1.2 Introduction

The Foroozan Field is located offshore Persian Gulf, approximately 100Km south of the Kharg Island in Iranian sector. The field is situated on the north-eastern flank of a very large domal anticline. The anticline straddles border between Iran and Saudi Arbia. The Iranian portion of the field is named Foroozan (formerly Fereydoun) whereas the Saudi Arabian part of the field is called Marjan. Foroozan and Marjan fields are part of one large structure. Both Foroozan and Marjan fields have started production in the mid-1970. Reference to the PEDCO report, totally there are 170 wells has been drilled in this field and the production is performed by 12 wellheads, 8 satellite platforms and 2 production platforms. Moreover, based on the above documents [PEDCO] at the time of preparing this report, 850 MMS bbls oil has been produced totally.

The Foroozan and Marjan fields are part of the world's largest petroleum producing trend, that the later one, Marjan, is reported to produce from Jurassic (Hanifa and Arab), in addition to the Cretaceous Fahliyan (Manifa, Yamama) and Kazhdumi (Burgan) reservoirs. Production was started in the Foroozan field from the Burgan Sands primarily. Oil production from the Lower-Kazhdumi (Burgan) and Fahliyan (Yamama) reservoirs as the two main pools in the field, namely F-03 and F-02 areas, has been started from 1970.

Based geological and reservoir studies on structural features, Petroleum systems, fluid composition and hydrocarbon contacts of Foroozan field, it is sub-divided into a 6 different areas, designated F-01, F-02, F-03N, F-03S, F-05 and F-08 areas.

Figure 1 & Figure 2 show the location of Foroozan oil field in Kharg area and platforms location respectively.

1.3 Well Objective

The main purpose of drilling F-18-03PH/MH was to evaluate the formations to Arab-D Mbr. (by inclination of 60°) and after data acquisition by Full Suite logs, the plan was to drill the main hole horizontal section in Yamama Formation but engineering team of IOOC and POSCO decided to change the angle of pilot well to 0° (vertically) and after investigation of pilot hole data, the target of main hole was changed to Burgan-A unit with inclination of 60° to deplete the existing hydrocarbon in Burgan-A around the polit hole which was cased cemented.

Due to these changes the F-18-03PH well drilled vertically by 26", 17 1/2," 12 1/4" and 8 1/2" bit size to 3018.5mMD (-2980.8MmTVDss) and the logging operation was done in each section according to plan. Then the cement plunges were set in the well.

Directional drilling started time drilling using 8 1/2" bit after drill out the cement plugs and side track point was announced at 1855mMD (-1817.5mTVDss) and it was continued to 2063mMD (-2010.4mTVDss) with maximum inclination of 36.7° in azimuth of 346.3°. The 7" liner was set at 2061.5mMD (-2009.2mTVDss) in U. Burgan-A member.

The 6 1/8" hole section was drilled in continue with maximum inclination of 51° in azimuth of 364° to 2133mMD (-2060.1mTVDss) in L. Burhan-A member and 4" Pre-packed screen was run in the hole and set at 2132.5mMD (-2059.8mTVDss).

Figure 3 and Figure 7 show the location of the F-18-03PH/MH wells on top of Arab member and U. Burgan A UGC map respectively. Also Figure 11 shows the F-18-03PH and MH well sketch.

2 Geology

2.1 Geological & Structural Setting

The Foroozan Structure is a broad, low amplitude anticline, probably developed over a basement high and lies at the northern plunge of the Saudi Arabia Marjan Field anticlinorium. Hydrocarbons have primarily been sourced from oil prone shale in the Cretaceous and Tertiary developed in the Mesopotamian fore-deep. The combination of thick source, large low relief structures and multiple reservoirs and seals has led to the accumulation of one of the world's largest concentration of un-degraded light oil in this region. In common with the other large domal anticlines in the area, the Foroozan structure was formed by halo-kinesis of the underlying Cambrian Hormuz salt during the early Tertiary. The salt movements began in the late Cretaceous and may be related to initial tectonic activity on the southwest margin of the Mesopotamian Fore-deep prior to the main deformation in the Zagros Fold belt further east. The salt movement created with very gentle anticlines with intervening salt withdrawal and fault collapse synclines. These synclines separate both individual fields in the area such as Zuluf and Marjan, and also form structural separation in some of the largest structures between F2 and F3 areas in Foroozan. Faulting appears particularly concentrated in these intervening synclinal areas, however and based on the seismic interpretation, extensional faulting is also observed over the crests and along the flanks of the anticlines. These crests of the separate segments of the Foroozan structure are situated on the up thrown side of these faults. The dominant fault trend in the Marjan/Foroozan area is NE-SW, a less developed and generally younger NW-SE trend. Most faults appear to show limited displacement (less than 30m) and are undoubtedly developed along fracturing in the carbonate sequences of the Dariyan (Dariyan), Fahliyan (Yamama) and Surmeh (Arab) formations*. The tectonic trend of oil fields with depth map of Burgan is shown in Figure 4.

*Based on IOOC documents.

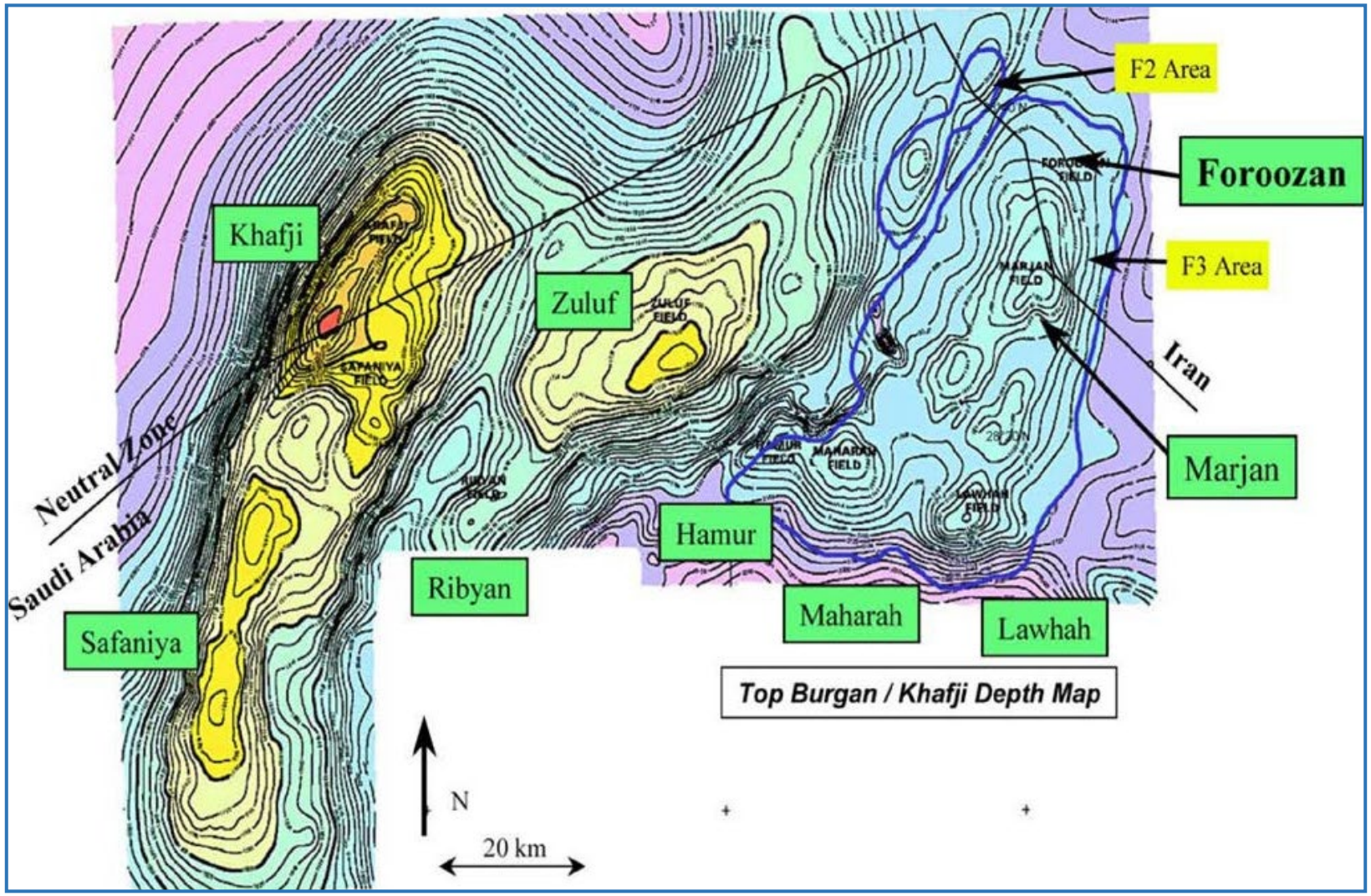

Figure 4: Oil Fields in the Safaniya Tectonic Trend

2.2 Sedimentary Environment

According to previous studies (Ziegler 1998),at the end of the Jurassic, the eastern part of region underwent substantial uplift. Subsequent erosion removed parts of the Hith evaporates and the underlying Surmeh Formation. The area was then submerged by another transgression from the north, and deposition of Fahliyan Formation limestone began. The marine sediments of the Fahliyan Formation which were deposited in a shallow shelf environment, forms a prominent limestone unit with good reservoir characteristics in different places.

As mentioned above, the Fahliyan Formation was deposited in a zone of middle shelf margin and shelf lagoonal region where argillaceous limestone are inter-bedded in thin beds of shale and some bio-clastic packstone.

The Early-Cretaceous Fahliyan Formation including Manifa, Yamama, and Lower-Ratawi members mainly consists of shallow water, massive limestone.

No major tectonic event disturbed the region during the Early Cretaceous. There was some differentiation due to minor movements associated with the South Fars – Qatar Arch and most of the sedimentological changes can be related to fluctuations in water depth. Two carbonate cycles have been defined and the more varied sediments of the upper cycle reflect an increased clastic sediment influx from the west and north in Saudi Arabia. Further east on the carbonate shelf in offshore of Iran, the distinction between the two cycles is lost.

The halokinesis activity led to formation of isolated highs (like Foroozan-Marjan structures) which supported small patches of reefs in offshore of Iran.

This Early Cretaceous deposition was terminated by a major Mid-Aptian unconformity which can be traced across the region in which the overlying beds indicating a distinctive change in depositional environment.

The primary reservoir in the Foroozan field is formed by fluvio-deltaic sandstones of the Burgan member (Burgan or Khafji sands). The Burgan sands are Middle Cretaceous Albian in age and sands form one of the largest clastic reservoir systems in the world stretching from Iraq to Saudi Arabia and reaching over 300m thick in the Safaniya Field. The Burgan in Foroozan is divided into a lower thick sandstone unit designated Burgan-B and an upper shalier unit designated Burgan A.

The field began production in 1974 and has been primarily produced from the Burgan sands.

Additional reservoirs in Foroozan include deeper carbonate-horizons of the Upper-Dariyan (Upper-Dariyan), Fahliyan (Yamama and Manifa) and Surmeh (Arab) formations, and thin sandstones of the Upper-Kazhdumi (Nahr-Umr) Sands which are above Burgan A reservoir.

As it mentioned in Table 1 the target reservoir is Burgan-A unit which is belonged to middle cretaceous age.

Middle Cretaceous-Aptian to Albian period included the deposition of the Dariyan, Kazhdumi (Burgan-B&A units and Upper Kazhdumi Mbr) formations and their regional equivalents. The Paleo facies of the late Early Cretaceous, Including Deposition of the Dariyan (Shu'aiba), Burgan, Kazhdumi, Mauddud members, and their Regional Equivalents in the Arabian Plate is shown in the Figure 5. The significant Late-Aptian regional unconformity and sedimentary hiatus separated rocks of Aptian age (e.g. Dariyan Formation) from those of Albian age (e.g. Burgan). This break probably coincided with a worldwide low stand in sea level and was followed by a gradually rising sea level that culminated by maximum flooding at the end of Albian [about 101 million years ago]. The opening of the central Atlantic Ocean caused uplift of the western part of the Arabian Craton and huge amount of deltaic sands and transitional marine clastics were flooded from the west and southwest. Well-defined salt domes in the southern Persian Gulf are attributed to movements of the Precambrian Hormuz salt and evaporates that began with salt pillowing in the Late Aptian-Albian due to structural reactivation.

The transgressive Albian deposits reflect a rise in sea level. The gradually rising sea level that followed the pre-Albian unconformity caused the deposition changing of clastic and carbonate. In general, by late Albian times, the Arabian Platform was widely flooded by shallow seas in which were deposited shallow- to progressively deep-marine carbonates in various sub basins around the plate margin.

The platforms that separate the various intra-shelf basins are the sites of shallow-water carbonate deposition (e.g. the Dariyan Formation). These bioclastic skeletal lime grainstones are the "rudist limestones". In part, they are composed of rudist banks (reefs) and aprons of large-scale, cross-bedded bioclastic debris and brecciated limestones.

At the close of Dariyan times, clastic sedimentation resumed through to the end of the Aptian. This shale sequence is considered to conformably overlie the Dariyan (as observed by Owen and Nasr, 1958), and has hitherto been referred to the lowermost part of the Kazhdumi Formation.

Dark organic-rich shales and argillaceous limestones of the Kazhdumi Formation characterize the eastern plate intra-shelf basins of Iraq and Iran, the eastern plate margin, as far as the southern Gulf region. The presence of ammonites and a foraminifera fauna indicate a deeper-marine depositional setting and connection with Neo-Tethys.

Over the Arabian Arch and Gulf area the Kazhdumi Formation and its equivalents represent an influx of clastics during the Albian following emergence and erosion of shallow-water Aptian carbonates.

At this time, alluvial plains covered most of Saudi Arabia, Kuwait and Iraq, with deltas progradation to the east, beyond which were shallow-marine waters to the open waters of the southern Tethys (modern Zagros Fault area).

The region was equatorial, and a humid climate prevailed. The Kazhdumi Formation is a distal equivalent of nearshore sandstones and shales of the Burgan member and suggesting close proximity to a fluvio-deltaic source.

The Middle Cretaceous commences with a newly-recognized hiatus of approximately 6 (to possibly 11) million years duration. Uplift of the cratonic source areas to the west caused a renewed influx of sands over large parts of the Arabian basin in the early Middle Albian. The Burgan member is characterized by thick deltaic sands in the west, thinning somewhat in the offshore (including the basal shales).

Carbonates on-lapped in a westerly direction and progressively displaced the clastics westward into interior Kuwait, resulting in the deposition of the Upper Albian Mauddud carbonates. The Mauddud member shows a gradual overall thickening towards the east and northeast and extends over most parts of the Arabian basin including north Iraq. The Mauddud member rests on the Nahr-Umr Formation in most parts of the basin. The contact between the two formations may result from a stratigraphic discontinuity developed during flooding of the clastic-dominated shelf, resulting in the deposition of shallow-water carbonates. The mechanism that shut off the supply of fine clastics from the source area to the west may be related to climatic change, or it could be attributed to a period of relative tectonic stability. The vertical and horizontal extension of this facies all over the Arabian basin indicates long-term stability of the basin.

The Mauddud member consists mainly of limestone with local basin margin rudist buildups in the offshore. Porosity of 10 –35% and permeability of 10 –110 md have been reported from different fields of

. the basin. This porosity is attributed to a combination of dolomitization, fracturing, and dissolution. The finalized Litho-Biostratigraphy chart is presented in Figure 6.

