sands, Intra Massive Sand Layer (within Massive Sand), Lower Massive sand, Sembar & Chiltan Limestone. Available VSP/checkshot data will be provided.
 - 3.6.3. To carry out seismic attribute analysis as appropriate to investigate and illuminate seismic character of significant depositional packages. Integration of seismic sequence stratigraphic model with seismic attribute interpretation results for identification of the potential stratigraphic deeper prospects; exploration potential and petroleum fairways in Lower Goru and Sembar Sands.
 - 3.6.4. To identify depositional sequences and systems tracts on optimum number of regional transacts passing through wells in order to map Seismic facies within the Sequence Stratigraphic Framework resulting from Sedimentological analysis to interpret stratigraphic relationships, depositional environments and their temporal & lateral distribution. The optimum number of transacts would be mutually decided between company and contractor.
 - 3.6.5. Generation of Time/Depth maps, Iso-chore and Iso-pach maps, facies maps, risk segment maps and all related others.
 - 3.6.6. Contractor will provide seismic project back up restorable on petrel/DSG workstation.
- 3.7. Contractor will suggest further working required to de-risk identified potential in an optimized and economical way.
- 3.8. Detailed Facies analysis and sequence framework modeling for all prospective lithological layers of lower Goru formation including Sembar and Chiltan formation.
- 3.9. Integration of sedimentological models and Seismic models for each reservoir (Lower

Goru Upper sands, Middle sand, Basal sand, Massive sands (sub layers of Massive sands as agreed by the client) and detailed evaluation for the resultant products for the whole area under study.

4. MATERIAL / DATA AVAILABLE:

4.1. SEISMIC DATA:

3-D Seismic Data covering an area of about 1145 Sq Km for the whole area lies under Tando Allah Yar E.L, NIM E.L and all other fields/area under study.

4.2. FEILD WISE DATA:

4.2.1. TANDO ALAH YAR:

- Well cuttings/Drill chips of all reservoir layers/formations in all above mentioned wells of all fields lie in Tando Allah Yar E.L.
- End of Well Reports & Composite logs for all Wells.
- Conventional suit of wireline logs in all Wells
- Image logs in 06 wells (Tando Allah Yar-1, Pasahki East-1, Tando Allah Yar North-1, Jumman Shah-1, Hanif-1 and Manna-1).
- 08 conventional cores in 08 wells from Upper sand intervals of Lower Goru Formation. (01 in Dars West-1, 01 in Tando Allah Yar-1, 01 in Tando Allahyar-2, 01 in Tando Allahyar-3, 01 in Tando Allahyar-4, 01 core from Tando Allahyar North-1, 01 core in Khokhar-1 and 01 core in Abri-1) *Total approximate Length of core for Upper sand interval of lower Goru formation is 70 meters.*
- 10 Conventional cores available in 07 wells from the interval of Middle, Basal and Massive sands of Lower Goru Formation. (01 in Dars Deep-1, 02 in Shah -1, 01 in Unnar-1, 02 in Manna-1, 01 in Hanif-1, 01 in Tando Allahyar SW-1 and 01 in Abri.1). *Total approximate Length of core is 56 meters.*
- 07 conventional Cores are available in Shale Packages of lower Goru formation i.e. Upper Shale, Lower Shale & Talhar Shale and Sembar formation. (01 core in Lower Shale of Lower Goru formation in Dars Deep-1, 02 cores in Manna-1 in Upper Shale (01) and Talhar Shale (01) and 02 cores in Well Hanif-1 (Talhar Shale of Lower Goru Formation). and 01 core in well Hanif-1 from Sembar formation. *Total approximate Length of core is 57 meters.*
- Conventional Core analysis (RCAL) in 06 wells (Unar-1, TAY-1, Tando AllahYar North-1, Dars Deep-1, Dars West-1, & Shah-1).
- Poro-Perm Analysis Report using Core for Unar 1 using core measurement system 300.
- Sedimentological Study Report (Based on Ditch Cuttings) for Tando Jam-1(using 637 samples), Unar-1(using 400 samples) & Shah-1 (using 438 Samples)
- Sedimentological Study Report (Based on post Eocene Ditch Cuttings) for Pasahki East-1 (using 419 Washed samples).
- Porosity & permeability report by using Core-1 (1485m -1494m) in Well Tando Allah Yar North-1 (Upper sand of Lower Goru Fm) using Core Mangement System (CMS-300).

- Porosity & permeability analysis by using Core (2924m – 2933m) in Well Unnar-1 (Massive sand of Lower Goru Fm) using Core Management System (CMS-300) at confined pressure @ 1500 Psi & 2000 Psi.
- Nanofossils Biostratigraphic report (using ditch cutting samples) for Tando Jam-1 (296 samples) & Shah- 1(298 samples).
- Geochemical Investigation of flush cuttings and core-1 (2552-2561m) sample for Abri 1.
- Dars-1 Geo-Chemical investigation using Flush Cuttings.
- Dars Deep-1 Geo-Chemical investigation.
- Preliminary Volumetric Reserves Estimates report of Tando Allahyar Oil Field.
- No SCAL is available.

4.2.2. NIM:

- Well cuttings/Drill chips of all reservoir layers/formations in all above mentioned well in Nim E.L.
- End of Well Reports & Composite logs of all wells.
- Conventional suit of wireline logs in all wells
- Image logs in 02 wells (Saand-2 and Aulia-1).
- 06 cores are available in 06 wells of from upper sands interval of Lower Goru formation (01 core from Rind Baloch-1, 01 core from Norai Jagir-1, 01 core from Gopang-1, 01 core from Bachani-1, 01 core from Saand-1 and 01 core in Saand-2). *Total approximate Length of core is 38 meters.*
- 01 Cores is available for Massive sand horizons of Lower Goru formation in well Chhutto-1. *Total approximate Length of core is 07 meters.*
- 05 cores from Talhar Shale of Lower Goru formation (02 cores in well Chhutto-1, 02 cores in Saand -1 well and 01 core in Saand -2 well). *Total approximate Length of core is 40 meters.*
- Conventional Core Analysis of well Gopang-1 core (2300-2309m) for upper sands of lower Goru formation.
- Conventional Core Analysis of well Rind Baloch-1 core for upper sands of lower Goru formation.
- Conventional Core Analysis of well Saand-1 core-1 for upper sands of lower Goru formation.
- Conventional Core Analysis of well Bachani-1 for upper sands of lower Goru formation.
- Poro-Perm Report using Core for Rind Baloch-1 using core measurement system-300.
- Sedimentological Study Report (Based on Ditch Cuttings) for Pakhro 1(using 300 samples).
- Sedimentological Study Report (Based on Ditch Cuttings) for Norai Jagir East-1 (using 336 samples).
- Sedimentological Study Report (Based on Ditch Cuttings) for Gopang-1 (using 508 samples).
- Geochemical investigation on flush cuttings samples for Bahadur-1.
- Geochemical investigation on flush cuttings samples for Nim west-1.
- Geochemical investigation on flush cuttings samples for Nim-1.

- Laboratory report on hydrocarbon source potential of rocks encountered in Bahadur -1 well.
- PSP with Ghost, Final Interpretation Report for Nim west-1.
- No SCAL is available.

4.2.3. KUNNAR / KUNNAR DEEP / KUNNAR WEST:

- Well cuttings/ditch cuttings of all reservoir layers/ formations in all wells of Kunnar, Kunnar Deep, Kunnar West fields.
- End of Well Reports & Composite logs for all Wells.
- Conventional suit of wireline logs in all Wells
- Image logs in only one well (Kunnar Deep-9) of Kunnar Deep field.
- 15 conventional cores in 06 well of Kunnar field (03 cores in Kunnar-1, 01 core in Kunnar-2, 03 cores in Kunnar-2, 02 cores in Kunnar-4, 02 cores in Kunnar-5) and 02 cores in well Kunnar East-1 (Upper sands of Lower Goru formation). *Total approximate Length of core is 125 meters.*
- 11 Conventional cores available for Massive Sand of Lower Goru formation in 04 wells of Kunnar Deep field (01 core in Kunnar Deep-5, 02 cores in Kunnar Deep-6, 02 cores in Kunnar Deep-7, 01 core in Kunnar Deep-9) and 05 cores from well Kunnar west-2 (Kunnar West Field). *Total approximate Length of core is 92 meters.*
- 04 Cores are available for Sembar formation in 02 wells of Kunnar Deep field (01 core in Kunnar Deep-10 and 03 cores in Kunnar Deep-9) *Total approximate Length of core is 36 meters.*
- Conventional Core analysis for well Kunnar-1 (Upper Sand).
- Conventional Core analysis for well Kunnar-2 (Upper Sand).
- Conventional Core analysis for well Kunnar-4 (Upper sand).
- Conventional Core analysis for well Kunnar-5 (Upper Sand).
- Conventional Core Analysis for well Kunnar Deep- 2 (Massive Sand).
- Conventional Core Analysis for well Kunnar East-1 (Upper sand).
- Gas Analysis Report for well Kunnar-2.
- Pro-Perm Report using Core for One of the Kunnar Deep Field
- Sedimentological Study Report (Based on Ditch Cuttings Approx. 500 Samples) for Kunnar West Well-1
- Nanofossils bio-stratigraphic report (more than 300 samples of ditch cuttings) for Kunnar South-1.
- No SCAL is available.

4.2.4. PASAHKI / PASAHKI DEEP / PASAHKI WEST DEEP:

- Well cuttings/ditch cuttings of all reservoir layers/formations in all above mentioned Pasahki & Pasahki Deep wells.
- End of Well Reports & Composite logs of all wells.
- Conventional suit of wireline logs in all wells
- Image logs in 1 well (Pasahki-6) of Pasahki field, 02 wells (Pasahki Deep-3 & 6) of Pasahki

deep field and 01 deep well (Pasahki East-1) in Pasahki East field.

- SHDT logs and processing reports for two of Pasahki Shallow wells (Pasahki-6 & 9) and one of the Pasahki deep well (Pasahki Deep-4).
- Reservoir Fluid study for of the Pasahki shallow well (Pasahki-1).
- 07 cores are available in 05 wells of Pasahki field (01 core in Pasahki-1, 01 core in Pasahki-2, 02 cores in Pasahki-3, 01 core in Pasahki North-1 and 02 cores in Pasahki WIW-1 – WIW stands for Water Injection Well). *Total approximate Length of core is 60 meters.*
- Total 09 Conventional Cores for Massive sand and 01 core for Basal sand of Lower Goru formation are available in 02 well of Pasahki Deep & 02 wells of Pasahki West Deep fields (01 core in Pasahki Deep-1, 05 cores in Pasahki Deep-7, 02 cores in Pasahki West Deep-1 "01 for Massive & 01 for Basal sand" and 02 cores in Pasahki West deep-2). *Total approximate Length of core is 75 meters.*
- RCAL of using one core for well Pasahki Deep-1.
- RCAL of two cores in Pasahki West Deep well-1
- RCAL of core-1 in Pasahki well-3.
- RCAL of core-1 in Pasahki well-1.
- Report on Porosity & permeability evaluation using core in Pasahki West Deep well-1(CSM-300).
- Initial Sedimentological study report for Well Pasahki East -1using 419 washed samples (Cuttings).
- Biomarker (Oil to Source rock correlation report) of the Pasahki Deep well-1.
- Geochemical investigation on fluid cuttings and core for one well of the Pasahki West Deep-1.
- No SCAL is available.

4.2.5. THORA /THORA DEEP / THORA EAST:

- Well cuttings/ditch cuttings of all reservoir layers/formations in all above mentioned Thora, Thora East, Thora North and Thora Deep wells.
- End of Well Reports & Composite logs of all wells.
- Conventional suit of wireline logs in all wells
- SHDT logs and processing reports for one of Thora Shallow wells (Thora-5).
- 12 cores are available in 04 wells of Thora field from Upper sands of Lower Goru formation (07 Cores in Thora-1, 03 cores in Thora-2, 01 core in Thora East-1 and 01 core in Thora North-1). *Total approximate Length of core is 100 meters.*
- 02 Cores are available in 02 wells of Thora Deep field from Massive sands of Lower Goru formation (01 core in Thora Deep-2 and 1 core in Thora Deep-1). *Total approximate Length of core is 16 meters.*
- Sedimentological study of Thora Deep well-1.
- Conventional core analysis of one core in Thora Deep well-1
- Conventional core analysis of one core in Thora Deep well-2
- Thora Deep-1 Geo-Chemical investigation.
- SCAL of well Thora-1 using Core-1.

4.2.6. SONO & SONO DEEP:

- Well cuttings/ditch cuttings of all reservoir layers'/formations wells.
- End of Well Reports & Composite logs of all wells.
- Conventional suit of wireline logs in all wells
- 05 cores are available in 02 wells of Sono from Upper sands of Lower Goru formation (04 cores in well Sono-1 and 01 Core in Well Sono-2). *Total approximate Length of core is 40 meters.*

4.2.7. MOOLAN & MOOLAN NORTH:

- Well cuttings/ditch cuttings of all reservoir layers/formations in all wells.
- End of Well Reports & Composite logs of all wells.
- Conventional suit of wireline logs in all wells
- No core is available.

4.2.8. LASHARI CENTER & LASHARI SOUTH:

- Well cuttings/ditch cuttings of all reservoir layers/formations in all wells.
- End of Well Reports & Composite logs of all wells.
- Conventional suit of wireline logs in all wells
- SHDT logs and processing reports for one of Lashari center Shallow wells (Lashari center-02).
- 08 cores are available in 04 wells of Lashari/ Lashari center /Lashari south/Lashari East from Upper sands of Lower Goru formation (01 core in well Lashari-1,01 core in Lashari Center-1, 02 cores in Lashari East-1and 04 cores in Lashari South-1) . *Total approximate Length of core is 67 meters.*
- Sedimentological study of Lashari South West well-01 using ditch cuttings.
- Sedimentological study of Lashari Deep well-01 using ditch cuttings.
- Well Lashari Centre 2, stratigraphic high resolution dipmeter, msd computations.
- No SCAL is available

4.2.9. MISSAN:

- Well cuttings/ditch cuttings of all reservoir layers/formations in all above Missan-1 well.
- End of Well Reports & Composite logs of of Missan-1 Well.
- Conventional suit of wireline logs in Missan-1 well
- 01 core is available in well Missan-01 from Upper sand of Lower Goru formation. *Total approximate Length of core is 5 meters.*
- No SCAL is available

4.2.10. DARU / DARU DEEP / URS:

- Well cuttings/ditch cuttings of all reservoir layers/formations in all above mentioned Daru, Daru Deep and Urs wells.

- End of Well Reports & Composite logs of all wells.
- Conventional suit of wireline logs in all wells
- 05 cores are available in 03 well of Daru from Upper sands of Lower Goru formation (02 cores in Daru-1 well, 02 cores in Daru-2 well and 01 core in Daru-3 well). *Total approximate Length of core is 40 meters.*
- 02 cores are available in well Urs -01 for Massive sand &. 01 core for Basal in Urs-1 well. *Total approximate Length of core is 27 meters.*
- 02 other core are available, 01 in well Daru Deep-01 from Lower Shale of Lower Goru formation and 01 in Urs -01 well for Talhar shale. *Total approximate Length of core is 18 meters.*
- No SCAL is available

4.2.11. BUZDAR & BUZDAR NORTH:

- Well cuttings/ditch cuttings of all reservoir layers/formations in all wells.
- End of Well Reports & Composite logs of all wells.
- Conventional suit of wireline logs in all wells
- 01 cores are available in well of Buzdar-01 from Upper sands of Lower Goru formation. *Total approximate Length of core is 05 meters.*
- No SCAL is available