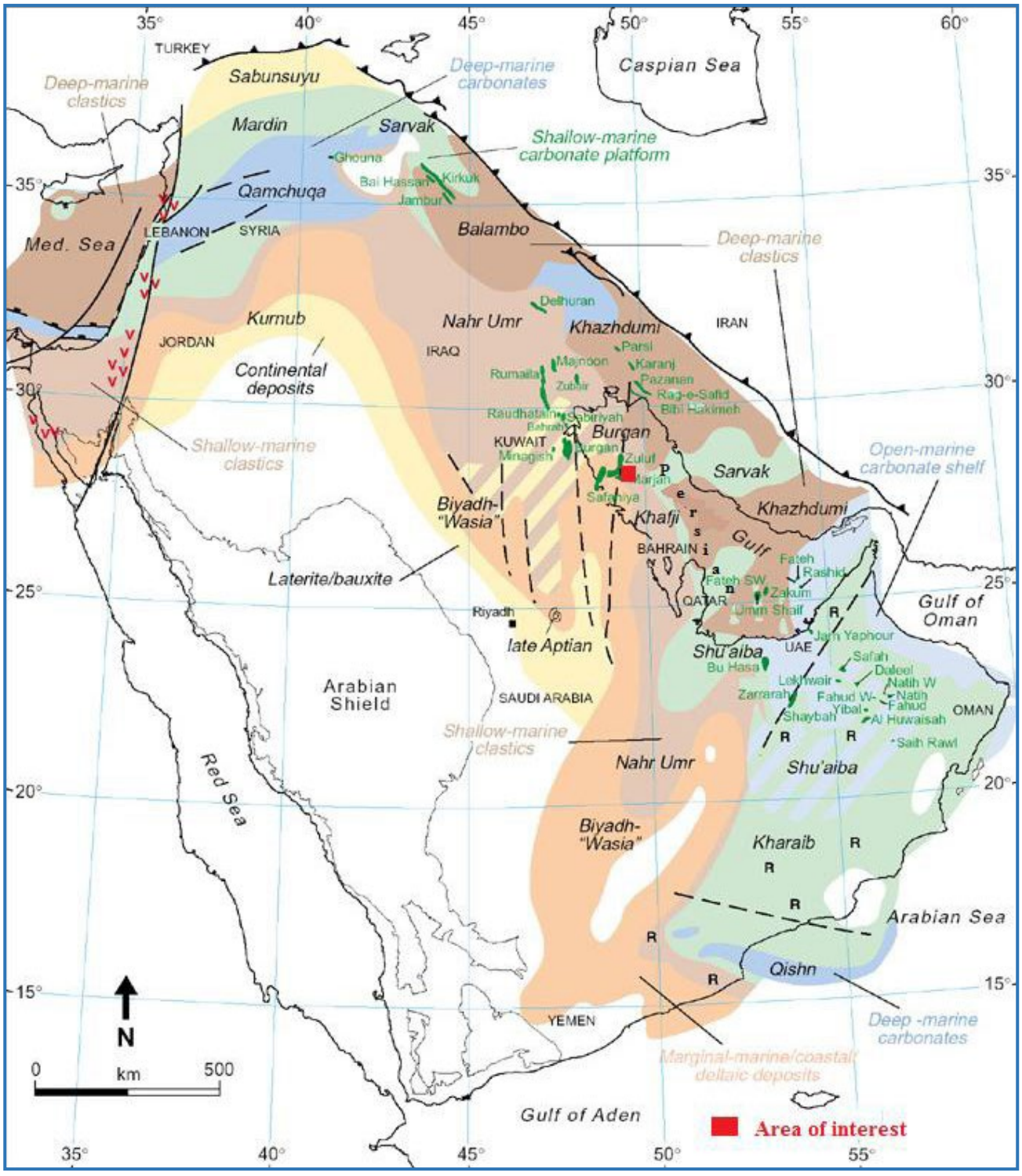

Figure 5: The Paleofacies of the late Early Cretaceous, Including Deposition of the Dariyan (Shu'aiba), Burgan, Kazhdumi, Mauddud members, and their Regional Equivalents in the Arabian Plate. (Ziegler,1998)

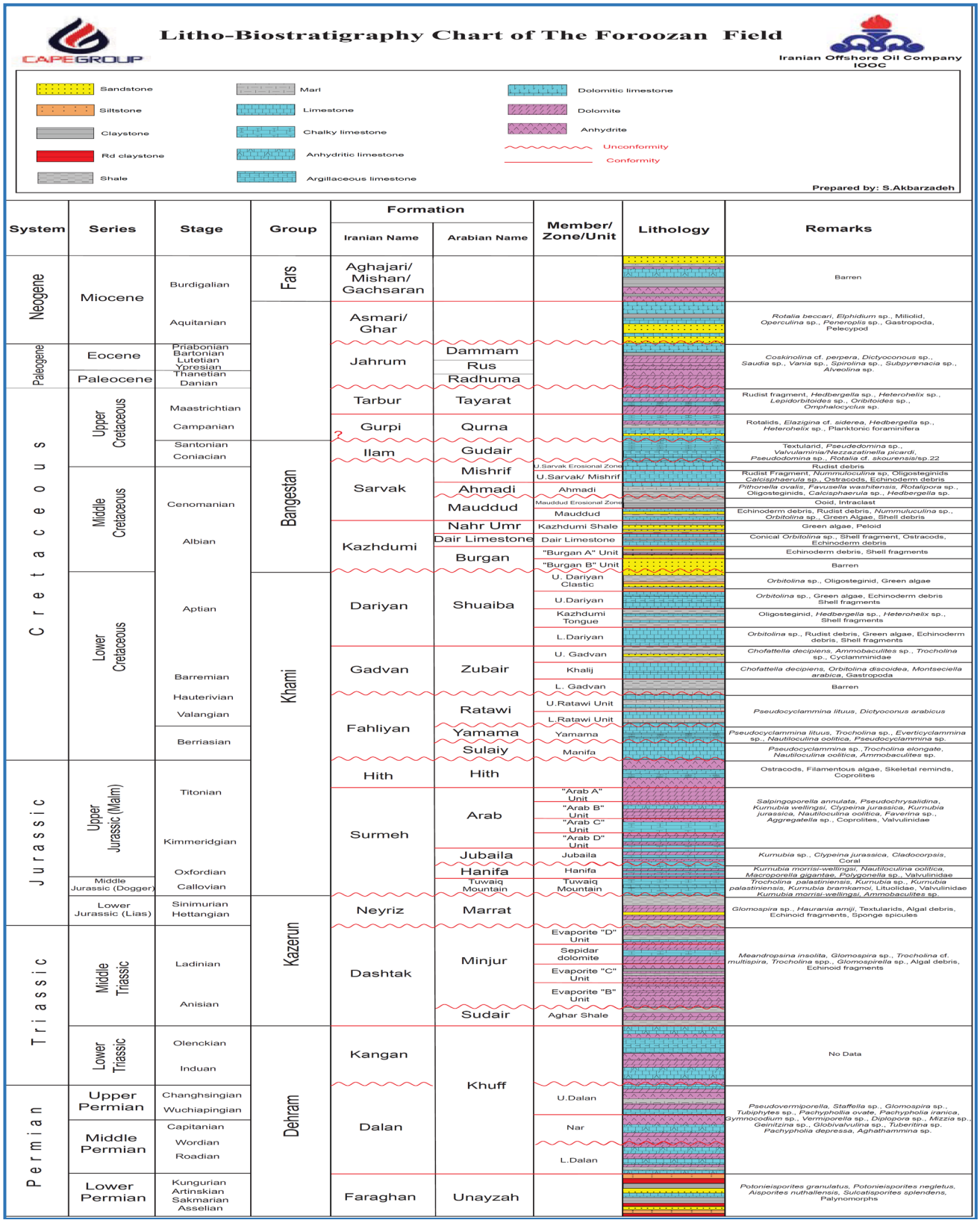

Figure 6: The Bio-Lithostratigraphic Chart of Foroozan Oil Field (CAPE GROUP Studies)

2.3 Stratigraphy

A normal stratigraphical succession of formations was drilled in the F-18-03PH and MH wells from surface to total depth in Arab-D member (In the pilot hole) and to Burgan-A unit (In the main hole). As shown in Figure 8 (domain is MD Due to existence of GWL in well section) the thicknesses of Upper Burgan-A is equal to 42.5mTVD in both of pilot hole and main hole and the thicknesses of Lower Burgan-A is equal to 28mTVD in pilot hole (In the main hole the well path didn't reached to the base of Lower Burgan-A) .is the same in the F-15-01-DT-Re-1H, F-15-02H and F-15-03H wells (about 3.5 m). But there is a minor change in its thicknesses around F-15 platform. Its thickness increases toward the north and east of F-15 platform which can be due to lateral depth changing in deltaic environments. Therefore it cause to decrease in depth and thickness of Burgan member, near the crest as it can be seen in the Figure 3 . The average thickness of U. Burgan A (Sand-2 zone) is about 4.5m in F-15 platform and it increases to 7-8m toward the flanks. The drilled stratigraphical succession of formations, members, units and zones are shown in Table 2 to .

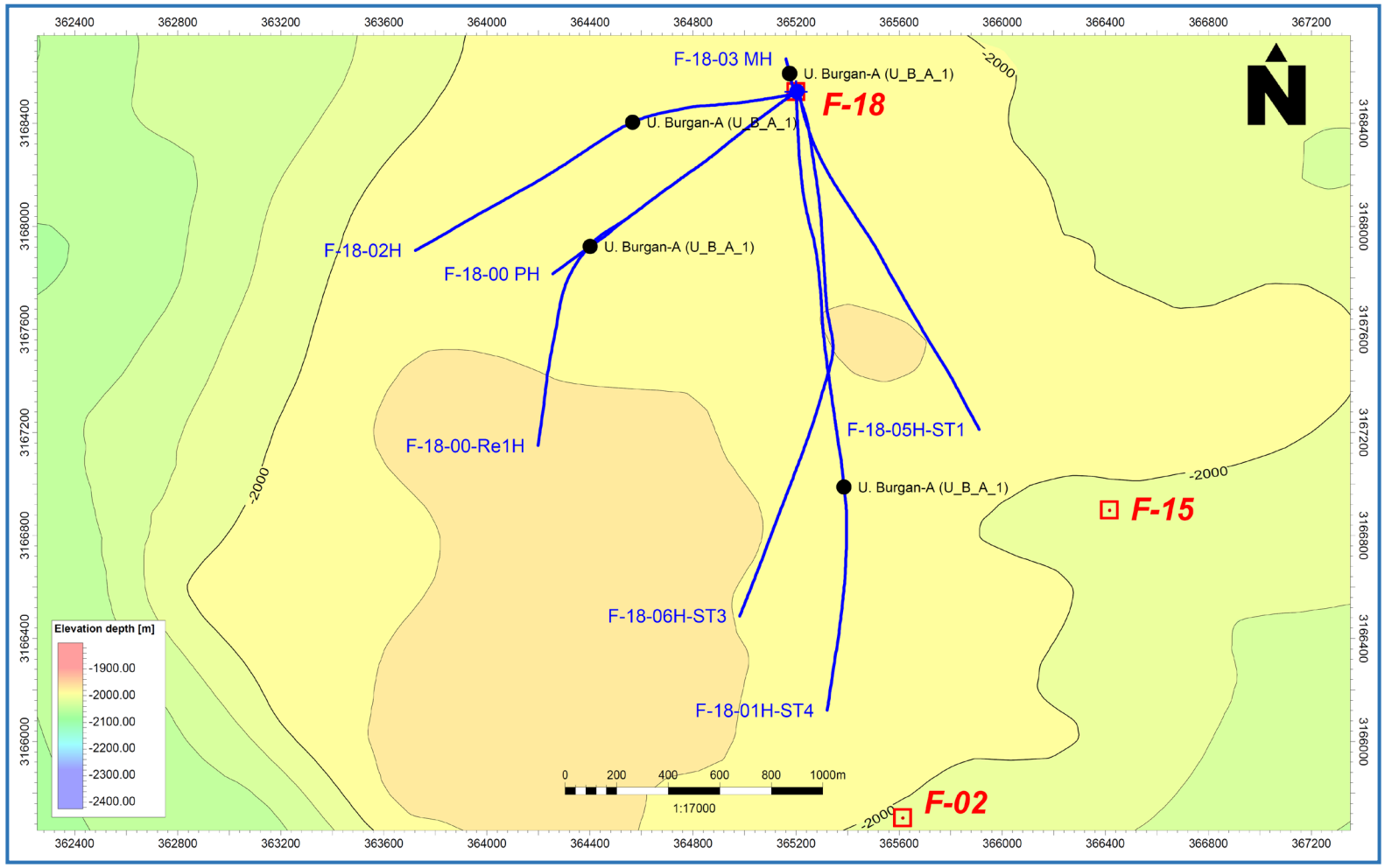

Figure 7: The F-18-03PH and MH Well Path on U. Burgan

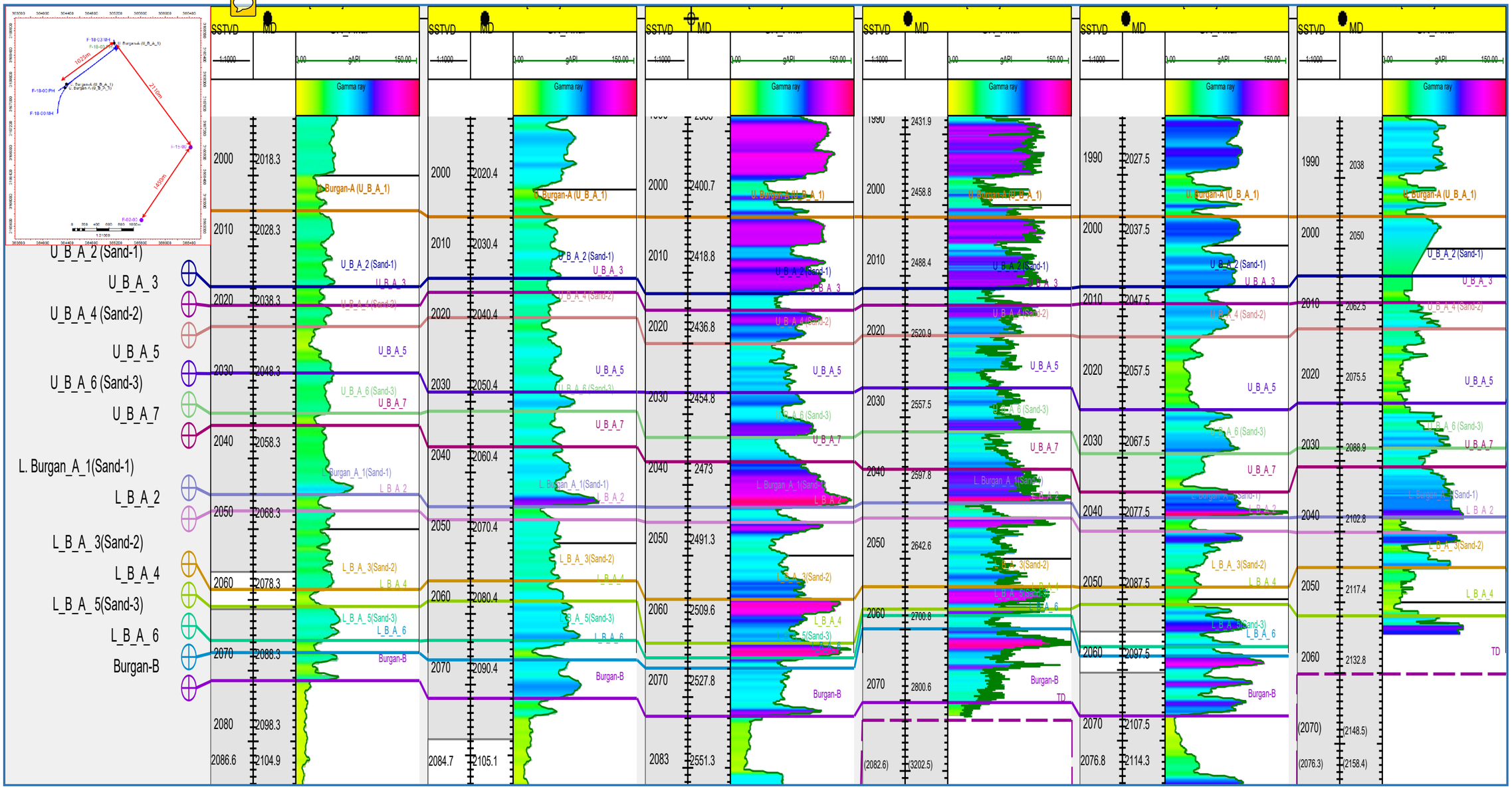

Figure 8: Burgan-A Correlation on the F-18 Wells and Nearby Wells

2.4 Lithology Description

2.4.1 The F-18-03PH Well

A normal stratigrphical succession of formations were drilled in the F-18-03PH well from surface to 3018.5 mMD (- 2098.8 mTVDss) in Arab Formation (Surmeh Formation), Arab-D member as follows:

- **Fars Group Formations: From 86.7 mMD (-50.5TVDss) to 520 mMD (-483.7 mTVDss) with 433.5m vertical thickness**

Fars Group formations consist of Anhydrite: transparent to white, hard to moderately hard, Marl/Claystone: Grey, green, red, soft, calcareous and white. Sand stone: translucent, colorful, fine grain, sub-sorted and Limestone: white to cream and hard.

- **Asmari-Ghar (CP) Zone: From520 mMD (-483.7 mTVDss) to 548 mMD (-511.7 mTVDss)with 28 m vertical thickness**

It mostly composed of Claystone: Grey, sticky and soft with Anhydrite: white to colorless, glassy, crystalline, medium to hard and Dolomitic Limestone: white, medium to hard I, I/III, A, B.

- **Asmari-Ghar Formation: From 548 mMD (-511.7 mTVDss) to 653.4 mMD (-617.1 mTVDss) with 105.4 m vertical thickness**

Asmari-Ghar Formation consists Sandstone: Transparent, glassy, white, medium sorted and medium rounded.

Claystone: Grey, soft and washable, some Anhydrate: white transparent, medium hard and crystalline.

- **Jahrum Formation: From 653.4 mMD (-617.1 mTVDss) to 1426.9 mMD (-1389.4 mTVDss) with 772.3m vertical thickness**

Jahrum Formation composed of Dolomite: cream and brown, medium hard to hard I/III, III. B, C.

Dolomitic Limestone: light cream to cream, light brown, Medium hard to hard I/III, B, C, in some parts it changes to A, And B.

Argillic Dolomite: Cream to light grey, brown, hard. I/III. A/B, B.

Claystone: Light grey to grey, medium hard and calcareous.

Also in the basal pat of Jahrum formation, there has been some trace of Lignite: black, medium hard and some Asphalten samples in upper part of it.

- **Tarbur/Tayarat Formation: From 1426.9 mMD (-1389.4 mTVDss) to 1609.4 mMD (-1571.9 mTVDss) with 182.5 m vertical thickness**

  Tarbur/Tayarat Formation mostly consists of argillaceous and dolomitic limestone: grey, brown, hard. I/III.I, A/B, A.

  Shale: dark grey, medium hard calcareous with Lignite: black, medium hard.

  Limestone: white, soft, II, B and chalky

- **Gurpi/Qurna Formation: From 1609.4 mMD (-1571.9 mTVDss) to 1698.5 mMD (-1661 mTVDss) with 89.1 m vertical thickness**

  Gurpi/Qurna Formation consists of argillaceous limestone: white to light green/grey, medium hard, II, B.

  Limestone: white and light grey, medium hard, I, II, A.

  Marl: dark grey, grey medium hard to soft.

- **Ilam/Gudair Formation: From 1698.5 mMD (-1661 mTVDss) to 1729.7 mMD (-1692.2 mTVDss) with 31.2 m vertical thickness**

  Ilam/Gudair Formation consists of Limestone: white. Light cream, white, medium hard to hard. I/III, I, B/C, A.

  Argillaceous limestone: light grey, grey, green grey medium to hard, I/ II, A.

  Also other has been some trace of Claystone: red to brown, soft, some calcareous.

- **Sarvak Formation: 1729.7 mMD (-1692.2 mTVDss) to 1931.1 mMD (-1893.6 mTVDss) with 201.4 m vertical thickness**

  Sarvak Formation is divided to Sarvak Erosional zone and Sarvak/Mishrif member, Ahmadi member, Mauddud Erosional zone and Mauddud members.

  - **Sarvak Erosional zone: 1729.7 mMD (-1692.2 mTVDss) to 1732.5mMD (-1695 mTVDss)** with **2.8 m vertical thickness**

    Sarvak Erosional zone is consist of Marl: Grey to dark grey. soft and sticky.

  - **Sarvak/Mishrif Mbr. From** 173[illegible]**mMD (-1695 mTVDss) to 1789.7 mMD (-178[illegible]2 mTVDss)** with **57.2 m vertical thickness**

    Sarvak/Mishrif Mbr. is consists of Limestone: light cream, white, medium to hard, I/II, A/B

    Claystone: red, red to brown, soft and calcareous.

  - **Ahmadi Mbr. From** 178[illegible] **mMD (-1785**[illegible]**mTVDss) to 1831.2 mMD (-1793.6 mTVDss) with 41.5 m vertical thickness**

It is composed of Argil limestone: light grey, grey, I/II, medium to hard, A/B.

Claystone: dark grey, soft to medium hard, calcareous, graded to shale.

Shale: dark grey, medium hard, fissile and some calcareous.

- **Erosion of Mauddud Mbr. 1831.2 mMD (-1793.6 mTVDss) to 1864.6 mMD (-1809 mTVDss) with 15.4 m vertical thickness**

It consist of Shale: dark brown, green grey, medium to hard, fissile and some calcareous.

- **Mauddud Mbr. From 1864.6 mMD (-1809 mTVDss) to 1931.1 mMD (-1893.6 mTVDss) with 84.6m vertical thickness**

It includes of Limestone: light cream, light grey, I/II, medium to hard. B, some glauconite and oil stain.

Argillaceous limestone: grey, light grey, I/II soft, medium to hard, A/B.

Marl: grey, green grey, soft and sticky.

➢ **Kazhdumi Formation: From 1931.1 mMD (-1893.6 mTVDss) to 2150.9mMD (-2113.4 mTVDss) with 219.8 m vertical thickness**

Kazhdumi Formation is divided to some members including Kazhdumi Shale, Dair Lst. and Burgan members. Also, Burgan member is divided to Burgan-A and Burgan-B units.

- **Kazhdumi Shale: From 1931.1 mMD (-1893.6 mTVDss) to 1993.8 mMD (-1956.3 mTVDss) with 62.7 m vertical thickness**

It mostly consists of Claystone: grey, green grey, soft and sticky.

Marl: grey, green grey, soft and sticky.

Shale: grey, dark grey medium to hard and fissile shale with high glauconitic content.

Sandstone: colorless, grey crystalline, fine grain, rounded, medium sorted.

Silty claystone: green, grey, dark grey medium to hard.

Limestone: light cream, light grey. I, I/II, medium to hard, A/B, some argillaceous.

- **Dair Lst. member: From 1993.8 mMD (-1956.3 mTVDss) to 2033.4 mMD (-1995.9 mTVDss) with 39.6 m vertical thickness**

It consists of Limestone: light cream, light grey. I, I/II, I/III medium to hard, A/B, some argillaceous.

Claystone: dark grey, green grey, soft and sticky.

Marl and shale: grey, dark grey medium to hard and fissile.

- **Burgan Member: From 2033.4 mMD (-1995.9 mTVDss) to 2150.9mMD (-2113.4 mTVDss) with 117.5 m vertical thickness.**

It consists of Sandstones, Silty claystone with interbeds of Claystone in Burgan-A unit and Burgan-B unit.

- Burgan-A Unit: From 2033.4 mMD (-1995.9 mTVDss) to 2104 mMD (-2066.5 mTVDss) with 70.6 vertical thickness

Burgan-A is divided to Upper Burgan-A and Lower Burgan-A. Upper Burgan-A is composed of seven layers with contents of clay and sand. Also, lower Burgan-A consists of some claystone and sandy layers.

Sandstone: glassy, translucent, hard, colorful, fine to medium gray, weak sorted, sub rounded, loos with free quartz.

Silty claystone: gray, dark brown, soft to medium.

Claystone: gray, green gray, soft and sticky clay.

- Burgan-B Unit: From 2104 mMD (-2066.5 mTVDss) to 2150.9mMD (-2113.4 mTVDss) with 46.9 m vertical thickness.

Burgan-B is mostly composed of:

Silty slay stone: grey to light grey, medium hard.

Sandstone: transparent, translucent, crystalline, Fine grain. Medium rounded and medium sorted.

➢ **Dariyan Formation: From 2150.9 mMD (-2113.4 mTVDss) to 2311.9 mMD (-2274.3 mTVDss) with 161 m drilled vertical thickness.**

Dariyan Formation is composed of four divisions such as Upper Dariyan Clastic zone, Upper Dariyan member, Kazhdumi Tongue and Lower Dariyan member.

- **U. Dariyan Clastic Zone: From 2150.9 mMD (-2113.4 mTVDss) to 2191.9 mMD (-2154.3 mTVDss) with 41 m vertical thickness.**

Upper Dariyan Clastic is composed of:

Shale: black, brown, dark brown, green grey, medium hard.

Limestone: white, off white, medium hard, I, A/B plus.

Claystone: grey, dark grey, soft-medium hard.

- **U. Dariyan Member: 2191.9 mMD (-2154.3 mTVDss) to 2198.4 mMD (-2160.8 mTVDss) with 6.5 m vertical thickness.**

Upper Dariyan is consist of limestone: white, off white, light cram, hard, I, A/B.

- **Kazhdumi Tongue Member: From 2198.4 mMD (-2160.8 mTVDss) to 2237.3 mMD (-2199.7 mTVDss) with 38.9 m vertical thickness.**

Kazhdumi Tongue is composed of: Claystone: dark grey, dark green grey, hard at the top.
Argillaceous limestone: dark grey, grey, dark green grey, hard, I/II, I, A/B, bituminous

- **L. Dariyan Member: From 2237.3 mMD (-2199.7 mTVDss) to 2311.9 mMD (-2274.3 mTVDss) with74.6 m vertical thickness.**

L. Dariyan Mbr. consists of white, cream, some chalky, I, II, I/II, medium to hard, fossiliferous lime stone with fair to good porosity and oil stain.

➢ **Gadvan Formation: From 2311.9 mMD (-2274.3 mTVDss) to 2397.8 mMD (-2336.4 mTVDss) with 86 m drilled vertical thickness.**

Gadvan Formation is divided to Upper Gadvan, Khalij and Lower Gadvan members.

- **U. Gadvan Mbr: From 2311.9 mMD (-2274.3 mTVDss) to 2365.8 mMD (-2328.3 mTVDss) with 53.9 m vertical thickness.**

Upper Gadvan Mbr. consists of: dark gray to gray, soft to medium hard, blocky clay stone; with inter-bedded fine grained, calc-cemented, brown-gray brown, sub sorted, oil-stained sand.

- **Khalij Mbr: From 2365.8 mMD (-2328.3 mTVDss) to 2373.9 mMD (-2336.4 mTVDss) with 8.1 m vertical thickness.**

Khalij member consists of chalky, crystalline, I/II, cream, off white, fossiliferous limestone.

- **L. Gadvan Mbr: From 2373.9 mMD (-2336.4 mTVDss) to 2397.8 mMD (-2336.4 mTVDss) with 23.9 m vertical thickness.**

Lower Gadvan Member: dark gray to gray, soft to medium hard, blocky, slightly calcareous clay stone.

Fahliyan formation is equal to Ratawi, Yamama and Manifa Formation in Arabian stratigraphic column.

➢ **Ratawi Formation: From 2397.8 mMD (-2336.4 mTVDss) to 2526 mMD (-2488.5 mTVDss) with 128.2 m vertical thickness.**

Ratawi Formation is divided to Upper Ratawi and Lower Ratawi members.

- **U. Ratawi Mbr: From 2397.8 mMD (-2336.4 mTVDss) to 2489.3 mMD (-2451.7 mTVDss) with 91.4 m vertical thickness.**

  U. Ratawi Mbr. consists of brown gray, cream, off white, I, I/II, medium hard to hard, lime stone and light gray, brown gray, medium hard, I, I/II argillaceous lime stone. Also, at the end of this member some thin light gray, light greenish gray, soft and sticky marl layers.

- **L. Ratawi Mbr: From 2489.3 mMD (-2451.7 mTVDss) to 2526 mMD (-2488.5 mTVDss) with 36.7 m vertical thickness.**

  L. Ratawi Mbr. consists of light brown to cream, buff, I, hard, with organic material lime stone and light gray, gray, greenish gray, soft to medium hard, I, I/II argillaceous lime stone.

➢ **Yamama Formation: From 2526 mMD (-2488.5 mTVDss) to 2797 mMD (-2759.4 mTVDss) with 270.9 m vertical thickness.**

Yamama Formation. consists of: light brown to cream, light gray, brown, I, I/II, hard to medium hard, oil stained with organic material lime stone. Light gray, gray, soft to medium hard, I, I/II argillaceous lime stone and gray, greenish gray, soft, blocky clay stone

➢ **Manifa Formation: From 2797 mMD (-2759.4 mTVDss) to 2821.9 mMD (-2784.3 mTVDss) with 24.9 m vertical thickness.**

Manifa Formation consists of brownish gray to brown, medium hard, I, I/II argillaceous lime stone.

➢ **Hith Formation: From 2821.9m MD (-2784.3 mTVDss) to 2886.4m MD (-2848.8 mTVDss) with 64.4 m vertical thickness**

Hith formation consists of white, soft to moderately hard, amorphous Anhydrite and light brown to brown, I, I/II, moderately hard with anhydrite patch lime stone.

➢ **Arab Formation: From 2886.4m MD (-2848.8 mTVDss) to 3018.5m MD (-2980.8 mTVDss) with 137.1 m vertical thickness (Drilled thickness)**

Arab Formation is equal to Surmeh Formation in Iranian stratigraphic column and it is divided to Arab-A, Arab-B, Arab-C and Arab-D Members.

- **Arab-A member: From 2886.4m MD (-2848.8 mTVDss) to 2909.4m MD (-2864.7 mTVDss) with 16m vertical thickness**

Arab-A member consisting of brown, dark brown, medium hard anhydrite and Limestone: Grey, hard, I, A.

- **Arab-B member: From 2909.4m MD (-2864.7 mTVDss) to 2915.2m MD (-2877.5 mTVDss) with 12.8 m vertical thickness**

  Limestone: Grey, light grey, medium hard, I/II, A/B with high oil stain content and brown, dark brown, medium hard anhydrite and with high argil content at the base of it.

- **Arab-C member: From 2915.2m MD (-2877.5 mTVDss) to 2933.5 m MD (-2895.8 mTVDss) with 18.3 m vertical thickness**

  Arab-C is composed of Limestone: Grey, light grey, medium hard, I, I/II, A, A/B

- **Arab-D member: 2933.5 m MD (-2895.8 mTVDss) to 3018.5m MD (-2980.8 mTVDss) with 84.6 m vertical thickness (Drilled thickness)**

  Arab-D is composed of Limestone: Grey, dark grey, hard, medium hard, I, I/II, A, A/B completely with high oil stain content.

1.1.1 The F-18-03MH Well

A normal stratigraphical succession of formations was drilled in the F-18-03MH well from Mauddud member by drill out cement with 8 1/2 "bit size from S.T.P. at 1855 mMD (-1817.5 mTVDss) to TD at 2133 mMD (-2060.1 mTVDss) in Burgan-A unit.

- **Sarvak Formation: In this main hole just the Mauddud member was drilled.**
  - **Mauddud Mbr. From side track point at 1855 mMD (-1817.5 mTVDss) to 1933 mMD (-1894.5 mTVDss) with 77m drilled vertical thickness.**

    It includes of Limestone: light cream, light brown, I, I/II, A/B medium hard to hard. B, with oil stain and organic matt.

    Claystone: grey, dark grey, soft and sticky with some calcareous.

- **Kazhdumi Formation: From 1933 mMD (-1894.5 mTVDss) to 2133 mMD (-2060.1 mTVDss) with 165.5 m drilled vertical thickness**

  Kazhdumi Formation is divided to some members including Kazhdumi Shale, Dair Lst. and Burgan members. Also, Burgan member is divided to Burgan-A and Burgan-B units.

  - **Kazhdumi Shale: From 1933 mMD (-1894.5 mTVDss) to 2006 mMD (-1957.4 mTVDss) with 62.9 m vertical thickness**

    It mostly consists of Claystone: grey, green grey, soft and sticky.

    Marl: grey, green grey, soft and sticky.

    Shale: grey, dark grey medium to hard and fissile shale with high glauconitic content.

    Sandstone: colorless, grey crystalline, fine grain, rounded, medium sorted.

    Silty claystone: green, grey, dark grey medium to hard.

    Limestone: light cream, light grey. I, I/II, medium to hard, A/B, some argillaceous.

  - **Dair Lst. member: From 2006 mMD (-1957.4 mTVDss) to 2044.5 mMD (-1995.4 mTVDss) with 38 m vertical thickness**

    It consists of Limestone: light cream, light grey. I, I/II, I/III medium to hard, A/B, some argillaceous.

    Claystone: dark grey, green grey, soft and sticky.

    Marl and shale: grey, dark grey medium to hard and fissile.

- **Burgan Member: From 2044.5 mMD (-1995.4 mTVDss) to 2133 mMD (-2060.1 mTVDss) with 64.7 m drilled vertical thickness.**

  Burgan member is divided to two units (Burgan-A and Burgan-B). in this main hole just the Burgan-A unit was drilled.