4.2.12. TANDO ALAM:

- Well cuttings/ditch cuttings of all reservoir layers/formations in all wells.
- End of Well Reports & Composite logs of all wells.
- Conventional suit of wireline logs in all wells
- 28 cores are available in 11 wells of Tando Alam from Upper sands of Lower Goru formation (04 cores in well Tando Alam-1, 04 cores in well Tando Alam-2, 03 cores in well Tando Alam-3, 05 cores in well Tando Alam-4, 02 cores in well Tando Alam-5, 02 cores in well Tando Alam-8, 02 cores in well Tando Alam-10, 03 cores in well Tando Alam-11, 01 core in well Tando Alam-12, 01 core in well Tando Alam-13 and 01 core in well Tando Alam-14).. *Total approximate Length of core is 224 meters.*
- 01 core is available in for Massive sand of Lower Goru formation in well Tando Alam Deep-1. *Total approximate Length of core is 9 meters.*
- No SCAL is available

4.2.13. DHACHRAPUR:

- Well cuttings/ditch cuttings of all reservoir layers/formations in all wells.
- End of Well Reports & Composite logs of all wells.
- Conventional suit of wireline logs in all wells
- 08 cores are available in well Dhachrapur-2, 01 core from Lower shale (Lower Goru fm), 01 core from Talhar shale (lower Goru fm) and 06 cores from Sembar Formation. *Total approximate Length of core is 63 meters.*

4.3. ADDITIONAL RELATED INFORMATION:

- 4.3.1. The above mentioned Data along with all in-house analysis/reports for cores, cuttings, fluids, RCAL, Sedimentology, Biostartigraphy (as per availability) will be provided to the consultant and the part of data set/material used for study. If, any new data will be acquired during the study (relevant to running phase of the study) will also be the part of the study data set.
- 4.3.2. Consultant will be required to send their professional team members for the study to G & R Lab of OGDCL, Islamabad for core examination, and consultation/discussion with G & R Lab professional regarding the core quality, cuttings quality, number and location of core plugs/whole core etc.
- 4.3.3. On completion of study, consultant will provide the client with six (06) hard copies of the final report including executive summary, all maps, figures etc. in colored printed form along with 06 digital copies of the same within 02 weeks after final presentation.
- 4.3.4. Consultant will also bound to provide all raw data of core analysis, Petrography, SEM, CL, XRD etc., along with their detailed reports in digital format.
- 4.3.5. Consultant will also bound to provide all maps as per TOR and Models of sedimentology & seismic as well as integrated conceptual/analyzed models for each reservoir & prospective layer under study in digital format which can be opened, editable and updatable using software in use by OGDCL or software recommended by OGDCL.
- 4.3.6. Consultant will also bound to provide all integrated sedimentology & seismic Models (on each prospective/reservoir layer under study) in digital format which can be opened, editable and updatable using software in use by OGDCL or software recommended by OGDCL.
- 4.3.7. Consultant may propose any further analysis/work to be done for more understanding of the field sedimentology, diagenetic sequence and sequence stratigraphy as well facies framework modeling with proper justification.
- 4.3.8. Consultant to quote the cost of the study in US \$ on Lump sum basis along with Study Phase wise cost break.
- 4.3.9. The cost for testing / analysis / evaluation of cores, cuttings etc. should also be mentioned separately even after this is the part of lump sum/phase wise costs.
- 4.3.10. The study has to be performed in the different Phases as described ahead under **Chapter-3** of the TOR

CHAPTER - 3

"DETAILED SCOPE OF WORK (PHASE WISE)"

The already described scope of work in chapter-2 is further elaborated in detail under a number of phases for better technical approach and understanding.

1. PHASE-1

1.1. "CORE DESCRIPTION AND INITIAL ASSESSMENT OF SEISMIC & OTHER WELL DATA"

- 1.1.1.** To ensure accurate documentation of sedimentological features the core should be checked for depth or marking errors for detailed core description prior to start of study. This process also allows for familiarization of the range of lithology and the positions of reservoir/formation boundaries.
- 1.1.2.** An integrated approach is required using open-hole logs and borehole image data as a reference and same must be calibrated to core features during description. This data in conjunction with core gamma (if available) to be used for core-to-log shifts during description. Furthermore, at the time of description, conventional core analysis (RCAL) and thin-sections analysis (if available) may be used to understand pore system developments and to calibrate core textures.
- 1.1.3.** The graphic core description must display a variety of geological features including but not Limited to the following.
- Lithological characteristics (*e.g.* sandstones vs mudrocks etc).
 - Grain size (measured using any sophisticated modern method) for clastic reservoirs.
 - Sedimentary structures (laminations, cross bedding, mud cracks *etc.*), ichnofabrics (burrow intensity/diversity), deformation structures (*e.g.* load structures).
 - Visual estimates of rock dirtiness.
 - Qualitative estimations of porosity and contributing pore types.
 - Cements (intensity, type and distribution), rock color, hydrocarbon staining,
 - Overview of fracture distribution (non-quantitative).
 - Key surfaces will be highlighted (*e.g.* hard grounds and erosion surfaces) and digital photographs must be taken of these and other key features.
 - Additional parameters (*e.g.* pre-existing schemes, can be captured or applied to the core at OGDCL's request/requirement/mutual understanding/agreement between Client & Consultant, as they may be important to understand reservoir)
- 1.1.4.** Review and initial assessment of the Seismic data, well data and petrophysical data/evaluation.

- 1.1.5. This phase of the study also includes the time of data collection.
- 1.1.6. The core description must be conducted in Pakistan.
- 1.1.7. During this phase of the study, professionals from the side of client (Technically looking after the fields under study) will be attached with consultant's team.

1.2. DELIVERABLES

- 1.2.1. Detailed core descriptions will be delivered as 1:50 scale enclosures and also represented on 1:200 scale well summary sheets (WSS) that display the core description along with wireline log data and core analysis data for the entire reservoir interval.
- 1.2.2. The all evaluation/understanding (positive / negative / constraints / issues / requirements) regarding review of the data (includes logs, seismic, core etc.) should be provided in digital format. In case of any analytical/assessment output from software, that should be compatible with OGDCL's using software (Petrel /DSG Petrophysics/DSG seismic /Techlog).
- 1.2.3. A summary report on the initial understanding of the reservoir, including the descriptive sequence of stratigraphic units / layers as evaluated during core visual analysis, logs etc.
- 1.2.4. The detailed evaluation report for the seismic data review/assessment and recommendations for further successful working on seismic data.
- 1.2.5. Detailed report of key findings would be submitted by the contractor followed by a presentation to client's management to conclude the Phase-1 before start of Phase -2 of the study.

2. PHASE-2

2.1. SEISMIC INTERPRETATION, PETROPHYSICAL EVALUATION, FACIES ASSOCIATION SCHEMING AND ASSESSMENT

After successful completion of Phase-1 and agreement regarding the understanding about data review / assessment / findings and data availability, the Phase - 2 will be started with the Seismic data interpretation / mapping and Litho-typing of the formations / strata under study and their genetic associations using available logs, cores, reports etc. The requirements and associated deliverable of the said objective in this phase are detailed below.

- 2.1.1. The genetic grouping of the lithotypes into genetic associations needs to be established for a better understanding of the vertical depositional evolution and lateral depositional variations.
- 2.1.2. Facies associations established will be taken forwards into the mapping phase. This is to be done by interpreting the core lithology in terms of sedimentological process, depositional energy levels, lithofacies stacking patterns, bedding styles, skeletal components and biological/ecological factors that result from different environmental conditions within an overall depositional setting (e.g. delta, channel,

overbank, outer ramp, marine, continental etc.).