  - Burgan-A Unit: From 2044.5 mMD (-1995.4 mTVDss) to 2133 mMD (-2060.1 mTVDss) with **64.7m drilled vertical thickness.**

  Burgan-A is divided to Upper Burgan-A and Lower Burgan-A.

  Upper Burgan-A Unit: From 2044.5 mMD (-1995.4 mTVDss) to 2099.9 mMD (-2037.9 mTVDss) with 42.5m vertical thickness.

  Upper Burgan-A is composed of seven layers with contents of clay and sand.

  Lower Burgan-A Unit: 2099.9 mMD (-2037.9 mTVDss) to 2133 mMD (-2060.1 mTVDss) with 22.2m drilled vertical thickness.

  Sandstone: glassy, translucent, hard, colorful, fine to medium gray, weak sorted, sub rounded, loos with free quartz.

  Silty claystone: gray, dark brown, soft to medium.

  Claystone: gray, green gray, soft and sticky clay.

Announced Well top of F-18-03PH and F-18-03MH (MD & TVDss) are tabulated in Table 2 and Table 3. Respectively. Also the details of zonation in F-18-03PH well and details of Kazhdumi zonation in F-18-03MH is presented in Table 4 to Table 12.

2.5 Formation Tops

The following tables (Table 2 to Table 12) demonstrate formations tops drilled in the F-18-03PH and MH wells along with their zonation. Differences between forecast and actual well tops are demonstrated in Table 13.

The used stratigraphic division is based on the latest studies on Foroozan stratigraphy (Figure 6)

Table 2: Drilled Formation Top in the F-18-03PH Well

Well	Time Unit			Stratigraphic Unit			Top (m)			Coordinates		Thickness		Formaion V. Thickness (m)	Remark
	Era (Erathem)	Period (System)		Epoch (Series)	Formation/Member/Unit/Zone		MD	TVD	TVDSS	Easting	Northing	mMD	mTVD		
F-18-03PH	Cenozoic	Tertiary	Neogene	Pliocene	Fars group		86.7	86.4	-50.5	365203.3	3168525.4	433.3	433.5	433.5	
				Miocene	Asmari_Ghar (CP)		520.0	519.9	-483.7	365204.0	3168523.7	28.0	28.0	28.0	
					Asmari_Ghar		548.0	547.9	-511.7	365204.5	3168523.4	105.4	105.4	105.4	
			Paleogene	Oligocene											
				Eocene	Jahrum (Eocene)		653.4	653.3	-617.1	365204.9	3168526.1	773.5	772.3	772.3	
				Paleocene											
	Mesozoic	Cretaceous		Upper Cretaceous (Senonian)	Tarbur(Tayarat)		1426.9	1425.6	-1389.4	365190.1	3168542.1	182.5	182.5	182.5	
					Gurpi(Qurna)		1609.4	1608.1	-1571.9	365189.2	3168539.9	89.2	89.1	89.1	
					Ilam(Gudair)		1698.5	1697.3	-1661.0	365188.9	3168538.0	31.2	31.2	31.2	
				Middle Cretaceous	Sarvak	U.Sarvak	Erosinal Zone	1729.7	1728.4	-1692.2	365188.5	3168537.9	2.8	2.8	
						U. Sarvak-Mishrif		1732.5	1731.2	-1695.0	365188.5	3168537.9	57.2	57.2	
						Ahmadi		1789.7	1788.4	-1752.2	365188.5	3168537.7	41.5	41.5	201.4
						Mauddud	Erosinal Zone	1831.2	1829.9	-1793.6	365188.2	3168537.6	15.4	15.4	
						Mauddud		1846.6	1845.3	-1809.0	365188.2	3168537.5	84.6	84.6	
	Mesozoic				Kazhdumi	Kazhdumi Shale (Nahr Umr)		1931.1	1929.8	-1893.6	365187.7	3168537.2	62.7	62.7	
						Kazhdumi Lst.(Dair Lst.)		1993.8	1992.5	-1956.3	365187.9	3168537.5	39.6	39.6	219.8
						Burgan	Burgan-A	2033.4	2032.1	-1995.9	365188.0	3168537.5	70.6	70.6	

RTE:36.24m

Well	Time Unit			Stratigraphic Unit			Top (m)			Coordinates		Thickness		Formaion V. Thickness (m)	Remark
	Era (Erathem)	Period (System)	Epoch (Series)	Formation/Member/Unit/Zone			MD	TVD	TVDSS	Easting	Northing	mMD	mTVD		
						Burgan-B	2104.0	2102.7	-2066.5	365188.0	3168538.0	46.9	46.9		
			Middle Cretaceous	Dariyan (Shuaiba)	Upper Dariyan	U.DariyanClastic	2150.9	2149.6	-2113.4	365188.3	3168538.1	41.0	41.0	161.0	
							2191.9	2190.6	-2154.3	365188.1	3168538.3	6.5	6.5		
					Kazhdumi Tongue		2198.4	2197.1	-2160.8	365188.1	3168538.4	38.9	38.9		
					L. Dariyan		2237.3	2236.0	-2199.7	365188.0	3168538.9	74.6	74.6		
				Gadvan (Zubair)	U. Gadvan		2311.9	2310.6	-2274.3	365187.5	3168538.8	53.9	53.9	86.0	
					Khalij		2365.8	2364.5	-2328.3	365187.6	3168538.7	8.1	8.1		
					L. Gadvan		2373.9	2372.6	-2336.4	365187.7	3168538.7	23.9	23.9		
			Neocomian	Fahliyan (Ratawi)	U. Ratawi		2397.8	2396.5	-2360.3	365187.8	3168538.8	91.4	91.4	128.2	
					L. Ratawi		2489.3	2488.0	-2451.7	365186.5	3168538.4	36.7	36.7		
				Fahliyan (Yamama)			2526.0	2524.7	-2488.5	365186.2	3168538.7	271.0	270.9	270.9	
				Fahliyan (Manifa)			2797.0	2795.6	-2759.4	365191.7	3168538.0	24.9	24.9	24.9	
		Jurassic	Upper Jurassic (Malm)	Hith			2821.9	2820.5	-2784.3	365192.1	3168537.9	64.5	64.5	64.5	
				Surmeh Arab	Arab-A		2886.4	2885.0	-2848.8	365193.2	3168537.3	16.0	16.0	131.7*	
					Arab-B		2902.4	2901.0	-2864.7	365193.4	3168537.1	12.8	12.8		
					Arab-C		2915.2	2913.8	-2877.6	365193.6	3168537.0	18.3	18.3		
					Arab-D		2933.5	2932.1	-2895.8	365194.0	3168536.7	84.6*	84.6*		
				T.D. PH			3018.5	3017.1	-2980.8	365195.8	3168535.6	* Drilled thickness to TD			

Table 3: Drilled Formation Top in the F-18-03MH Well

Well	Stratigraphic Unit			Top (m)			Coordinates		Thickness		Remark
	Formation/Member/Unit/Zone			MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03MH	Kazhdumi	Kazhdumi Shale		1933.0	1930.8	-1894.5	365185.6	3168548.3	67.6	62.9	RTE: 36.24m
		Kazhdumi Lst.(Dair Lst.)		2000.6	1993.7	-1957.4	365180.1	3168572.2	43.9	38.0	
		Burgan	U Burgan-A	2044.5	2031.7	-1995.4	365175.2	3168593.5	55.4	42.5	
			L Burgan-A	2099.9	2074.2	-2037.9	365166.7	3168627.9	33.1	22.2	
	TD			2133.0	2096.4	-2060.1	365160.7	3168651.7			

Table 4: Zonation of Sarvak Formation/Mauddud Member in the F-18-03PH Well

Well	Stratigraphic Unit			Top (m)			Coordinates		Thickness		Remark
	Formation/Member/Zone			MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03PH	Sarvak	Mauddud	Mauddud Erosional Zone	1831.2	1829.9	-1793.6	365188.2	3168537.6	15.4	15.4	Based on Log RTE: 36.24m
			Mauddud_1	1846.6	1845.3	-1809.0	365188.2	3168537.5	10.4	10.4	
			Mauddud_2	1857.0	1855.7	-1819.5	365188.1	3168537.5	16.4	16.4	
			Mauddud_3	1873.4	1872.1	-1835.8	365188.0	3168537.4	10.7	10.7	
			Mauddud_4	1884.1	1882.8	-1846.5	365187.9	3168537.4	7.1	7.0	
			Mauddud_5	1891.1	1889.8	-1853.6	365187.9	3168537.4	18.0	18.0	
			Mauddud_6	1909.1	1907.8	-1871.6	365187.7	3168537.3	9.4	9.4	
			Mauddud_7	1918.5	1917.3	-1881	365187.7	3168537.2	12.6	12.6	

Table 5: Zonation of Kazhdumi Formation/Upper Kazhdumi Member in the F-18-03PH Well

Well	Stratigraphic Unit			Top (m)			Coordinates		Thickness		Remark
	Formation/Member/Unit			MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03MH	Kazhdumi	U Kazhdumi	Kazhdumi Shale (KZ_1)	1933.0	1930.8	-1894.5	365185.6	3168548.3	4.0	3.9	F-18-03-MH RTE: 36.24m
			KZ_2	1937.1	1934.7	-1898.4	365185.4	3168549.4	6.9	6.6	
			KZ_3	1944.0	1941.3	-1905.1	365184.9	3168551.3	7.5	7.1	
			KZ_4 (Sand-1)	1951.5	1948.4	-1912.2	365184.4	3168553.6	8.6	8.1	
			KZ_5	1960.1	1956.5	-1920.3	365183.7	3168556.5	5.8	5.4	
			KZ_6 (Sand-2)	1965.9	1961.9	-1925.7	365183.3	3168558.5	11.7	10.8	
			KZ_7	1977.6	1972.8	-1936.5	365182.3	3168562.8	23.1	20.9	

Table 6: Zonation of Kazhdumi Formation/Burgan-A in the F-18-03PH Well

Well	Stratigraphic Unit				Top (m)			Coordinates		Thickness		Remark
	Formation/Member/Zone				MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03PH	Kazhdumi	Burgan	Brgan-A	U. Burgan-A (U_B_A_1)	2033.4	2032.1	-1995.9	365188.0	3168537.5	9.9	9.9	Based on Log RTE: 36.24m
				U_B_A_2 (Sand-1)	2043.3	2042.1	-2005.8	365187.9	3168537.5	2.4	2.4	
				U_B_A_3	2045.7	2044.5	-2008.2	365187.9	3168537.5	4.7	4.7	
				U_B_A_4 (Sand-2)	2050.4	2049.1	-2012.9	365187.9	3168537.5	10.3	10.3	
				U_B_A_5	2060.7	2059.5	-2023.2	365187.9	3168537.6	6.2	6.2	
				U_B_A_6 (Sand-3)	2067.0	2065.7	-2029.4	365187.8	3168537.6	5.4	5.4	
				U_B_A_7	2072.4	2071.1	-2034.9	365187.9	3168537.7	3.6	3.6	
				L. Burgan_A_1(Sand-1)	2076.0	2074.7	-2038.5	365187.9	3168537.7	1.9	1.9	
				L_B_A_2	2077.9	2076.6	-2040.4	365187.9	3168537.7	12.6	7.9	
				L_B_A_3(Sand-2)	2090.5	2084.5	-2048.3	365187.9	3168537.8	2.9	2.4	
				L_B_A_4	2093.4	2087.0	-2050.7	365188.0	3168537.8	0.8	6.0	
				L_B_A_5(Sand-3)	2094.2	2092.9	-2056.7	365188.0	3168537.9	1.1	1.3	
				L_B_A_6	2095.4	2094.3	-2058.0	365188.0	3168537.9	8.7	8.5	

Table 7: Zonation of Dariyan Formation/Lower Dariyan Member in the F-18-03PH Well

Well	Stratigraphic Unit			Top (m)			Coordinates		Thickness		Remark
	Formation/Member/Zone			MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03PH	Dariyan	Lowre Dariyan	L.Dariyan (LDR-1)	2237.3	2236.0	-2199.7	365188.0	3168538.9	10.5	10.5	Based on Log RTE: 36.24m
			LDR-2	2247.8	2246.5	-2210.3	365187.9	3168538.9	2.7	2.6	
			LDR-3	2250.4	2249.1	-2212.9	365187.9	3168538.9	10.8	10.8	
			LDR-4	2261.3	2260.0	-2223.8	365187.8	3168538.9	13.2	13.2	
			LDR-5	2274.5	2273.2	-2237.0	365187.7	3168538.8	17.2	17.2	
			LDR-6	2291.7	2290.4	-2254.2	365187.6	3168538.8	20.2	20.2	

Table 8: Zonation of Yamama Formation in the F-18-03PH Well

Well	Stratigraphic Unit		Top (m)			Coordinates		Thickness		Remark
	Formation /Zone		MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03PH	Yamama (Fahliyan)	Yamama-1	2526.0	2524.7	-2488.5	365186.2	3168538.7	7.0	7.0	Based on Log RTE: 36.24m
		Yamama-2	2533.0	2531.7	-2495.4	365186.2	3168538.7	9.2	9.2	
		Yamama-3	2542.2	2540.9	-2504.7	365186.3	3168538.6	1.6	1.6	
		Yamama-4	2543.8	2542.5	-2506.3	365186.3	3168538.5	6.6	6.6	
		Yamama-5	2550.4	2549.1	-2512.8	365186.4	3168538.5	1.4	1.4	
		Yamama-6	2551.8	2550.5	-2514.2	365186.4	3168538.4	6.5	6.5	
		Yamama-7	2558.3	2556.9	-2520.7	365186.5	3168538.4	2.6	2.7	
		Yamama-8	2560.9	2559.6	-2523.4	365186.6	3168538.4	16.5	16.5	
		Yamama- 9	2577.5	2576.1	-2539.9	365187.0	3168538.3	2.8	2.8	
		Yamama-10	2580.2	2578.9	-2542.7	365187.1	3168538.3	129.0	129.0	
		Yamama-11	2709.2	2707.9	-2671.6	365190.0	3168538.3	87.8	87.8	

Well	Stratigraphic Unit		Top (m)			Coordinates		Thickness		Remark
	Formation//Zone		MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03PH	Manifa (Fahliyan)	Manifa-1	2797.0	2795.6	-2759.4	365191.7	3168538.0	14.2	14.2	Based on Log RTE: 36.24m
		Manifa-2	2811.2	2809.8	-2773.6	365192.0	3168538.0	10.7	10.7	

Table 9: Zonation of Hith Formation in the F-18-03PH Well

Well	Stratigraphic Unit		Top (m)			Coordinates		Thickness		Remark
	Formation/Zone		MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03PH	Hith (Surmeh)	Hith-1	2821.9	2820.5	-2784.3	365192.1	3168537.9	5.7	5.7	Based on Log RTE: 36.24m
		Hith-2	2827.6	2826.2	-2789.9	365192.2	3168537.8	9.8	9.7	
		Hith-3	2837.3	2835.9	-2799.7	365192.3	3168537.8	7.5	7.5	
		Hith-4	2844.8	2843.5	-2807.2	365192.5	3168537.7	7.4	7.4	
		Hith-5	2852.2	2850.9	-2814.6	365192.6	3168537.6	17.8	17.8	
		Hith-6	2870.0	2868.7	-2832.4	365192.9	3168537.5	3.1	3.1	
		Hith-7	2873.2	2871.8	-2835.5	365192.9	3168537.4	13.2	13.2	

Table 10: Zonation of Arab (Surmeh) Formation in the F-18-03PH Well

Well	Stratigraphic Unit			Top (m)			Coordinates		Thickness		Remark
	Formation/Member/Zone			MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03PH	Arab (Surmeh)	Arab-A	Arab-A	2886.4	2885.0	-2848.8	365193.2	3168537.3	1.4	1.4	Based on Log RTE: 36.24m
		Arab-B	Arab-B(C.R)	2887.8	2886.4	-2850.2	365193.2	3168537.3	14.5	14.5	
			Arab-B	2902.4	2901.0	-2864.7	365193.4	3168537.1	5.0	5.0	
		Arab-C	Arab-C(C.R)	2907.3	2905.9	-2869.7	365193.5	3168537.1	7.9	7.9	
			Arab-C	2915.2	2913.8	-2877.6	365193.6	3168537.0	10.6	10.6	
		Arab-D	Arab-D(C.R)	2925.8	2924.4	-2888.1	365193.8	3168536.8	7.7	7.7	
			Arab-D	2933.5	2932.1	-2895.8	365194.0	3168536.7	84.6*	84.6*	