- 2.1.3.** A unified and/or updated genetic (environmental) lithotypes association scheme need to be developed and applied as interval data to the cored wells (including the uncored portion of the cored wells) and displayed on the core sedimentary logs (CSL).
- 2.1.4.** Careful consideration needs to be taken in developing the scheme so that it is not too ‘granulated’, having an unmanageable number of environmental categories, or having too few ‘buckets’ so that data resolution and therefore understanding is lost.
- 2.1.5.** A hierarchal approach need to be taken for developing this scheme where appropriate (*e.g.* shoreface being composed of upper, mid and lower shoreface) and qualified/coded accordingly, so that the scheme can be ‘expanded’ or ‘collapsed’ if needed for later applications (*e.g.* for reservoir modeling).
- 2.1.6.** The facies association scheme and the environments represented need to be illustrated in an appropriate diagram and conceptual depositional model along with associated core and thin-section photomicrograph.
- 2.1.7.** Seismic data interpretation & Time/Depth structural mapping of 08 horizons/ levels, namely Top Lower Goru, Top Middle sand, Top Basal Sand, Top Massive Sands, Intra Massive Sand Layer (within Massive Sand), Lower Massive sand, Sembar formation & Chiltan Limestone.
- 2.1.8.** Consultant to finalize the petrophysical evaluation and estimation of the all reservoirs/possible reservoirs/prospective layers using the complete set of available well data.

2.2. DELIVERABLES

- 2.2.1.** Preliminary 1:50 scale core description sheets with descriptive and interpretive text as PDF enclosures and digital data files which will be compatible with OGDCL’s using software (Petrel /DSG/Techlog).
- 2.2.2.** Digital (Excel) data of tops data (lithotypes/facies associations)
- 2.2.3.** QC of Revised/checked core to log shift.
- 2.2.4.** Time/Depth/attribute/velocity maps on suitable scale.
- 2.2.5.** Seismic project (Interpretation etc.) back up restorable on petrel workstation.
- 2.2.6.** Complete petrophysical evaluation/interpretation, resultant ELANS, correlations between wells. All outputs should be provided digital format (which will be played with Techlog as well as Decision space software).
- 2.2.7.** PPT document of key observations.
- 2.2.8.** Detailed report of key findings would be submitted by the contractor followed by a presentation to OGDCL management on conclusion of the Phase-2.

3. PHASE-3

3.1. STRATIGRAPHIC FRAMEWORK AND SEISMIC ATTRIBUTE ANALYSIS

In order to understand the facies (*i.e.* sand body) distribution it will be important to place the cored intervals into a robust correlative sequence stratigraphic framework for depositional settings in integration with the study of seismic attributes and their analysis with a delicate & optimized way.

3.1.1. SEQUENCE STRATIGRAPHIC FRAMEWORK

- 3.1.1.1.** Sequence stratigraphic framework and its holistic view of facies distribution in the study area (upon the density of well data/core data available). Assessment of the diagenetic Overprint will also be covered in this phase.
- 3.1.1.2.** Sequence stratigraphy should provide the necessary (essential) time-based correlative framework to understanding lateral facies variability. This should be supported by biostratigraphy (if available) and heavy mineral data as interpreted/evaluated by the consultant during petrography for lithotyping and facies analysis.
- 3.1.1.3.** The sequence stratigraphic or correlative horizons will be used as the divisions for assessing lateral facies variability in the form of facies maps or facies trend maps.
- 3.1.1.4.** Furthermore, un-cored wells will also be correlated with available log data, petrographic analysis of well cuttings to increase the resolution of the data for subsequent mapping.
- 3.1.1.5.** Evaluation of depositional systems, at any scale, through time and space in response to changes in relative sea level through sequence stratigraphic techniques. If technically appropriate the transgressive-regressive accommodation cycles (T-R cycles) of Embry and Johannsson (1992) may be adopted utilizing cored intervals.
- 3.1.1.6.** The cored wells will be used to form the foundation for developing the sequence stratigraphic model in study area, as these contain the highest confidence data.
- 3.1.1.7.** As part of the process developed the sequence stratigraphic framework, a cycle analysis diagram will be generated for a key well with the best core coverage.
- 3.1.1.8.** The whole process/outputs of the development of stratigraphic frame work should be aligned and integrated with agreed results/parameters of petrophysical evaluation/interpretation.

3.1.2. SEISMIC ATTRIBUTE ANALYSIS

Seismic attribute analysis (attributes to be analysed should be firm after consultation with Client's representative) as appropriate to investigate and illuminate seismic character of significant depositional packages.

3.1.3. DELIVERABLES

- 3.1.3.1.** A summary diagram of the sequence stratigraphic cyclicity against a 'type' well/succession (Lateral as well as Vertical) will be prepared for inclusion in the final report.
- 3.1.3.2.** Detailed review (with results/analysis) regarding the diagenetic changes as evaluated during this Phase of the study.
- 3.1.3.3.** Seismic Sequence Stratigraphic Framework and Maps.
- 3.1.3.4.** Complete report on Seismic Attribute Analysis, Attribute maps and other related information, results
- 3.1.3.5.** PPT document of key observations.
- 3.1.3.6.** Detailed report of key findings would be submitted by the contractor followed by a presentation to OGDCL management on conclusion of the Phase-3.

4. PHASE-4

4.1. CHARACTERIZATION OF UN-CORED INTERVALS & WELLS TO EXTEND THE SEQUENCE STRATIGRAPHIC FRAMEWORK FOR THE WHOLE AREA UNDER STUDY AND DIAGENETIC ANALYSIS

To provide a complete view of the facies distribution over the study area and to assist in the development/extension of the sequence stratigraphic framework, consultant should do a facies association interpretation for the un-cored wells and un-cored stratigraphic intervals using the available field data/well data, to perform this analytical as well as conceptual facies distribution modeling consultant should give a proper consideration to the interpreted facies / depositional sequence using seismic data. Following are the key objectives of the Phase-4.

- 4.1.1.** The interpretation to be performed by calibrating the cored lithotypes facies associations with wireline logs, borehole image log responses, and well bore data, cuttings analysis using microscopic and XRD techniques in order to make interpretation much closer to realistic for the un-cored intervals/wells.
- 4.1.2.** The sequence stratigraphic evaluation, definitions, distribution and final conclusion should be agreed and signed off with concerning division of Reservoir Management & Exploration (Prospect Generation) departments, OGDCL at the end of this stage, prior to the generation of any reservoir architecture or maps.
- 4.1.3.** The diagenetic overprint will be assessed by preparation, description, Study, Evaluation & interpretation of standard (3" x 1") thin section, stained thin sections using conventional petrographic evaluation/study which should be supported by

CL (Cathodic luminance) descriptions (requires polished thin sections) and SEM descriptions (from rock chips).

- 4.1.4.** In addition, XRD analyses of whole rock and clay fraction, fluid inclusion analysis which will generate temperature data of selected cement phases and modal analyses to generate quantitative data of the sedimentological and diagenetic attributes of samples to allow for statistical analyses of rock types.
- 4.1.5.** XRD analysis will provide quantitative data on the mineralogical/clays types and abundances and will support the findings of the routine petrography.
- 4.1.6.** It is important that XRD samples are taken from the sample material that the thin sections are made from. The un-cored intervals and wells may need to carry out XRD using Cuttings accurately corresponding to the required interval / zone. Both Bulk and Clay Fraction analysis to be carried out by XRD.
- 4.1.7.** A subset of the thin section samples will be described using the SEM in order to ensure compatibility of results between datasets.
- 4.1.8.** CCA (Conventional Core Analysis), SCAL and MICP (Mercury injection capillary pressure) data will be incorporated (If available) in order to provide a characterization of the diagenetic overprint and assess pore systems and cement volumes types to help understand the controls on reservoir quality.
- 4.1.9.** To ensure that the thin sections are representative of the range of reservoir quality developed and the range of lithology's and depositional environments recorded sample selection will utilize coded porosity-permeability cross plots.
- 4.1.10.** A sample selection will be done with consultation of representative from Reservoir management department, OGDCL.
- 4.1.11.** Findings from the CL (Cathodic luminance), SEM (Scanning electron microscope) and XRD (X-Ray Diffraction) analyses will be integrated into these observations/interpretations.
- 4.1.12.** The key petrographic characteristics and reservoir properties of the identified litho-types understanding gained from the petrographic analyses will be placed into the context of the paragenetic sequence that outlines graphically the order of the various diagenetic processes (*e.g.* cementation, dissolution) that have occurred to the rock since its deposition. This must be supported by evidence from photomicrographs in an appropriate report illustration.