Table 11: Zonation of Kazhdumi Formation/Upper Kazhdumi Member in the F-18-03MH Well

Well	Stratigraphic Unit			Top (m)			Coordinates		Thickness		Remark
	Formation/Member/Unit			MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03MH	Kazhdumi	U Kazhdumi	Kazhdumi Shale (KZ_1)	1933.0	1930.8	-1894.5	365185.6	3168548.3	4.0	3.9	F-18-03-MH RTE: 36.24m
			KZ_2	1937.1	1934.7	-1898.4	365185.4	3168549.4	6.9	6.6	
			KZ_3	1944.0	1941.3	-1905.1	365184.9	3168551.3	7.5	7.1	
			KZ_4 (Sand-1)	1951.5	1948.4	-1912.2	365184.4	3168553.6	8.6	8.1	
			KZ_5	1960.1	1956.5	-1920.3	365183.7	3168556.5	5.8	5.4	
			KZ_6 (Sand-2)	1965.9	1961.9	-1925.7	365183.3	3168558.5	11.7	10.8	
			KZ_7	1977.6	1972.8	-1936.5	365182.3	3168562.8	23.1	20.9	

Table 12:Zonation of Kazhdumi Formation/Upper Burgan-A Unit in the F-18-03PH Well

Well	Stratigraphic Unit					Top (m)			Coordinates		Thickness		Remark
	Formation/Member/Unit				Zone	MD	TVD	TVDSS	Easting	Northing	mMD	mTVD	
F-18-03MH	Kazhdumi	Burgan	Burgan-A	Upper Burgan-A	U. Burgan-A (U_B_A_1)	2044.5	2031.7	-1995.4	365175.2	3168593.5	10.3	8.4	F-18-03-MH
					U_B_A_2 (Sand-1)	2054.8	2040.1	-2003.9	365173.8	3168599.3	4.7	3.8	
					U_B_A_ 3	2059.5	2043.9	-2007.6	365173.1	3168602.1	4.7	3.7	
					U_B_A_4 (Sand-2)	2064.2	2047.6	-2011.3	365172.5	3168604.9	13.7	10.5	
					U_B_A_5	2077.9	2058.1	-2021.8	365170.3	3168613.4	8.5	6.4	
					U_B_A_6 (Sand-3)	2086.4	2064.4	-2028.2	365169.0	3168618.9	3.6	2.6	
					U_B_A_7	2090.0	2067.1	-2030.9	365168.4	3168621.3	9.8	7.1	
				Lower Burgan-A	L. Burgan_A_1(Sand-1)	2099.9	2074.2	-2037.9	365166.7	3168627.9	3.1	2.2	
					L_B_A_2	2103.0	2076.4	-2040.1	365166.2	3168630.0	7.1	5.0	
					L_B_A_ 3(Sand-2)	2110.1	2081.3	-2045.1	365164.9	3168634.9	10.2	6.8	
					L_B_A_4	2120.3	2088.2	-2051.9	365163.1	3168642.2	12.8*	8.2*	
					TD	2133	2096.37	-2060.1	365160.73	3168651.69	*Drilled Thickness		

Table 13: Comparison Between Forecast and Actual Formation Top in the F-18-03PH Well

Well	Stratigraphic Unit			Forecast Top (RKB:36.24m)			Actual Tops (RKB:36.24m)			Difference			Reasons
	Formation/Member/Unit/Zone			mMD.	mTVDss	TVD Thick.	MD	TVD	TVDSS	MD.	TVDss	TVD Thick.	
F-18-03PH	Fars group			86.7	86.4	461.8	86.7	86.4	433.5	0.0	0.0	28.3	The differences are due to Lack of nearby wells data and uncertainty of static model
	Asmari_Ghar			548.3	548.2	102.0	548.0	547.9	105.4	0.3	0.3	-3.4	
	Jahrum (Eocene)			650.4	650.2	770.4	653.4	653.3	772.3	-3.0	-3.1	-1.9	
	Tarbur(Tayarat)			1421.8	1420.6	187.6	1426.9	1425.6	182.5	-5.0	-5.0	5.1	
	Gurpi(Qurna)			1609.4	1608.2	86.0	1609.4	1608.1	89.1	0.0	0.1	-3.1	
	Ilam(Gudair)			1695.4	1694.2	48.0	1698.5	1697.3	31.2	-3.1	-3.0	16.8	
	Sarvak	U. Sarvak-Mishrif		1743.4	1742.2	44.0	1732.5	1731.2	57.2	10.9	11.0	-13.2	
		Ahmadi		1787.4	1786.2	47.0	1789.7	1788.4	41.5	-2.3	-2.2	5.5	
		Mauddud	Erosional Zone	1834.4	1833.2	16.0	1831.2	1829.9	15.4	3.2	3.4	0.6	
		Mauddud		1850.4	1849.2	86.0	1846.6	1845.3	84.6	3.8	4.0	1.4	
	Kazhdumi	Kazhdumi Shale		1936.4	1935.2	67.0	1931.1	1929.8	62.7	5.3	5.4	4.3	
		Kazhdumi Lst.(Dair Lst.)		2003.4	2002.2	42.0	1993.8	1992.5	39.6	9.6	9.7	2.4	
		Burgan	Burgan-A	2045.4	2044.2	64.0	2033.4	2032.1	70.6	12.0	12.1	-6.6	
			Burgan-B	2109.4	2108.2	22.7	2104.0	2102.7	46.9	5.4	5.5	-24.2	
	Dariyan	U. Dariyan Clastic		2132.1	2130.9	27.8	2150.9	2149.6	41.0	-18.8	-18.7	-13.2	
		U. Dariyan		2160.0	2158.7	6.0	2191.9	2190.6	6.5	-31.9	-31.9	-0.5	
		Kazhdumi Tongue		2165.0	2164.7	21.9	2198.4	2197.1	38.9	-33.4	-32.4	-17.0	
		L. Dariyan		2187.7	2186.6	140.6	2237.3	2236.0	74.6	-49.5	-49.3	66.0	
	Gadvan	U. Gadvan		2328.5	2327.2	37.5	2311.9	2310.6	53.9	16.6	16.7	-16.4	
		Khalij		2366.0	2364.7	5.5	2365.8	2364.5	8.1	0.2	0.2	-2.6	
		L. Gadvan		2371.5	2370.2	17.5	2373.9	2372.6	23.9	-2.4	-2.4	-6.4	

Well	Stratigraphic Unit		Forecast Top (RKB:36.24m)			Actual Tops (RKB:36.24m)			Difference			Reasons
	Formation/Member/Unit/Zone		mMD.	mTVDss	TVD Thick.	MD	TVD	TVDSS	MD.	TVDss	TVD Thick.	
	Ratawi	U. Ratawi	2389.0	2387.7	67.5	2397.8	2396.5	91.4	-8.8	-8.8	-23.9	
		L. Ratawi	2456.3	2455.2	42.0	2489.3	2488.0	36.7	-33.0	-32.7	5.3	
	Yamama		2498.5	2497.2	358.0	2526.0	2524.7	270.9	-27.5	-27.4	87.1	
	Manifa		2856.5	2855.2	39.5	2797.0	2795.6	24.9	59.5	59.6	14.6	
	Hith		2896.0	2894.7	70.5	2821.9	2820.5	64.5	74.1	74.2	6.0	
	Arab	Arab-A	2966.5	2965.2	15.0	2886.4	2885.0	16.0	80.1	80.3	-1.0	
		Arab-B	2981.5	2980.2	29.0	2902.4	2901.0	12.8	79.1	79.3	16.2	
		Arab-C	3010.5	3009.2	38.0	2915.2	2913.8	18.3	95.3	95.4	19.8	
		Arab-D	3048.5	3047.2		2933.5	2932.1		115.0	115.2		

shows the cross section of the F-15-01DT-Re1H-ST2 well and also Burgan-A cross sections are presented with LWD logs in , and . The well correlation log with nearby wells is observed in and the reservoir correlation loge is shown in Figure 8.

2.6 Sampling

Two sets of washed and unwashed cuttings were collected every 1m-2m from Fars group at 458mMD (-421.8 mTVDss) to TD at 3018.5 mMD (-2280 mTVDss) in F-18-03PH well, in addition to the samples were taken for lithological determination and Calcimetry. Also, two sets of washed and unwashed cuttings were collected every 1m-2m from Mauddud member at 1853mMD (-1816.8 mTVDss) to TD at 2133 mMD (-2060.1 mTVDss) in F-18-03MH well.

The well site geologist, taking into account the rate of penetration, the shows, and the lithological variations, has adjusted the sampling intervals.

Cutting samples data are tabulated in Table 14 and Table 15 .Washed, unwashed samples were bagged at each interval and sent onshore according to the drilling program and was delivered to IOOC geologist supervisor. The details of sampling records are available in Appendixes II.

Calcimetry test was performed on most of samples and drilling parameters such as WOB, ROP, GPM, SPP etc. were recorded as well.

The thin section of cutting samples of theF-18-03PH and F-18-03MH wells will be prepared by PGO Company and the results of studies will be issued by specific report.

Table 14: Summary of Washed Samples Sheet of the F-18-03PH Well

Box No.	Sample No.		Formation/Member/Zone	Interval (mMD)		Sampling Rate	Remarks
	From	To		From	To		
F-18-03-PH							
1	1	44	Fars Group	458	546	2m	Washed
1	45	96	Asmari/ Ghar	546	650	2m	Washed
1 - 11	97	622	Jahrum	650	1426	1-2m	Washed
11 - 16	623	806	Tarbur	1426	1615	1m	Washed
16 - 18	807	894	Gurpi	1615	1703	1m	Washed
18 - 19	626	943	Ilam	1703	1752	1m	Washed
19 - 20	944	986	U.Sarvak/Mishrif	1752	1795	1m	Washed
20 - 21	987	1024	Ahmadi Mbr.	1795	1833	1m	Washed
21 - 22	632	1039	Mauddud Erosional zone	1833	1848	1m	Washed
22 - 24	1040	1122	Mauddud	1848	1931	1m	Washed
24 - 25	1123	1184	U.Kazhdumi	1931	1993	1m	Washed
25 - 26	1185	1225	Dair	1993	2034	1m	Washed

26 - 29	1225	1341	Burgan A	2034	2150	1m	Washed
29 - 30	1342	1369	U.Dariyan- Clastic	2150	2190	1m	Washed
30	1370	1376	U.Dariyan	2190	2197	1m	Washed
30 - 31	1377	1416	Kazhdumi-Tongue	2197	2237	1m	Washed
31 - 33	1417	1487	L.Dariyan	2237	2312	1m	Washed
33 - 34	1488	1542	U.Gadvan	2312	2367	1m	Washed
34	1543	1548	Khalij	2367	2373	1m	Washed
34 - 35	1549	1572	L.Gadvan	2373	2397	1m	Washed
35 - 36	1573	1619	U.Ratawi	2397	2458	1m	Washed
36 - 38	1620	1686	L.Ratawi	2458	2525	1m	Washed
38 - 45	1687	1953	Yamama	2525	2792	1m	Washed
45 - 46	1954	1998	Manifa Mbr.	2792	2837	1m	Washed
46 - 47	1999	2062	Hith Fm.	2837	2901	1m	Washed
47	2063	2071	Arab-A	2901	2910	1m	Washed
47 - 48	2072	2103	Arab-B	2910	2942	1m	Washed
48 - 49	2104	2136	Arab-C	2942	2975	1m	Washed
49 - 50	2137	2179	Arab-D	2975	3018	1m	Washed
F-18-03MH							
1	1	29	Mauddud	1853	1932	2m	Washed
1 - 2	30	46	Kazhdumi Shale	1932	1996	2-4m	Washed
2	47	59	Dair Limestone	1996	2040	2-4m	Washed
2 - 3	60	79	U. Burgan-A	2040	2098	2m	Washed
3	79	88	L. Burgan-A	2098	2133	4m	Washed

Table 15: Summary of Unwashed Samples Sheet of the F-18-03MH Well

Box No.	***Sample No.***		***Formation/Member/Zone***	***Interval (mMD)***		***Sampling Rate***	***Remarks***
	From	***To***		***From***	***To***		
F-18-03PH							
1	1	1	Ilam	1750	1752	2m	UnWashed
1	2	22	U.Sarvak/Mishrif	1752	1794	2m	UnWashed
1 - 2	23	41	Ahmadi Mbr.	1794	1832	2m	UnWashed
2	42	49	Mauddud Erosional zone	1832	1848	2m	UnWashed
2 - 3	50	90	Mauddud	1848	1930	2m	UnWashed
3 - 4	91	121	U.Kazhdumi	1930	1992	2m	UnWashed
4	122	142	Dair	1992	2034	2m	UnWashed
4 - 5	143	183	Burgan-A	2034	2116	2m	UnWashed
5 - 6	184	200	Burgan-B	2116	2150	2m	UnWashed
6	201	214	U.Dariyan-Clastic	2150	2190	2m	UnWashed
6	215	217	U.Dariyan	2190	2196	2m	UnWashed

6	218	237	Kazhdumi-Tongue	2196	2236	2m	UnWashed
6 - 7	238	273	L.Dariyan	2236	2312	2m	UnWashed
7 - 8	274	300	U.Gadvan	2312	2366	2m	UnWashed
8	301	303	Khalij	2366	2372	2m	UnWashed
8	304	315	L.Gadvan	2372	2396	2m	UnWashed
8 - 9	316	346	U.Ratawi	2396	2458	2m	UnWashed
9 - 9	347	365	L.Ratawi	2458	2496	2m	UnWashed
10 - 13	366	515	Yamama	2496	2796	2m	UnWashed
13 - 14	516	535	Manifa Mbr.	2796	2836	2m	UnWashed
14	536	567	Hith Fm.	2836	2900	2m	UnWashed
15	568	572	Arab-A	2900	2910	2m	UnWashed
15	573	598	Arab-B	2910	2962	2m	UnWashed
16	599	604	Arab-C	2962	2974	2m	UnWashed
16	605	626	Arab-D	2974	3018	2m	UnWashed
F-18-03MH							
1	1	8	Mauddud	1860	1930	10m	UnWashed
1	9	14	Kazhdumi Shale	1930	1990	10m	UnWashed
1	15	19	Dair Limestone	1990	2040	10m	UnWashed
1	20	21	Up. Burgan-A	2040	2060	10m	UnWashed

2.7 Master Log

Mud logging Service has plotted the Master Log by related software's, while drilling the well and all the geological data such as GR, ROP, Wire Line and LWD logs has been loaded into software. The Master Log was reported via PDF format to Tehran office every day. Final relevant master log for these wells in scale of 1/1000 is attached in Appendix I.

2.8 Coring

The coring operation in F-18-03-PH has been done in 4 steps and 20 runs in total. The Nadin Petro Core Companies Coring BHA consist of 8 1/2 "core head PDC (with 4" core hole), slick stabilizer and 2-4 fiberglass core barrel for each run.

The coring method in Sarvak (Mauddud Mbr.), Kazhdumi and Dariyan formations as '' Conventional Coring'' and in Fahliyan Formation (Ratawi and Yamama Mbrs.) as '' oriented Coring''. Note: also 1.5m Oriented coring catch in the top of Dariyan formation, but the coring method changed to conventional due to low rate of penetration and jamming problem.

Total coring interval 442.03m and total core recovery meterage 439.9m (recovery percent 96.8 %). The steps of coring operation are as below:

First Step:

First step starts from 1846m TMD (0.5m before Mauddud Mbr.) and ended in 1998.4m TMD (4.5m inside Dair Mbr. of Kazhdumi formation) by 7 runs. the coring BHA pulled out to surface. Run in hole with rotary BHA and drilling continued to 2032m TMD. Then rotary BHA pulled out to surface for next coring step.

Second Step:

This step started from 2032m TMD (1m before Burgan A Mbr.) and ended in 2169.44m (about 19m inside U. Dariyan Mbr.) as 6 runs. the coring BHA pulled out to surface. Run in hole with rotary BHA and drilling continued to 2222m TMD. Then rotary BHA pulled out to surface for next coring step.

Third Step:

The 3rd step started from 2222m TMD (24.5m inside Kazhdumi Tongue Mbr.) and ended in 2274.19m (about 34.85m inside L. Dariyan Mbr.) by 3 runs. the coring BHA pulled out to surface. Run in hole with rotary BHA and drilling continued to 2460m TMD. Then rotary BHA pulled out to surface for next coring step.

Forth Step:

The final step started from 2460m TMD (62.5m inside U. Ratawi Mbr. of Fahliyan Fm.) and ended in 2560m (about 34.85m inside L. Dariyan Mbr.) by 4 runs. After finish the job, coring BHA pulled out to surface and vertical drilling continued to total depth 3018.5m TMD at Arab D member of Surmeh formation.

The coring operation details was shown in below table:

Table 16: Coring Dats of F-18-03PH Well

Run no.	Depth		Metrage	Sum	Box no.	Operation Date	Recovery		Formation/ Member/Unit	Core top description	Problem	methode of Service
	From	to					Meter	Percrnt				
1	1846.00	1860.60	14.60	150.40	1 to 14	1401-09-04	14.00	0.96	Mauddud kazhdumi Dair Lst.	Sh: gn, gnshgy, md hd, fissile, sm organic material.	Jamming	HD Conventional Coring
2	1860.60	1874.80	14.20		15 to 28	1401-09-05	13.03	0.92		Lst: crm, lt brn, sft- md hd, vugy, fracture filled by oil, in part neomorphism (crystalization), bearing fossil.	Jamming	HD Conventional Coring
3	1875.80	1891.80	16.00		29 to 44	1401-09-06	15.06	0.94		Lst: crm, lt gy, md hd, hd, fracture filled by organic material, bearing fossil.	Jamming	HD Conventional Coring
4	1892.80	1917.45	24.65		45 to 68	1401-09-09	23.90	0.97		Lst: brn, lt brn, crm, sft, md hd, sm vugy, microfracture filled by oil, bearing fossil.	Jamming	HD Conventional Coring
5	1917.45	1941.85	24.40		69 to 93	1401-09-11	24.25	0.99		Lst: lt gy, gy, nill porosity, dense, microfracture, interbeded with Claystone, organic material, bearing fossil.	Jamming	HD Conventional Coring
6	1941.85	1970.00	28.15		94 to 121	1401-09-12	28.15	1.00		Lst: lt gy, crm, organic material, microfractured, nill porosity, dense, bearing fossil, interbeded with Claystone, high glauconite.	-	HD Conventional Coring
7	1970.00	1998.40	28.40		122 to 150	1401-09-13	28.40	1.00		Clst: gnsh gy, dk gy, hd, dense, grdd to Sh	-	HD Conventional Coring
	1998.40	2032.00	33.60	Drilling					Dair Lst.			
8	2032.00	2069.00	37.00	137.44	151 to 187	1401-09-16	37.00	1.00	Dair Lst. BurganA BurganB U.Dariyan Clastic	Clst: dk gy, gy, hd, grdd to Sh.	-	HD Conventional Coring
9	2069.00	2106.00	37.00		188 to 224	1401-09-17	37.00	1.00		Clst: dk gy, gy, hd, grdd to Sh.	-	HD Conventional Coring
10	2106.00	2126.50	20.50		225 to 245	1401-09-18	20.50	1.00		Sst: dk brn, colourless, sft, very fine to fine grain, well sort, sub rndd, oil contain.	-	HD Conventional Coring
11	2126.50	2137.30	10.80		246 to 257	1401-09-19	10.80	1.00		Sst: brn, dk brn, sft, medium grain, well sort, sub rndd, oil contain.	-	HD Conventional Coring
12	2137.30	2144.80	7.50		258 to 263	1401-09-20	5.30	0.71		Sst: brn, dk brn, sft, medium grain, well sort, sub rndd, oil contain.	Jamming	HD Conventional Coring
13	2144.80	2169.44	24.64		264 to 289	1401-09-21	24.64	1.00		Sst: brn, dk brn, sft, medium grain, well sort, sub rndd, good porosity, oil contain, interbeded with Coal.Coal: blk, hd, blky, glossy.	-	HD Conventional Coring
	2169.44	2222.00	52.50	Drilling					U.Dariyan Clastic U. Dariyan			
14	2222.00	2223.54	1.54	52.09	290 to 291	1401-09-24	1.43	0.93	U. Dariyan L. Dariyan	Arg Lst: gy, lt gy, poor porosity, hd, dense, organic material, bearing fossil,	-	HD Oriented Coring
15	2223.64	2260.00	36.36		292 to 328	1401-09-25	36.36	1.00		Arg Lst: gy, lt gy, poor porosity, hd, dense, organic material, bearing fossil,	-	HD Conventional Coring
16	2260.00	2274.19	14.19		329 to 343	1401-09-26	14.19	1.00		Lst: lt crm , crm, poor porosity, hd, fracture filled by calcite	-	HD Conventional Coring
	2274.19	2460.00	185.00	Drilling					L. Dariyan U Gadvan Khalij L. Gadvan U.Ratawi			
17	2460.00	2496.50	36.50	100.00	344 to 380	1401-09-30	36.50	1.00	U Ratawi L Ratawi Yamama	Lst: lt crm , lt gy, nill porosity, hd, interbeded with Claystone	-	HD Oriented Coring
18	2496.50	2533.50	37.00		381 to 417	1401-09-01	37.00	1.00		Lst: crm , buf, nill porosity, hd, sm fractured filled by organic material	-	HD Oriented Coring
19	2533.50	2537.70	4.20		418 to 421	1401-09-04	4.00	0.95		Lst: lt brn, brn, buf, nill porosity, hd, fractured, beearing fossil	-	HD Oriented Coring
20	2537.70	2560.00	22.30		422 to 444	1401-09-05	22.30	1.00		Lst: brn, lt brn, crm, poor porosity, hd, fractured, oil contain	-	HD Oriented Coring
Total			439.93				433.81	96.85%				

3 Drilling History

3.1 Summary Report of the F-18-03PH Well

3.1.1 26" Hole Section

[Surface to 458 mMD (-421.8 mTVDss)]

Skid f/ well F18-04H to F18-03PH, P/U & M/U 16" Fishing Magnet & RIH, Tag sea bed @ 88m & POOH to Surface. RIH w/ 26" Drilling BHA#01, Tag sea bed & Drill 26" hole section f/ 88m to 183m.

Resume Drilling 26" Hole section f/ 183m to 213m,R/B last stand. Run survey TOTCO @184m (Deviation: 0.5 Degree). RIH f/ 185m to 213m.Resume Drilling 26" Hole section f/ 213m to 329m, Run survey TOTCO @ 300m (Deviation: 0.25 Degree). RIH f/ 300m to 329m.Resume Drilling 26" Hole section f/ 329m to 386m,

Drill 26" hole section f/ 386m to 458m (26" Section TD). CBU, Perform Wiper Trip while Run TOTCO Survey @ 440m. While Run Back to BTM, OBS. Hole Filled up, Clear Same.

Pump Hi-vis pill, CBU, Spot 300 BBLS 75 PCF pill. POOH 26" Rotary BHA#01 to Surface. R/U 20" Casing Handling Tools (Nepta Co.), Run 20" Casing 133 PPF & 94 PPF W/D f/ 453m to 454m . M/U 21 1/4" 2K CHH.

Land 21 1/4" CHH 2K in 30" Landing Ring, CBU, Spot Hi-vis pill. RIH w/ Cement Stab in Stinger (AHAP Co.) & Sting in to 20" Float Shoe. Perform Cement Job as per plan. Back off CHH RT, L/D Landing Assy., R/D 20" Casing Handling Tools. PREPARE TO SKID

3.1.2 17 1/2 " Hole Section

[458 mMD (-421.8 mTVDss) to 992 mMD (-884.6 mTVDss)]

Skid f/ well F18-00PH to well F18-03PH. N/U 21 1/4" BOP. P/U and RIH w/ BOP test plug. Perform BOP test. Install wear bushing. RIH w/ 17 1/2" SlickBHA#02 to BTM. Perform 20" CIT. D/O shoe track. Drill 3m new formation while displace drilling fluid to new mud. Perform FIT. POOH BHA to 30m.

Cont. POOH 17 1/2" Slick BHA to surface. P/U & M/U Directional BHA#03 & RIH to BTM (461m). Start drilling 17 1/2" hole section in rotary mode f/ 461m to478m (KOP). Pump Hi-vis pill, CBU. R/U Sealand Co. wireline sheaves. RIH w/ Gyro survey tools to 453m (Run#01) & Take survey, Set tool face,

StartDirectional Drilling 17 1/2" Hole section f/ 478m to 514m. Run Gyro @ 489m (Run#02) as per PGO Co. DD & MWD engineers request.

Cont. Directional Drilling 17 1/2" Hole section f/ 514m to 667m while run Gyro @ 461.78m (Run#03), 490m (Run#04), 519m (Run#05) & 547m (Run#06) as per PGO Co. DD & MWD engineers request.

Cont. Directional drilling 17 1/2" hole section f/ 667m to 841m.

Cont. Directional Drilling 17 1/2" Hole f/ 841m to 922m (Section TD). Sweep the hole. Perform wiper trip by POOH 17 1/2" BHA#03 f/ 922m to 677m while wash & B/R tight intervals and clear same.

Cont. Wiper trip by POOH 17 1/2" Drilling BHA f/ 677m to 454m (20" casing shoe) and run back to BTM while wash & B/R & R/D and clear tight intervals, CBU. Perform wiper trip by POOH 17 1/2" BHA f/ 922m to 718m and run back to BTM while wash & B/R & R/D and clear tight intervals. CBU.

Cont. CBU. POOH 17 1/2" Directional BHA#03 to surface. Retrieve wear bushing. R/U G.V Kish Co. wireline tools. Perform CDR-DSI-FIAC-NGT wireline log, Log up f/ 922m (Section TD) to 438m, POOH to surface, R/D wireline tools. R/U 13 3/8" Casing handling tools. Run 13 3/8" casing, 68 PPF, L-80, BTC to 346m (Totally Run 29 Jts 13 3/8" Casing, 68 PPF, L-80, BTC)

Cont. Run 13 3/8" Casing to Shoe Depth (920m). Stablish Circulation, Perform Cement Job. Lift up 21 1/4" BOP Stack. Centre 13 3/8" casing inside 21 1/4" CHH. Set 13 3/8" HGR slips. Rough Cut Casing, L/D Landing Assy. R/D casing handling tools. N/D 21 1/4" BOP Stack. Prepare to skid on well F18-04.

3.1.3 12 1/4" Hole section
[992 mMD (-884.6 mTVDss) to 1829 mMD (-1791.5 mTVDss)]

Skid f/ well F18-01H-ST-04 on well F-18-03PH & N/U 18 3/4" high pressure BOP, work on BOP bottom fixed ram & variable ram oil leakage. Function test same, P/U & M/U 12 1/4" slick BHA#04, RIH to 778m.

Cont. RIH f/ 778 to 895m, string take weight, D/O & clear shoe track and rat hole. Drill 3m new formation while displace the well w/ bentonite mud & perform LOT. POOH 12 1/4" slick BHA#04 to surface, P/U & M/U 12 1/4" directional BHA#05 RIH to 680m.

Cont. RIH w/ 12 1/4" Directional BHA#05 f/ 780m to 925m. Start directional drilling 12 1/4" hole section f/ 925m to 928m. Perform leak off test. Resume Directional drilling 12 1/4" hole section f/ 928m to 1086m w/ 5-30 bph DHL.

Cont. Directional drilling 12 1/4" hole section f/ 1086m to 1250m w/ 10-45 bph DHL.

Cont. Directional drilling 12 1/4" hole section f/ 1250m to 1256m w/ 10-45 bph DHL, Obs. string stuck @ 1239m While recycle mud pumps that got free w/ downward torque, Perform wiper trip by Wash & B/R f/ 1256m to 920m (13-3/8" CSG shoe) w/ good open hole condition, Obs. Well (12 bph DHL.), RIH to 1256m (BTM) & Cont. Directional drilling 12 1/4" hole section f/ 1256m to 1353m w/ 10-45 bph DHL.

Cont. Directional drilling 12 1/4" hole section f/ 1353m to 1360m w/ 10-45 bph DHL. Try to take survey @ 1357m, obs. no signal. Change mud pumps & try again, not successful. Decision made to conduct rotation, obs. string stuck, work on same, got free. Wash & B/R f/ 1360m to 1200m. Cont. POOH BHA f/ 1250m to surface on elevator. RIH w/ 3 1/2" OEDP string f/ surface to 1338m. Pump & spot 250 bbls LCM pill 80 ppb. POOH 3 1/2" OEDP string f/ 1338m to 770m. Connect TDS, monitor DHL w/ different flow rates

Cont. monitoring dynamic loss. Close BOP, perform stress cage method by applying 100-150 psi pressure to squeeze LCM. RIH w/ 3 1/2" OEDP string f/ 770m to 1000m. Pump & spot 100 bbls LCM pill 80 ppb. POOH 3 1/2" OEDP string f/ 1000m to 750m. Monitor dynamic DHL w/ 600 gpm, 30 bph, record totally 30 bbls loss. Close BOP, perform stress cage method by applying 100-200 psi pressure to squeeze LCM. RIH w/ 3 1/2" OEDP string f/ 750m to 1180m.

Cont. RIH w/ 3 1/2" OEDP string f/ 1180m to 1255m, string take weight, connect TDS, try to establish circulation, no success, string plug. POOH string f/ 1255m to 920m, unplug same. RIH w/ 3 1/2" OEDP string f/ 920m to 1200m. Connect TDS, W/D f/ 1200m to 1360m. Cont. circulation while monitor DHL w/different flow rates. POOH 3 1/2" OEDP string f/ 1360m to surface. RIH w/ 12 1/4" Directional BHA#06 f/ surface to 261m.

Cont. RIH w/ 12 1/4" Directional BHA#06 f/ 261m to 1100m, string take weight. Wash & R/D f/ 1100m to 1360m. Start Drilling 12 1/4" hole section f/ 1360m to 1446m w/ 0-40 bph DHL.

Cont. Drilling 12 1/4" hole section f/ 1446m to 1460m. Perform short wiper trip by wash & B/R f/ 1460m to 1340m & wash & R/D f/ 1340m to BTM. Resume Drilling 12 1/4" hole section f/ 1460m to 1475.5m, obs. suddenly stop return, complete loss. Activate PBL sub @ two stds off btm, pump & spot 40 bbls conventional LCM pill 80 ppb. POOH BHA f/ 1420m to 1332m. Connect TDS, monitor DHL w/ 625 & 700 gpm, NL/NG. De-activate PBL sub, wash & B/R f/ 1332m to 1100m, cont. POOH BHA f/ 1100m to 1070m on elevator in good hole condition. RIH w/ 12 1/4" Directional BHA#06 f/ 1070m to 1408m, string take weight. Wash & R/D f/ 1408m to 1475.5m. Resume Drilling 12 1/4" hole section f/ 1475.5m to 1476m, encounter w/ complete loss, no return, no annulus level. Activate PBL sub @ two stds off btm, pump & spot 60 bbls conventional LCM pill 80 ppb, no annulus level. POOH BHA f/ 1420m to 1200m. Pump & spot 150 bbls conventional LCM pill 80 ppb, no annulus level. POOH BHA f/ 1200m to 1100m.

Cont. POOH 12 1/4" Directional BHA#06 f/ 1100m to surface. RIH w/ 12 1/4" Rotary BHA#07 f/ surface to 1470m. Pump & spot 120 bbls waste OBM, no return. POOH BHA f/ 1470m to 1150m. RIH f/ 1150m to 1470m. Pump & spot 240 bbls waste OBM, no return. POOH BHA f/ 1470m to 1360m. RIH w/ BHA f/ 1360m to 1470m. Pump & spot 160 bbls conventional LCM pill 80 ppb + 60 bbls conventional LCM pill 20 ppb. POOH BHA f/ 1470m to 1100m, Try to establish circulation obs. string plug. POOH BHA f/ 1100m to 730m.

POOH 12 1/4" Rotary BHA#07 f/ 730m to surface. RIH w/ 12 1/4" Rotary BHA#08 f/ surface to 1100m. Monitor DHL w/ different flow rates. Wash down f/ 1100m to 1476m. Start Rotary drilling f/ 1476m to 1484.5m w/ 25-40 bph DHL.

Cont. Rotary drilling 12 1/4" hole section f/ 1484.5m to 1487.5m w/ 40-60 bph DHL. Stop drilling @ 1487.5m due to severe loss. POOH BHA f/ 1487.5m to 1450m. Pump & spot 50 bbls conventional LCM pill 80 ppb. POOH BHA f/ 1450m to 1280m. Monitor DHL w/ different flow rates. RIH w/ BHA f/ 1280m to BTM. Try to connect TDS, obs. TDS saver sub pin thread twist off inside drill pipe tool jt box. POOH BHA f/ 1487.5m to 920m (13 3/8" casing shoe). Replace TDS saver sub. RIH w/ BHA f/ 920m to 1487.5m. Resume rotary drilling 12 1/4" hole section f/ 1487.5m to 1505m w/ 10-60 bph DHL.