4.2. DELIVERABLES

- 4.2.1.** The Petrographic, XRD, SEM CCL etc descriptions, analysis & figures integrated with the thin section descriptions for the same sample location will be provided in a PDF format.
- 4.2.2.** Thin section descriptions in PDF format
- 4.2.3.** SEM, XRD, CL, etc. results and raw data
- 4.2.4.** SEM, XRD, CL, etc. descriptions/Analysis in PDF format

- 4.2.5. Appropriate diagrams displaying the diagenetic overprint and the paragenetic sequence.
- 4.2.6. Digital data of facies associations for the Cored & Un-cored intervals as well as uncored wells.
- 4.2.7. 1:200 scale well summary plots of the cored wells showing all core derived data and interpretation of the uncored intervals
- 4.2.8. Sequence stratigraphic cycle diagram.
- 4.2.9. Sequence stratigraphic picks in Excel.
- 4.2.10. A summary diagram of the sequence stratigraphic cyclicity against a 'type' well/secession (Lateral as well as Vertical including cored wells, cored intervals, uncored intervals of the same horizon, un-cored wells) will be prepared for inclusion in the final report.
- 4.2.11. Detail evaluation report on diagenetic overprints/ changes (lateral/vertical) as observed & evaluated/interpreted including their distribution, reasons/causes, effects (negative/positive), significance.
- 4.2.12. Initial reservoir models based on diagenetic property changes horizontally and vertically for the area / reservoir/formations under study.
- 4.2.13. PPT document of key observations.
- 4.2.14. Detailed report of key findings would be submitted by the contractor followed by a presentation to OGDCL management on conclusion of the Phase-4.

5. **PHASE-5**

This phase of the study will conclude the reservoir quality, integrated facies architecture and their distribution throughout the study area and finally the integrated inferred as well as conceptual reservoir Characterization based on the outputs from all phases of the study.

5.1. **INTEGRATED RESERVOIR QUALITY ANALYSIS, MAPPING AND CHARACTERIZATION**

- 5.1.1. In this phase, Reservoir Quality Analysis, Mapping and characterization of Reservoir/reservoirs/prospective reservoirs is to be done in order to understand the controlling mechanisms influencing reservoir quality and to appreciate sedimentary architecture and diagenetic variability in a reservoir context, the following tasks (not limited to) will be performed.
- 5.1.2. Cross-plotting of the routine core analysis dataset to sedimentological parameters (lithotypes and facies associations) in order to test the influence of primary depositional fabrics and integrate the same with the understanding of the pore stems gain from thin section and advanced petrographic analyses.

- 5.1.3. The result is required to be illustrated in appropriate diagrams and the understanding carried forwards to the implications for reservoir behavior and reservoir quality prediction.
- 5.1.4. The key questions must be answered during this process that if reservoir quality is predictable from the sedimentological facies alone, or if a diagenetic overprint partially or completely masks the depositional influence on quality.
- 5.1.5. Preparation of agreed transects through 3D seismic data volume for sequence stratigraphic framework.
- 5.1.6. Identification of depositional sequences and systems tracts on optimum number of regional transects passing through wells in order to map Seismic facies within the Sequence Stratigraphic Framework resulting from Sedimentological analysis to interpret stratigraphic relationships, depositional environments and their temporal & lateral distribution.
- 5.1.7. Generation of Iso-chore and Iso-pach maps, facies maps, risk segment maps and all other related/required maps.
- 5.1.8. This part of phase-5 should be concluded with complete reservoir quality mapping and modeling keeping a large scale approach for utilization of all tested, evaluated, observed, studied, interpreted core data, log data, reports as well as 3D seismic data which resulted in reservoir properties, their distribution, diagenetic changes, seismic attributes etc.

5.2. **INTEGRATED FACIES ARCHITECTURE AND MAPPING**

- 5.2.1. The sequence stratigraphic framework will be used to hang the facies interpretation.
- 5.2.2. Facies maps will be produced for up the required number of intervals, which will need prior discussion and approval with Client prior to map generation and finalization.
- 5.2.3. Mapped intervals may be combinations of depositional sequences with special focus on particular transgressive or regressive phases of a given cycle.
- 5.2.4. The decision on what intervals to map will depend on the significance of any facies to reservoir performance and/or facies heterogeneity over the stratigraphic intervals, which will be finalized after consultation of Client's representatives.
- 5.2.5. For each mapped interval a 'bubble' or pie chart map will be produced that plots the proportional thickness of facies developed over an interval.
- 5.2.6. As an interval will represent a period of time, any facies map representing the trend map of the most likely distribution of facies over that time interval.
- 5.2.7. The distribution of facies will be illustrated by generating geologically conditioned/steered boundaries to facies using various percentage proportions of the key facies (*e.g.* 75-100% mid-ramp 50-75% mid-ramp, *etc.*).
- 5.2.8. These maps must help to identify sand fairways and the nature of transition areas.

- 5.2.9.** Any software (which is compatible with softwares used by OGDCL) will be used to generate the maps & areal polygons representing the boundaries of geological facies based on an interpretation from the core and un-cored well dataset.
- 5.2.10.** The data format for the geological facies polygons will be ESRI Shape File. The ESRI Shape file will be delivered in addition to the PDF report deliverable.
- 5.2.11.** All geospatial data will be fully attributed with metadata regarding the horizon name and any other appropriate attribute data.
- 5.2.12.** All geospatial data generated will be correctly spatially referenced to the Coordinate Reference System as per OGDCL's CRS.
- 5.2.13.** Scale maps will be generated for each subsurface horizon and annotated with appropriate interpretation information.
- 5.2.14.** Charts will include standard cartographic elements of a legend, scale information, geodetic reference, figure, and name/reference and data sources.
- 5.2.15.** Cross sections representing strike and dip section across each area will be generated and number of cross sections to be generated in consultation with client's representative.
- 5.2.16.** Cross sections for each field must illustrate likely inter-well facies architecture. These diagrammatic representations are important to create in conjunction with the mapping process, as the two deliverables are interlinked and represent the same data.
- 5.2.17.** Other cross sections for each field (if required) will be line correlations that show the boundaries of the sequence stratigraphic surfaces only between the well
- 5.2.18.** Integration of Seismic sequence stratigraphic transacts with seismic attribute interpretation results for identification of the any potential stratigraphic prospects, exploration potential and petroleum fairways in Lower Goru formation and Sembar formation.

5.3. DELIVERABLES

- 5.3.1.** Appropriate maps and model displaying the controls on reservoir quality and distribution.
- 5.3.2.** Facies trend maps with ArcGIS database/shape files
- 5.3.3.** Reservoir architecture correlations
- 5.3.4.** Complete modeled reservoir facies distribution along with all properties.
- 5.3.5.** Facies distribution Charts for proportional thickness.
- 5.3.6.** Cross sections representing strike and dip section across each area.
- 5.3.7.** Any Other additional deliverable as required for better understanding of above.
- 5.3.8.** All deliverables regarding reservoir/ prospective/ agreed layers and formations

mapping, their distribution, their characterization, interpretation, diagenetic properties and modeling should be provided in a format which will be viewed, edited, updated using software available with OGDCL as mentioned in previous pages.

- 5.3.9.** Seismic interpretation (Horizon, faults, attributes, velocity analysis), maps etc.
- 5.3.10.** PPT document of key observations.
- 5.3.11.** Detailed report of key findings would be submitted by the contractor followed by a presentation to OGDCL management on conclusion of the Phase-5.

CHAPTER - 4

"REPORT & PRESENTATION"

1. REPORTING

- 1.1. A detailed commentary for all the illustrations with an appropriate number of diagrams which provide details of the findings of the study, Conclusions, implications and key uncertainties will be highlighted in the report along with recommendations.
- 1.2. Appendices will list all study data and must also be available digitally in an editable format (*e.g.* Microsoft Excel, Word, Text or etc.)
- 1.3. An initial digital version of the report should be issued for Client's review followed by 03 hard copies and digital version on CD/DVD.