Cont. Rotary drilling 12 1/4" hole section f/ 1505m to 1525m w/ 10-40 bph DHL. Stop drilling @ 1524m due to rig amphion system faults. POOH BHA f/ 1525m to 1450m. Work on amphion system, rectify the problem. Wash & R/D f/ 1450m to 1525m. Resume rotary drilling 12 1/4" hole section f/ 1525m to 1555m w/ 10-50 bph DHL.

Cont.Rotary drilling 12 1/4" hole section f/ 1525m to 1606m w/ 10-50 bph DHL.

Cont.Rotary drilling 12 1/4" hole section f/ 1606m to 1626m w/ 35-50 bph DHL. Stop drilling @ 1626m due to severe loss. POOH BHA f/ 1626m to 1590m. Pump & spot 100 bbls SFK Co. LCM pill 45 ppb. POOH BHA f/ 1590m to 1280m. Connect TDS, monitor DHL. RIH w/ BHA f/ 1280m to 1310m, wash & R/D f/ 1310m to 1626m. Resume Rotary drilling 12 1/4" hole section f/ 1626m to 1632m w/ 35-60 bph DHL.

Cont. Rotary drilling 12 1/4" hole section f/ 1632m to 1671m w/ 35-70 bph DHL while pumping conventional LCM pill 40 ppb periodically w/ 35-70 bph DHL.

Cont. Rotary drilling 12 1/4" hole section f/ 1671m to 1707.5m w/ 25-50 bph DHL while pumping conventional LCM pill 40 ppb periodically. POOH f/ 1707.5m to 1670m, string take weight. B/R f/ 1670m to 1600m.

Spot 100 bbls SFK LCM pill 65 ppb @ 1600m. POOH f/ 1600m to 1590m, string take weight. B/R f/ 1590m to 1500m, POOH f/ 1500m to 1440m. Spot 100 bbls conventional LCM pill 40 ppb @ 1440m. POOH f/ 1440m to 1210m in good hole condition. Spot 100 bbls conventional LCM pill 40 ppb @ 1210m. POOH f/ 1210m to 1000m. Monitor DHL w/ 500-600 gpm, 40 bph. POOH f/ 1000m to 860m. Monitor DHL w/ different flow rates. Obs. DHL decreased gradually f/ 40 bph to NL-NG. Work on TDS. Squeeze 100 bbl LCM into formation. Monitor DHL w/ 550 to 900 gpm, NL-NG. RIH f/ 860m to 1245m, string take weight. R/D f/ 1245m to 1707.5m (BTM).

Resume rotary drilling 12 1/4" hole section f/ 1707.5m to 1747.5m w/ 30-45 bph DHL.

Cont. rotary drilling 12 1/4" hole section f/ 1747.5m to 1792m w/ 35-45 bph DHL.

Cont. rotary drilling 12 1/4" hole section f/ 1792m to 1824m w/ 30-40 bph DHL.

Cont. rotary drilling 12 1/4" hole section f/ 1824m to 1830m (Section TD) w/ 30-40 bph DHL. Sweep the hole. B/R f/ 1830m to 1380m. Fill up string by Fresh mud. RIH to 1585m, string take weight. Try to establish circulation, obs. string is plugged. POOH to 930m. Try to unplug string, no success. Cont. POOH f/ 930m to surface, obs. flapper pin of float valve is broken. B/O & L/D D&M tools that have been racked on rig floor f/ previous runs.

Cont. B/O & L/D D&M tools that have been racked on rig floor f/ previous runs. RIH w/ 12 1/4" Rotary BHA#09 f/ surface to 1015m, string take weight. R/D f/ 1015m to 1829m. POOH f/ 1829m to 1745m, string take weight. B/R f/ 1745m to 1570m.

Cont. B/R f/ 1570m to 1500m. POOH f/ 1500m to 1440m. RIH f/ 1440m to 1550m. POOH f/ 1550m to 1000m while Spot 100 bbl SFK LCM pill 65 ppb @ 1550m, 100 bbl conventional LCM pill 40 ppb @ 1350m & 100 bbl conventional LCM pill 40 ppb @ 1150m. Monitor DHL w/ different flow rates. W/U f/ 1000m to 900m. Close Hydrill, squeeze 100 bbl LCM to formation. Establish circulation, monitor DHL w/ different flow rates. RIH f/ 900m to 1264m, string take weight. R/D f/ 1264m to 1829m

Establish circulation, monitor DHL w/ different flow rates @ 1829m while work on mud properties. Displace hole w/ 75 pcf fresh mud. POOH f/ 1829m to 1777m, string take weight. B/R f/ 1777m to 1515m. POOH 12 1/4" rotary BHA#09 f/ 1515m to surface. Retreive Wear bushing. R/U GV Kish Wireline Sheaves.

RIH w/ wireline logging BHA#01 (MSFL- DLL - GR), Log down f/ 920m to 1815m, Log up f/ 1815m to 845m. POOH f/ 845m to surface. RIH w/ wireline logging BHA#02 (XRMI, CDR, GR) to 1815m. Log up f/ 1815m to 845m. POOH f/ 845m to surface. RIH w/ TLC logging BHA#03 (XMAC- CDR - ZDL - CNL - DSL - GR) to 43m, load sources

Perform surface test of logging BHA#03 (XMAC- CDR - ZDL - CNL - DSL - GR). RIH to 915m. Establish circulation. M/U SES. RIH Pump down head on wireline f/ surface to 871.3m, latch same in Connector sub. Cont. RIH f/ 915m to 1220m on 5 1/2" DP, obs. Telemetry data is lost. POOH f/ 1220m to 950m.Unlatch and POOH Pump down head to surface, perform surface tools test meanwhile establish circulation

Test logging tools @ surface. RIH Pump down head f/ surface to 871.3m, latch same in Connector sub three times but no data received on surface. Unlatch and POOH on wireline f/ 871.3m to surface. POOH Logging BHA#03 f/ 915m to surface. Slip & Cut. RIH w/ 12 1/4" Rotary BHA#10 f/ surface to 950m. String take weight. R/D f/ 950m to 1170m.

Cont. R/D f/ 1170m to 1829m. Establish circulation w/ 500 gpm, CBU while monitor DHL, 10-15 pbh. W/U f/ 1829m to 1572m. POOH f/ 1572m to 1366m. Stop operation due to leakage of Hydraulic hose

of BX Elevator. Work on same, replace BX Elevator w/ manual one. Try to POOH, obs. string is stuck, work on same, string got free. POOH f/ 1366m to 1337m.

Cont. POOH 12 1/4" Rotary condition BHA#10 f/ 1337m to surface while work on TDS hydro-motor @ 920m (13 3/8" casing shoe), remove same. RIH w/ G.V Kish Co. wireline logging BHA#04 f/ surface to 1757m, take weight. Try to pass same, not successful. Log up f/ 1757m to 875m while repeat log up section f/ 1020m to 920m. POOH wireline logging BHA#04 f/ 920m to surface. P/U & M/U G.V Kish Co. TLC logging BHA#05 (in progress)

Cont. P/U & M/U TLC logging BHA#05, RIH same to 912m. M/U SES, RIH w/ pump down head on wireline. Latch same in connector sub. Cont. RIH w/ TLC logging BHA#05 f/ 912m to 1713m, string take weight. Try to pass same, no success. Start TLC logging up operation f/ 1713m to 912m. Unlatch Pump Down Head f/ Connector sub, POOH same on wireline f/ 893m to surface. B/O & L/D SES. L/D pump down head. R/D wireline sheaves. POOH TLC logging BHA#05 f/ 912m to 770m.

Cont. POOH TLC logging BHA#05 f/ 770m to surface while L/D logging tools. RIH w/ 12 1/4" Rotary condition BHA#11 f/ surface to 920m (13 3/8" casing shoe). Wait to receive TDS hydro-motor. Receive same, rectify the problem. Cont. RIH w/ 12 1/4" Rotary condition BHA#11 f/ 920m to 1087m, string take weight. Connect TDS, wash & R/D f/ 1087m to 1200m, w/ 7-10 bph.

Cont. wash & R/D w/ 12 1/4" Rotary condition BHA#11 f/ 1200m to 1830m while clear tight intervals. CBU while condition mud in well. POOH BHA f/ 1830m to 920m while clear tight spots. Run back w/ 12 1/4" Rotary condition BHA#11 f/ 920m to 1720m in very good hole condition.

Cont. RIH w/ 12 1/4" Rotary Condition BHA#11 f/ 1720m to 1830m (BTM) on elevator in very good hole condition. CBU till get clean shaker. Spot 100 bbls polymer solution 73 pcf. POOH BHA f/ 1830m to surface on elevator. Retrieve wear bushing. R/U Sarvak Co. 9 5/8" casing running tools. Run 9 5/8" casing f/ surface to 750m (Totally run 61 jts 9 5/8" casing, 53.5 PPF, L-80, PJE).

Cont. Run 9 5/8" CSG, 53.5 PPF, L-80, PJE f/ 750m to 1826m (9 5/8" casing shoe depth). Perform Cement job as per program. Set 9 5/8" casing hanger slips.

Pressure test 9 5/8" casing hanger slips. Rough cut 9 5/8" casing. L/D 9 5/8" landing jts. R/D 9 5/8" casing handling tools. N/D 18 3/4" 15K BOP stack. Final cut 9 5/8" casing. Install THS assembled w/ DSA. N/U 18 3/4" BOP stack. Perform BOP pressure test (in progress)

3.1.4 8 1/2 " Hole section [1829 mMD (-1791.5 mTVDss) to 3018.5 mMD (-2980.8 mTVDss)]

Cont. BOP pressure test. Install wear bushing. Replace TDS saver sub & TDS bails. RIH w/ 8 1/2" BHA f/ surface to 1756m meanwhile L/D 9 jts 5 1/2" HWDP & 36 jts 5 1/2" DP due to high rotating hours and P/U & M/U 9 jts 5 1/2" HWDP & 27 jts 5 1/2" DPs jt by jt.

Cont. wash & R/D f/ 1756m to tag TOC @ 1766m. D/O cement f/ 1766m to top of 9 5/8" float collar @ 1801m. Perform CIT. Cont. D/O shoe track f/ 1801m to 1826m, clear rat hole to 1830m. CBU. Clean surface line & dump WBM pits. Displace mud in well w/ 83 pcf OBM. POOH 12 1/4" Slick BHA#12 f/ 1830m to 1590m. Close BOP, M/U FOSV. Wait on receive fuel.

Cont. wait on receive fuel. Iships Co. refused to start operation @ 12:30 despite the POSCO procedure.

Cont. wait for Iships Co. to start operation. RIH w/ 8 1/2" Slick BHA#12 f/ 1590m to 1830m. Drill 4m new formation f/ 1830m to 1834m. CBU. Perform LOT. Resume drilling 8 1/2" hole section f/ 1834m to 1846m. CBU. POOH 8 1/2" Slick BHA#12 f/ 1846m to 250m.

Cont. POOH 8 1/2" Slick BHA#12 f/ 250m to surface while P/U & M/U 13 jts 6 1/2" DC jt by jt, R/B same. RIH w/ 8 1/2" Coring BHA#01 f/ surface to 1846m (BTM). CBU. Perform coring operation f/ 1846m to 1860.6m. No progress, CBU.

POOH 8 1/2" Conventional Coring BHA#01 f/ 1860.6m to surface, recover core. RIH w/ 8 1/2" Conventional Coring BHA#02 (Three No. core barrel) f/ surface to 1860.6m (BTM). Resume 8 1/2" Conventional coring operation f/ 1860.6m to 1861.2m.

Cont. 8 1/2" Conventional coring operation f/ 1861.2m to 1875.8m. No progress. CBU. POOH 8 1/2" Conventional Coring BHA#02 f/ 1875.8m to surface, recover core.

RIH w/ 8 1/2" Conventional Coring BHA#03 (Three No. core barrel) f/ surface to 1875.8m (BTM). Resume coring operation f/ 1875.8m to 1892.8m. No progress. CBU. POOH f/ 1892.8m to 1000m.

Cont. POOH 8 1/2" Coring BHA#03 f/ 1000m to surface, recover 16m core. RIH w/ Coring BHA#04 f/ surface to 580m. Slip & Cut. Cont. RIH to 1892.8m (BTM). Resume coring operation f/ 1892.8m to 1899m.

Cont. coring operation f/ 1899m to 1917.45m. No progress. CBU. POOH 8 1/2" coring BHA#04 f/ 1917.4m to surface while recover 23.9m core. RIH w/ 8 1/2" coring BHA#05 f/ surface to 30m.

Cont. RIH w/ Coring BHA#05 f/ 30 to 1917.4m (BTM). Resume coring operation f/ 1917.4m to 1941.8m. No progress. CBU.

POOH 8 1/2" coring BHA#05 f/ 1941.8m to surface while recover 24.25m core. RIH w/ coring BHA#06 to 1941.8m. Resume coring operation f/ 1941.8m to 1950m.

Cont. coring operation f/ 1950m to 1970m. POOH 8 1/2" coring BHA#06 f/ 1970m to surface while recover 28.15m core. RIH w/ coring BHA#07 (4 No. core barrel) to 1800m.

Cont. RIH w/ 8 1/2" coring BHA#07 f/ 1800m to 1970m. Resume coring operation f/ 1970m to 1998.4m. POOH 8 1/2" coring BHA#07 f/ 1998.4m to surface while recover 28.4m core. RIH w/ 8 1/2" Rotary BHA#13 f/ surface to 1050m.

Cont. RIH w/ 8 1/2" Rotary BHA#13 f/ 1050m to 1826m. Wash & R/D f/ 1826m to 1998.4m (BTM). Resume drilling 8 1/2" hole section f/ 1998.4m to 2032m, NL-NG.. Establish circulation, work on mud properties. POOH f/ 2032m to surface. RIH w/ 8 1/2" Coring BHA#08 (4 No. Core barrel) f/ surface to 1640m

Cont. RIH w/ coring BHA#08 f/ 1640m to 1970m. Wash & R/D to 2032m (BTM). Resume coring operation f/ 2032m to 2069m، NL/NG.. POOH 8 1/2" coring BHA#08 f/ 2069m to 760m. Establish circulation @ 760m. Cont. POOH f/ 760m to 38m. L/D 4 jts 4 3/4" inner tube while recover 37m core.

RIH w/ 8 1/2" coring BHA#09 f/ surface to 2069m (BTM). Resume coring operation f/ 2069m to 2106m, NL/NG. POOH f/ 2106m to 1200m

Cont. POOH 8 1/2" coring BHA#09 f/ 1200m to 500m. Establish circulation. Cont. POOH f/ 500m to 38m. L/D 4 jts 4 3/4" inner tube while recover 37m core (Recovery factor: 100%). RIH w/ 8 1/2" coring BHA#10 f/ surface to 2106m (BTM). Resume coring operation f/ 2106m to 2125m.

Cont. 8 1/2" coring operation f/ 2125m to 2126.5m, No progress. POOH 8 1/2" coring BHA#10 f/ 2126.5m to surface while recover 20.5m core (Recovery factor: 100%). RIH w/ 8 1/2" coring BHA#11 f/ surface to 600m. Slip & Cut. Cont. RIH f/ 600m to 683m

Cont. RIH w/ 8 1/2" coring BHA#11 f/ 683m to 2026.5m (BTM). Resume 8 1/2" coring operation f/ 2126.5m to 2137.3m. No. progress. POOH 8 1/2" coring

BHA#11 f/ 2137.3m to surface while recover 10.8m core. RIH w/ 8 1/2" coring BHA#12 (Three core barrel) f/ surface to 28m.

Cont. RIH w/ 8 1/2" coring BHA#12 f/ 28m to 2137.3m (BTM). Resume 8 1/2" coring operation f/ 2137.3m to 2144.8m. No. progress. POOH 8 1/2" coring BHA#12 f/ 2137.3m to 100m

Cont. POOH 8 1/2" Conventional coring BHA#12 f/ 100m to surface, recover core. RIH w/ 8 1/2" Conventional coring BHA#13 (Three core barrel) f/ surface to 2144.8m (BTM). Resume 8 1/2" coring operation f/ 2144.8m to 2169.4m. POOH 8 1/2" coring BHA#13 f/ 2169.4m to 520m

Cont. POOH 8 1/2" coring BHA#13 f/ 520m to surface. RIH w/ 8 1/2" Rotary drilling BHA#14 f/ surface to 2169.4m (BTM). Resume Drilling 8 1/2" hole section f/ 2169.4m to 2198m

Cont. Rotary drilling 8 1/2" hole section f/ 2198m to 2222m. Sweep the hole. POOH 8 1/2" Rotary drilling BHA#14 f/ 2222m to surface. RIH w/ 8 1/2" Orinted

coring BHA#14 (two core barrels) f/ surface to 1826m.