2. REPORTS & PRESENTATIONS

- 2.1. The consultant will submit at the end of every fortnight, a detailed fortnightly progress report to client in soft and hard form, covering the work performed during that period.
- 2.2. The consultant will submit soft and Hardcopies for Draft reports at the completion of each phase which should include all the results of that particular phase and all prior phases. This is meant to combine the discussions during presentation on the results of all completed phases and layout of the phase ahead.
- 2.3. Final report for each phase (or as required) will be submitted to client (both hard & soft copies) after incorporating the suggested information/improvements within two weeks of presentation so that approval for next phase may be accorded.
- 2.4. After final presentation, the consultant will provide four copies of the final report along with four copies of management executive summary reports with necessary amendment/changes as an outcome of discussion in presentation.
- 2.5. Final report will be submitted within two weeks after the receipt of the comments from client on draft report and incorporating/amending the same in the final version.
- 2.6. The report will include in detail, all aspects of the study with the conclusions and recommendations derived from the study.
- 2.7. On completion of study, consultant will provide the client with six (6) hard copies of the final report including executive management summary, all maps and figures in colored printed form along with 6 digital copies of the same within 02 weeks after final presentation.

CHAPTER - 5

"TERMS & CONDITIONS"

1. GENERAL TERMS & CONDITIONS

- 1.1. It will be preferred that all phases of the study should be carried out at one location. However, in COVID-19 or similar situation if required, location may be changed with the approval GM (Reservoir Management), OGDCL.
- 1.2. The study will be carried out by the same office invited to bid for the study.
- 1.3. The study will be conducted by the consultant with active participation and involvement of technical team of OGDCL.
- 1.4. After signing of the contract, Consultant/ Firm will carry out data review in stipulated time. In this review, consultant will check whether the available data is enough to carry out all study phases to meet the objectives mentioned in TORs. If required, Consultant will recommend necessary data acquisition with mutual agreement with OGDCL. Any delay in study due to agreed data acquisition will be excluded from the study timeline. Consultant will incorporate all newly acquired data along with previously available dataset in the study. After incorporating this data in the study, consultant will be fully responsible for study outcomes and recommendations.
- 1.5. All phases will have to be accomplished in association with OGDCL Reservoir Professionals deputed by Reservoir Management department. The responsibility of the accomplishment of all kind of work/ studies will be on the consultant's part.
- 1.6. The personnel deputed by the consultant carrying out the said study should be dedicated fully to this study and will be available throughout their relevant phase of this study.
- 1.7. Consultant should mention their bid cost estimates in total all-inclusive along with the bid cost estimates of each phase separately (as per study phases described in TOR's Chapter-3) but OGDCL will evaluate the bid on total cost basis along with other criteria given in Annexure – 1.
- 1.8. OGDCL may arrange a pre-bid meeting on request to explain the present status of field and objective of study. The consultants will participate in the meeting at their own cost.
- 1.9. Consultant will submit their invoices on each phase basis, as described in Chapter -3 "Detailed Scope of Work - Phase Wise" of This TOR. The total cost of the study mentioned in the Financial Proposal by the consultant will be taxable as per Government of Pakistan Rules or any other amount announced time to time by GOP in this regard.
- 1.10. All geological, geophysical, drilling, testing, production, well logs, Wireline logs, core and fluid analysis (as available) data required for the study will be provided to the consultant free of charge. Such material will be the property of OGDCL, and the Consultant will treat all data and information supplied by OGDCL and those acquired by consultant during the implementation of the study with utmost confidentiality.
- 1.11. OGDCL reserves the right to discontinue any study/ any task/ any service related to above scope of work at any stage without assigning any reason. OGDCL reserves the right to reject the services of any professional provided by the consultant/ firm at any time/ any

stage and hence it will be the responsibility of the consulting firm to provide the replacement without any delay accordingly.

- 1.12. Upon completion of the study, firm/consultant strictly bound to return all the data shared for the purpose of study back to OGDCL.

2. TIMING

- 2.1. The project will commence with the signing of the contract. A detailed work plan should be submitted with the Technical Proposal. The total time of the main study is 84 weeks, however, data collection/review (10 weeks), presentation (03 weeks), and draft report review (05 weeks) will be exclusive of the mentioned time (73 weeks). Total time of the study all-inclusive will be 102 weeks.
- 2.2. Bidders will submit legible Gantt Charts in their bids as required in Annexure – 1.
- 2.3. Firms/ Consultant giving time frame extending beyond 110 weeks (All-Inclusive as para 2.1 above) will be considered NON-RESPONSIVE.

3. SUBMISSION OF PROPOSALS

- 3.1. Technical & Financial proposals should be given separately, in two sealed envelopes, clearly marked “Integrated Sedimentological and Reservoir Characterization Study”.
- 3.2. A soft copy (PDF) of the technical proposal must be submitted along with the hard copy.
- 3.3. The technical proposal must contain a brief history of consulting firm along with the information required in Annexure – 1. OGDCL encourages the bidders to submit concise bids covering the required information.
- 3.4. The financial bid should contain phase wise break down of the costs (in USD) for different major activities to be done in that respective phase of the study along with the total cost for that respective phase.
- 3.5. Consultant also to provide total cost for the whole study from start of the study to the final report submission as lump sum cost.

*Note: Consultant will provide the study cost break up as required in above Para 3.4. and lump sum cost a para 3.5. above. For the purpose of financial evaluation, only total (lump sum) cost for the whole study will be considered. Consultant will provide the study cost break up as required in table given in **Annexure-3**.*

4. EVALUATION CRITERIA

The Technical evaluation will be based on the criteria below. These criteria have been further elaborated and sub categorized in Annexure – 1.

Sr. #	Category	Marks/Points
1	Firm Experience	25
2	Technical Approach	25
3	Work Plan & Skill Transfer Plan	20
4	Professional's Experience and Qualification	30
Total Marks/Points		100

- 4.1. Criteria for selection of the consultant will be based on Clause-3B of PPRA Rules (Quality & Cost Based Selection).
- 4.2. 80% weight age will be given for technical evaluation and 20% for financial evaluation. The lowest bidder will attain maximum marks in financial evaluation and others would be ranked on the sliding scale.
- 4.3. The points obtained in technical evaluation and financial evaluation will then be combined and bidder attaining maximum points will be awarded the contract.
- 4.4. Firm/ Consultant having total firm experience less than 15 years in Reservoir Studies will be considered NON-RESPONSIVE.
- 4.5. The experience of the firm/consultant with its sister companies, affiliates/subsidiaries will not be considered towards the total experience of the firm in sub categories 1.1,1.2 &1.3 of Annexure-1.
- 4.6. Experience of the firm / Consultant must be provided in tabulated format (Ref. Annexure 2) including "Company Name, Name of the project, Country of the Project, Study Year, Type of Reservoir (i.e. Reservoir Facies & Depositional Environment), Number of wells, Software used & Brief description of Problem Statement/ Scope of Work (8 - 10 Lines max)".
- 4.7. The consultant will assign dedicated team leads and their alternates to various disciplines involved in this study. Team leads with at least two team members in their respective teams will be dedicated to this project. Study group consisting of team leads, their alternatives and team members will be specified by the firm / consultant as required in **table below**. However, for category # 4 of evaluation criteria i.e. "Professionals' Qualification & Experience" (Annexure-1) only team leads and two team members will be evaluated by OGDCL as team leads of their respective discipline will be considered responsible for the working in the project.

Sr.#	Discipline	Team Lead	Alternate Team Lead	Team Members	
1	Sedimentology				
2	Petrophysics				
3	Sequence Stratigraphy				
4	Geophysics				
5	Reservoir Geology and Geo-Modeling				

- 4.8.** In case of defection of any dedicated team lead/ member, the consultant will be responsible to engage a professional of similar domain/caliber.
- 4.9.** The consultant shall provide at its own expense suitably qualified personnel to act as Project Coordinator/Project Manager to ensure efficient performance of the studies to achieve the objectives. Project Coordinator/Project Manager may or may not be a part of above tabulated team. The Project Coordinator shall act on behalf of the consultant and shall be responsible for supervising all the consultant's Work responsibilities, and for maintaining liaison between the Company and the consultant.
- 4.10.** Bidding firm/ consultant should submit unambiguously, all relevant information required for evaluation according to criteria described in this chapter Para-4 (Evaluation Criteria) and further elaborated and sub categorized in Annexure – 1.
- 4.11.** Bidders may request clarifications on evaluation criteria before submitting bid. After the submission no reservation, excuse, justification would be accepted from any of the bidders.
- 4.12.** OGDCL urges the bidder to stay to the point in their bids and avoid submitting unnecessary detail or marketing stuff with the bid.
- 4.13.** Bidders scoring minimum in any of the subcategories given in Annexure – 1 will be considered responsive except those mentioned in under 2.3 and 4.4 of Terms and conditions of these TORs.
- 4.14.** The **financial** proposal of bidders obtaining less than 80% points in total and less than 70% points in each category (Tabulated under Para 4) in the technical evaluation will not be opened and treated as NON-RESPONSIVE.

5. SOFTWARE COMPATIBILITY

- 5.1.** Following G&G software are available with OGDCL. The consultants/ firms will be required to provide all the work on the software listed below:
- a. Petrel (G&G)
 - b. DSG (Decision Space Geoscience)

- c. DSP (Decision Space Petrophysics)
 - d. Techlog
- 5.2. Consultant may opt to use software other than those available at OGDCL considering the evaluation criteria (Annexure – 1). However, OGDCL would require final models in software as mentioned in TORs for future inhouse updates and it will be consultant's responsibility to provide error free & future updatable models as per OGDCL's requirement.

6. OGDCL PARTICIPATION AND SKILL TRANSFER

- 6.1. OGDCL's seven (07) Professionals (including Petrophysicist, Reservoir Geologist & any other nominated by Reservoir Management Department) will participate in performing the Lab work, analytical work, Geological, Petrophysical, Facies architecture, modeling etc. for their active participation and inputs accordingly.
- 6.2. Consultant will involve OGDCL professionals in all phases of the study.
- 6.3. OGDCL & JV Partner may like to have this study accomplish in association with its professionals without any financial impact on the consultant. However, consultant will provide computer, international phone, internet facility and office space for working. Consultant will also provide transport from residence to office. The responsibility of the accomplishment of all kind of Work/ Studies will lie on the consultant.
- 6.4. OGDCL professionals in different disciplines will be attached with the consultant time to time for discussion, inputs and supervision. Due to importance and uniqueness of this study which includes multi-disciplinary work, GM (RMD) will decide phase wise schedule & duration of participation of OGDCL professionals after having discussion with consultant according to the study volume (phase wise) and requirement.

Integrated Sedimentological and Reservoir Characterization Study

Technical evaluation Criteria

Note:	<p>a. The consultant must provide Hard as well as soft (PDF) copies of Technical Bid.</p> <p>b. A legible Gantt chart will be provided by the consultant covering all the activities included Category 3.</p> <p>c. Bidders should submit required relevant information clearly according to the TORs and required in this annexure. Ambiguous or irrelevant information will not be entertained.</p> <p>d. Experience of the firm / Consultant must be provided in tabulated format (Ref. Annexure 2) including "Company Name, Name of the project, Country of the Project, Study Year, Type of Reservoir (i.e. Reservoir Facies & Depositional Environment), Number of wells, Software used & Brief description of Problem Statement/ Scope of Work (8 - 10 Lines max)".</p> <p>e. The experience of the firm/consultant with its sister companies, affiliates/subsidiaries will not be considered towards the total experience of the firm in sub categories 1.1, 1.2 & 1.3.</p>	
Sr. No.	Category	Points
	Total Marks	100.00
1	Firm Experience	25.00
1.1	Total Experience of the firm/ consultant in Integrated Sedimentological and Reservoir Characterization Study	5.00
	45 or more Years	5.00
	30 or more Years	4.00
	15 or more Years	3.00
Note:	<p>a. Firm/ Consultant having Total Experience less than 15 years in Integrated sedimentological & reservoir Characterization studies Studies will not be entertained. Therefore, consultant should clearly mention its total relevant experience in Integrated sedimentological & reservoir Characterization studies with proof / Completion certificate.</p> <p>b. Personnel Experience will not be taken as substitute of Firm/ Consultant Experience</p>	
1.2	Experience of the firm/ consultant in last five (05) years in similar projects internationally (other than Pakistan, India & Iran)	15.00
	15 or more Projects/ Studies	15.00
	10 - 14 Projects/ Studies	12.00
	5 - 9 Projects/ Studies	9.00
	1 - 4 Projects/ Studies	4.00

Note:	<p>a. Company Name, Name of the project, Country of the Project, Study Year, Type of Reservoir (i.e. Reservoir Facies & Depositional Environment), Number of wells, Software used & Brief description of Problem Statement/ Scope of Work (8 - 10 Lines max) should be clearly mentioned in a table to support the claim. (Ref. Annexure 2)</p> <p>b. Only those Projects/ Studies will be considered for evaluation for which information required in Note "a" would be provided.</p> <p>c. Consultant should clearly mention only the relevant studies/ Projects.</p>	
1.3	Experience of the firm/ consultant in last five (05) years in similar projects in Pakistan and similar regions (India & Iran)	5.00
	10 or more Projects/ Studies	5.00
	5 - 9 Projects/ Studies	4.00
	1 - 4 Projects/ Studies	2.00
Note:	<p>a. Company Name, Name of the project, Country of the Project, Study Year, Type of Reservoir (i.e. Reservoir Facies & Depositional Environment), Number of wells, Software used & Brief description of Problem Statement/ Scope of Work (8 - 10 Lines max) should be clearly mentioned in a table to support the claim (Ref. Annexure 2).</p> <p>b. Only those Projects/ Studies will be considered for evaluation for which information required in Note "a" would be provided.</p> <p>c. Consultant should clearly mention only the relevant studies/ Projects.</p>	
2	Technical Approach	25.00
2.1	OGDCL's satisfaction on Previous studies	5.00
	Excellent	5.00
	Good	4.00
	Average	2.00
	Poor	0.00
Note:	<p>a. OGDCL will rate firm/ consultant according to OGDCL's experience in past studies i.e. post study implementation of study recommendations and outcomes including IRS, Geological & Reserves certification studies etc. with that firm/ consultant.</p> <p>b. Firm/ Consultant should clearly mention past studies carried out for OGDCL.</p> <p>c. Firms/ Consultant appearing for the first time in OGDCL will be rated as "Good".</p>	
2.2	Technical approach w.r.t. OGDCL's TORs	15.00
2.2.1	Phase 1 as per TORs	3.00
2.2.2	Phase 2 as per TORs	3.00
2.2.3	Phase 3 as per TORs	3.00
2.2.4	Phase 4 as per TORs	3.00
2.2.5	Phase 5 as per TORs	3.00
Note:	<p>a. OGDCL will rate firm/ consultant according to relevance with scope of work given in TORs.</p> <p>b. Maximum marks carried by each item are given. Consultant will score between 0 and maximum marks.</p> <p>c. Marking will be made with the best, unbiased and thoroughly professional judgement by OGDCL.</p>	
2.3	Compatible technical softwares Usage as available to OGDCL (Petrel (G&G), DS Geosciences, DS Petrophysics, Techlog)	5.00

	100% in line with TORs	5.00
	50% or Less	2.50
Note:	<p>a. Firms/ Consultant using softwares other than mentioned above but submitting final models in format compatible with above-mentioned software will be given 2.5 marks. It will be consultant's responsibility to provide error free, future updatable models in OGDCL's software formats as mentioned in TORs.</p> <p>b. Software versions must be clearly mentioned in the proposal. Only Latest software versions will be considered for evaluation.</p>	
3	Work Plan & Skill Transfer Plan	20.00
Note:	a. A Gantt chart will be provided by the consultant for covering all the activities included in the Work plan over the course of the study.	
3.1	Timeline (Including Data Collection, Data review, Report Review, Presentation & Final Report) - 88 Weeks (As per TOR)	5.00
	Less Than or equal to 83 Weeks in total all inclusive	5.00
	88 Weeks (time line in-line with TOR)	4.00
	More than 88 Weeks	2.00
Note:	<p>a. Firms/ Consultant giving timeline equal to OGDCL's envisaged time frame will be marked 4.0.</p> <p>b. Firms/ Consultant giving the Less Than or equal to 82 Weeks will be given 5 marks.</p> <p>c. Firms/ Consultant giving time falling between "a" & "b" will be given marks between 4 and 5.</p> <p>d. Firms/ Consultant giving time frame extending beyond 94 weeks will not be considered for evaluation.</p>	
3.2	Interaction Plan (Presentations, Meetings, & Reports)	5.00
	25 or more Reports	5.00
	20 or more Reports	4.00
	15 or more Reports	3.00
Note:	<p>a. Purpose of these presentatians and reports is better interaction between OGDCL and consultant's teams leading to better understanding and execution of this study accordingly.</p> <p>b. Every report will be followed by a presentation/ meeting, which includes kick off meeting, data review meeting, Bi-weekly progress reports & meetings, phase wise reports and meetings, Draft reports & meetings, final report & final presentation.</p> <p>c. Interaction plans consisting of less than 15 reports and presentations (each) will be rated as zero (0).</p>	
3.3	Technical Sessions (Phase wise Workflows) - With Knowledge transfer theme	3.00
	10 or more	3.00
	7 or more	2.40
	5 or more	1.80
Note:	<p>a. Purpose of these sessions is Knowledge sharing</p> <p>b. OGDCL envisages two technical session for each phase covering general workflow, relevency and implementation to this study, challages encountered, their solutions, and way forward. These sessions should not exceed 3 hrs each. (10 sessions in total)</p> <p>c. These session will purely be of technical nature and should address basic to advanced levels for audience ranging from entry level professionals to mid careers.</p> <p>d. A Separate Gantt chart will be provided of these session</p>	

3.4	Participation of OGDCL's Personnel	7.00
	Hands-on	7.00
	Combination of Physical & Virtual	5.60
	Virtual only	2.80
Note:	<p>a. Presentations & Technical session mentioned in 3.2 & 3.3 will not be a substitute of this participation plan.</p> <p>b. "Hands-on " means that OGDCL's nominees will participate physically in relevent phases of the study in consultant's office and consultant will give a firm plan.</p> <p>c. "Virtual only" means that only virtual participation via video link will be carried out and consultant will submit firm participation plan.</p> <p>d. "Combination of Hands-on & Virtual" means that both physical & virtual participation will partially be carried out phase wise as per TOR and consultant will submit firm participation plan accordingly.</p> <p>e. Firm/consultant submitting no firm participation plan will be given zero (0) marks.</p> <p>f. Firm/consultant should provide a Separate Gantt chart for participation plan.</p>	
4	Professionals' Qualification & Experience	30.00
Note:	<p>a. Firm/ Consultant shall provide a dedicated team lead for every discipline along with a back up candidate.</p> <p>b. For evaluation puposes, only Team leads' qualification & experience will be rated</p>	
4.1	Qualification	12.00
Note:	<p>a. BS means Bachelor of Science equivalent to 16 years education while MS means Master of Science equivalent to 18 years education.</p> <p>b. Project manager must be a sedimentologist with sound background and knowledge of RCAL, SCAL, core description, XRD, SEM & other industry practices and experience of similar studies</p> <p>c. Professional Experience must include a timeline of experience alongwith brief description of Job nature and Projects undertaken.</p>	
	Project Manager (Geologist / Geophysicist)	2.00
	PhD	2.00
	MS	1.60
	BS	1.20
	Sedimentologist (Clastics)	2.00
	MS or Higher Geology	2.00
	BS Geology	1.60
	Both BS and MS in other disciplines	0.00
	Petrophysicist	2.00
	BS and MS or higher Geology/ Geophysics	2.00
	BS or MS Geology/ Geophysics	1.60
	Both BS and MS in other disciplines	0.80
	Sequence Stratigrapher (Clastics)	2.00
	BS and MS or higher Geology / Geophysics	2.00
	BS or MS Geology / Geophysics	1.60
	Both BS and MS in other disciplines	0.00
	Geophysicist	2.00
	BS and MS or higher Geophysics	2.00
	BS or MS Geophysics	1.60
	Both BS and MS in other disciplines	0.00
	Reservoir Geologist/ GeoModeler	2.00

	BS and MS or higher Geology	2.00
	BS or MS Geology	1.60
	Both BS and MS in other disciplines	0.80
4.2	Experience	18.00
Note:	<i>a. Only relevant experience will be considered for evaluation purpose instead of Total Experience. Therefore, Consultant should clearly mention the number of years of relevant experience along with experience timeline and key projects undertaken by each personnel to support the claimed experience.</i>	
	Project Manager	3.00
	20 Years or more	3.00
	15 to 19 Years	2.40
	10 to 14 Years	2.10
	5 to 9 Years	1.50
	Sedimentologist (Clastics)	3.00
	20 Years or more	3.00
	15 to 19 Years	2.40
	10 to 14 Years	2.10
	5 to 9 Years	1.50
	Petrophysicist	3.00
	20 Years or more	3.00
	15 to 19 Years	2.40
	10 to 14 Years	2.10
	5 to 9 Years	1.50
	Sequence Stratigrapher (Clastics)	3.00
	20 Years or more	3.00
	15 to 19 Years	2.40
	10 to 14 Years	2.10
	5 to 9 Years	1.50
	Geophysicist	3.00
	20 Years or more	3.00
	15 to 19 Years	2.40
	10 to 14 Years	2.10
	5 to 9 Years	1.50
	Reservoir Geologist/ GeoModeler	3.00
	20 Years or more	3.00
	15 to 19 Years	2.40
	10 to 14 Years	2.10
	5 to 9 Years	1.50

EXPERIENCE OF THE FIRM / CONSULTANT

Sr. #	Company /Client Name	Name of the Project	Country of the project	Project Year	Reservoir Type (Facies / Env. of Deposition - Clastic / Carbonate)	Number of wells used	Software used	Brief description of Problem Statement / Scope of Work

FINANCIAL EVALUATION RATE FORMAT						
Sr. #	Study Phases	Major Activities / Working in Each Phase				Total Cost (US \$)
		1	2	3	4	
1	Phase-1	Core Description	Initial Assessment of Seismic Data	Initial Assessment of Well Data	Any other associated activity with description	
	Cost (US \$)					
2	Phase-2	Seismic Interpretation	Petrophysical Evaluation	Facies association Scheming and Assessment	Any other associated activity with description	
	Cost (US \$)					
3	Phase-3	Sequence Stratigraphic Framework and facies Distribution	Seismic Attribute Analysis		Any other associated activity with description	
	Cost (US \$)					
4	Phase-4	Evaluation and Characterization of Un-cored Intervals for Sequence Stratigraphic Framework extension	Diagenetic Analysis of facies		Any other associated activity with description	
	Cost (US \$)					
5	Phase-5	Integrated Reservoir Quality, Analysis , Mapping	Reservoir Characterization		Any other associated activity with description	
	Cost (US \$)					
6	<i>Total Lump Sum Cost (including all applicable taxes duties and Levies etc. except Provincial Sales Tax/ Islamabad Capital Territory Tax on Services in Pakistan.)</i>					

Note:-

Following documents must be attached with the bid:-

- Bid bond of **USD 40,000/- (US Dollar Forty Thousand Only)** with technical bid. Please see tender documents and clarification (online transfer of funds to OGDCL) uploaded on OGDCL website for further detail.
- The master set of tender documents (services) uploaded on OGDCL website (www.ogdcl.com) is the integral part of this TOR.
- Bidding form, Integrity & ethics undertaking, Affidavit duly signed & stamped by Public Notary, Data Summary Sheet, Duly signed & stamped Draft Contract and tender documents.