Cont. RIH w/ 8 1/2" Orinted coring BHA#14 f/ 1826m to 2222m (BTM). Perform 8 1/2" oriented coring operation f/ 2222m to 2223.6m. Stop coring due to low ROP & suspect of jamming. POOH BHA f/ 2223.6m to surface. RIH w/ 8 1/2" Conventional coring BHA#15 (four core barrels) f/ surface to 1400m.

Cont. RIH w/ 8 1/2" Conventional coring BHA#15 f/ 1400m to 2223.6m (BTM). Perform 8 1/2" Conventional coring operation f/ 2223.6m to 2260m. POOH coring BHA f/ 2260m to surface.

RIH w/ 8 1/2" Conventional coring BHA#16 (two core barrels) f/ surface to 2260m (BTM). Perform 8 1/2" Coring operation f/ 2260m to 2274.1m. POOH BHA f/ 2274.1m to 20m.

Cont. POOH 8 1/2" Conventional Coring BHA#16 f/ 20m to surface. RIH w/ 8 1/2" Rotary BHA#15 f/ surface to 2274.1m (BTM). Resume Rotary drilling 8 1/2" hole section F/ 2274.1m to 2380m.

Cont. Rotary Drilling 8 1/2" hole section f/ 2380m to 2460m. POOH 8 1/2" Rotary BHA#15 f/ 2460m to surface. RIH w/ 8 1/2" Oriented Coring BHA#17 (Four Core Barrels) f/ surface to 45m.

Cont. P/U & M/U 8 1/2" Oriented Coring BHA#17 (Four Core Barrels), RIH to 2460m (BTM). Perform 8 1/2" Oriented Coring operation f/ 2460m to 2496.5m successfully. POOH BHA f/ 2496.5m to 1000m, NL/NG.

Cont. POOH 8 1/2" Oriented Coring BHA#17 f/ 1000m to surface. RIH w/ 8 1/2" Oriented Coring BHA#18 (Four Core Barrels) f/ surface to 2496.5m (BTM). Perform 8 1/2" Oriented Coring operation f/ 2496.5m to 2533.5m successfully, NL/NG.

CBU. POOH 8 1/2" Oriented Coring BHA#18 to surface. Retrieve wear bushing. RIH w/ G.V Kish Wireline logging BHA#01 (XMAC-Resistivity-CDR-GR-6 Arm Caliper) f/ surface to 2533.5m (BTM). Start Log up in open hole section f/ 2533.5m to 1826m (9 5/8" casing shoe).

Repeat log up in 8 1/2" open hole section f/ 1926m to 1826m (9 5/8" casing shoe). Log up in 9 5/8" Casing f/ 1826m (9 5/8" casing shoe) to 1660m. POOH Wireline logging BHA#01 f/ 1660m to surface. RIH w/ Wireline logging BHA#02 (Density- Neutron- GR- Caliper) f/ surface to 2533.5m (BTM), Log up in 8 1/2" open hole section f/ 2533.5m to 1826m (9 5/8" casing shoe), Repeat Log up in 8 1/2" open hole section f/ 1900 to 1826m (9 5/8" casing shoe). Log up in 9 5/8" Casing f/ 1826m (9 5/8" casing shoe) to 1650m. POOH Wireline logging BHA#02 to surface. RIH w/ WireLine Logging BHA#03 (Resistivity-Acoustic- CDR- GR- Caliper) f/ surface to 2533.5m (BTM). Log up in 8 1/2" open hole section f/ 2533.5m to 2200m.

Cont. Log up in 8 1/2" open hole section f/ 2200m to 1826m (9 5/8" casing shoe). RIH w/ Wireline logging BHA#03 (Resistivity-Acoustic-CDR-GR-Caliper) f/ 1826m to 1876m. Repeat log up in 8 1/2" open hole section f/ 1876m to 1826m (9 5/8" casing shoe). POOH Wireline logging BHA#03 f/ 1826m to surface. RIH w/ 8 1/2" Oriented Coring BHA#19 (Four Core Barrels) f/ surface to 1750m while P/U & M/U 48 jts new 5 1/2" DPs and L/D 16 stds 5 1/2" DPs jt by jt due to high rotating hours.

Cont. RIH w/ 8 1/2" Oriented Coring BHA#19 (Four Core Barrels) to 2533.5m (BTM). Resume 8 1/2" Oriented Coring Operation f/ 2533.5m to 2537.7m. Stop Coring due to jamming. POOH 8 1/2" Oriented Coring BHA#19 f/ 2537.7m to surface. RIH w/ 8 1/2" Oriented Coring BHA#20 (Four Core Barrels) f/ surface to 2200m.

Cont. RIH w/ 8 1/2" Oriented Coring BHA#20 (Four Core Barrels) f/ 2200m to 2537.7m (BTM). Resume Coring Operation to 2560m. POOH to surface & L/D Coring BHA.

RIH W/ G.V. Kish Co. Logging BHA#04 (RCT - GR) As TLC to 1792m, Run Pump Down Head & Latch Same In Connector Sub, Lost Telemetry, Unlatch Pump Down Head & POOH Same to Surf., Cut 100m Wireline @ 2 Stages & Perform Continuity Test, No Success.

Cut 1800m Wireline, Latch Pump Down Head In Connector Sub & Resume RIH f/ 1792m to 2310, POOH Logging Tools to 1920 Meanwhile Recorded Formation Press. @ 48 Spots As Planned (20 Spots Valid), Run Back to 2115m & Repeat Press. Recording (Ok).

POOH G.V. Kish Co. TLC Logging Tools f/ 2115m to 1870 & Recorded Formation Press. @ 14 Spots, 9 Spot Valid (Totally 62 Spots, 29 Spot Valid); Run Back & Took Formation Fluid Samples @ 4 Spots As Planned, POOH to 1794m (SES On Surf.), NL-NG.

POOH Logging Tools f/ 1794m To Surf. & RIH W/ 7" Magnet & Junk Sub to 2560m (BTM), Worked On Junk Sub & Tagged BTM W/ Magnet, POOH to 450m, NL-NG.

Cont. POOH Fishing BHA f/ 200m to Surf., Obs. Minor Metal Swarf On Fishing Magnet & Retrieved 2 No Irregular Shaped Metal Pieces f/ Junk Sub; RIH W/ 8 1/2" PDC Bit & PKOK New 6 3/4" DHM to 2560m (BTM); Resume Directional Drlg Formation to 2636m W/ NL-NG.

Cont. Directional Drlg Formation In Rotary Mode f/ 2636m to 2786m W/ 0-4 BPH Down Hole Losses.

Cont. directional drilling 8 1/2" Hole Section In rotary mode f/ 2786m to 2815m. Perform wiper trip f/ 2815m to 2538m. Perform GR log f/ 2538m to 2521m. RIH f/ 2521m to 2787m in good hole condition. R/D f/ 2787m to 2815m (BTM). Resume directional drilling 8 1/2" hole section in rotary mode f/ 2815m to 2874m.

Cont. drilling 8 1/2" hole section f/ 2874m to 2980m

Cont. drilling 8 1/2" hole section f/ 2980m to 3018.5m. B/R f/ 3018.5m to to 2815m as short wiper trip. POOH 8 1/2" directional BHA# 16 f/ 2815m to 1800m in good hole condition. Slip & Cut. Run back to 3018.5m (BTM) in good hole condition. CBU till shaker clean. POOH f/ 3018.5m to 2400m

Cont. POOH 8 1/2" directional BHA# 16 f/ 2400m to surface. RIH w/ Wireline logging BHA#05 (XMAC-Resistivity-CDR) to 3020m (BTM, Wireline depth).Log up f/ 3020m to 2400m. POOH to surface. RIH w/ Wireline logging BHA#06 (Neutron-Density-GR) to 3020m (BTM, Wireline depth). Log up f/ 3020m to 2950m

Cont. Log up (Neutron-Density-GR) f/ 2950m to 2400m. POOH wireline logging BHA#06 f/ 2400m to surface. RIH w/ Wireline logging BHA#07 (NMR-GR) to 3020m (Wireline depth). Log up f/ 3020m to 2120m

Cont. Log up (NMR-GR) f/ 2120m to 1826m (9 5/8" CSG Shoe). POOH f/ 1826m to surface. RIH w/ Wireline logging BHA#08 (OBMI-CBIL) to 3020m (BTM, Wireline depth). Log up f/ 3020m to 2450m

POOH wireline logging BHA#08 f/ 2450m to surface. Install 11" Wear bushing. RIH w/ 8 1/2" Rotary BHA#17 to 3018.5m (BTM) in good hole condition. CBU. POOH f/ 3018.5m to 870m

Cont. POOH 8 1/2" Rotary BHA#17 f/ 870m to surface. RIH w/ G.V. Kish Co. TLC Logging BHA#09 (RCT-GR) f/ surface to 1792m, Run Pump Down Head & latch same in connector sub. Resume RIH f/ 1792m to 2500m

Cont. POOH 8 1/2" Rotary BHA#17 f/ 870m to surface. RIH w/ G.V. Kish Co. TLC Logging BHA#09 (RCT-GR) f/ surface to 1792m, Run Pump Down Head & latch same in connector sub. Resume RIH f/ 1792m to 2500m

Cont. RIH w/ TLC Logging BHA#09 f/ 2500m to 3005m as plan, POOH TLC logging BHA#09 while record formation pressures @ three spots successfully, try to record formation pressure @ 2972m, not successful. POOH TLC Logging BHA#09 f/ 2972m to 18m while unlatch & POOH wireline @ 1792m.

Cont. POOH TLC Logging BHA#09 to surface. RIH w/ TLC logging BHA#10 to 1794m, Run Pump Down Head & latch same in connector sub. Try to activate RCT tools probe section, not successful. POOH Pump Down Head to surface & L/D same. POOH TLC logging BHA#10 f/ 1794m to 400m

Cont. POOH TLC Logging BHA#10 f/ 400m to surface. RIH w/ Wireline Logging BHA#11 (RCT-GR) f/ surface to 3020m. POOH RCT-GR tools f/ 3020m to 2320m while recording formation pressures @ 47 spots (28 valid spots). Cont. POOH Wireline Logging BHA#11 f/ 2320m to 1700m

Cont. POOH Wireline Logging BHA#11 f/ 1700m to surface. L/D 5 stds 5 1/2" DPs & 5 stds 5 1/2" HWDPs stds due to high rotating hrs jt by jt. P/U & M/U TLC Logging BHA#12 (RCT-GR), Try to surface test and operate RCT tools probe section several times, not successful. Set 11" Wear bushing in THS. L/D 11 stds 5 1/2" DPs due to high rotating hrs jt by jt. P/U & M/U 9 jts 5 1/2" HWDP, POOH & R/B same. RIH w/ 3 1/2" OEDP string (8 stds) f/ surface to 620m followed by 5 1/2" DPs while P/U & M/U 40 jts 5 1/2" DPs

Cont. RIH w/ 3 1/2" OEDP string f/ 620m to 3018.5m (BTM). Set four balance cement plug as per plan and plug back the well f/ 3018.5m (BTM) to 2199m

Cont. POOH 3 1/2" OEDP string f/ 2250m to surface while set balance cement plug #05 & #06 as per plan and plug back the well. Change top & bottom seal of shear ram BOP. Perform 18 3/4" BOP pressure test.

Set 11" wear bushing in THS. RIH w/ 8 1/2" Slick BHA#18 f/ surface to 1793m & tag TOC @ 1793m. D/O cement f/ 1793m to 1845m. POOH 8 1/2" SlickBHA#18 f/ 1845m to surface. RIH w/ 8 1/2" Directional BHA#19 f/ surface to 20m.

3.2 Summary Report of the F-18-03MH Well

3.2.1 Starting Side Tracking hole in 8 1/2" for the F-18-03MH Well [1845mMD (-1807.5mTVDss) to 1850 mMD (-1812.5mTVDss)]

The tool face was set and performed open hole sidetrack 8 1/2″hole section in slide mode Cont. RIH w/ 8 1/2" Directional BHA#19 f/ 20m to 1845m (BTM). Resume D/O cement f/ 1845m to 1850m. Start time drilling 8 1/2" hole section f/ 1850m to 1854m, NL/NG.

3.2.2 8 1/2″ Hole Section in the F-18-03MH Well [1850 mMD (-1812.5mTVDss) to 2063 mMD (-2010.4mTVDss)]

Cont. Time drilling 8 1/2" hole section f/ 1854m to 1859m. Confirm side track depth @ 1855m. Cont. Directional drilling 8 1/2" hole section in slide & rotary modes f/ 1859m to 1868m

Cont. Directional Drilling 8 1/2" hole section f/ 1868m to 1878m. POOH 8 1/2" Side track BHA f/ 1878m to surface. RIH w/ New 8 1/2" Directional BHA#20 f/ surface to 1000m.

Cont. RIH w/ New 8 1/2" Directional BHA#20 f/ 1000m to 1878m (BTM). Resume Directional Drilling 8 1/2" hole section in slide & rotary modes f/ 1878m to 1946m, NL/NG

Cont. Directional Drilling 8 1/2" hole section f/ 1946m to 2046m, 0-1 bph DHL.

Cont. Directional Drilling 8 1/2" hole f/ 2046m to 2063m (8 1/2" Section TD). Wash & B/R f/ 2063m to 1826m (9 5/8" casing shoe) & run back to bottom on elevator in good hole condition as wiper trip. CBU. POOH 8 1/2" Directional BHA#20 f/ 2063m to surface. Retrieve wear bushing. R/U Sarvak Co. 7" Liner handling tools. Run 7" Liner, 29 ppf, L-80, PJE f/ surface to 49m (totally run 4 jts).

Cont. Run 7" Liner string f/ 49m to 301m (Totally run 25 Jts). P/U & M/U IDC Co. 7" x 9 5/8" Liner hanger assy., R/D Sarvak Co. 7" Liner handling tools. Cont. Run 7" Liner string f/ 301m to 2061.5m. Set 7" x 9 5/8" Liner hanger. Release setting tools. Perform cement job as per program. POOH 7" liner hanger setting tools f/ 1756.5m to 1754m, obs. Drawworks break failed. R/U circulating swage, perform circulation meanwhile work on drwworks .

Cont. work on drawworks meanwhile circulation w/ 200-400 gpm. POOH 7" liner hanger setting tools f/ 1754m to surface. Install 11" Wear Bushing. RIH w/ 3 1/2" OEDP to 1756m (TOL). Pump 40 bbl Retarder Hi-Vis pill as balance. POOH f/ 1756m to 1580m.

Pump 30 bbl cement slurry 118 pcf @ 1580m as balance. Cont. POOH 3 1/2" OEDP string f/ 1580m to surface. P/U & M/U 8 1/2" slick BHA#21, RIH to 700m. POOH f/ 700m to 340m while L/D 36 jt 5 1/2" DP due to high working time. Run back f/ 340m to 660m on 5 1/2" DPs, POOH F/ 660m to 340m while L/D 33 jt 5 1/2" DP due to high working time meanwhile WOC. (Totally L/D 69 jt 5 1/2" DP). Cont. POOH f/ 340m to surface. P/U, M/U and prepare 12 1/4" Directional BHA for next well, R/B same. Run back w/ 8 1/2" slick BHA#21 f/ surface to 25m.

Cont. RIH w/ 8 1/2" slick BHA#21 f/ 25m to 1450m, tag TOC @ 1450m. CBU. D/O CMT f/ 1450m to 1470m, Check integrity of cement w/ 10 kips, OK. CBU till shaker clean. Close BOP, Perform positive pressure test against CMT plug w/ 500 psi, OK. Displace the well w/ 84 pcf Inhibited brine (CaCl2). POOH f/ 1450m to surface. Retrieve 11" wear bushing. N/D 18 3/4" 15K BOP. Install abandon cap 11", 5K on 11" THS. Prepare to Skid f/ well F-18-03MH to F-18-05H

3.2.3 6 1/8" Hole section
[2063 mMD (-2010.4mTVDss) to 2133 mMD (-2060.1 mTVDss)]

Skid f/ well F-18-02H to F18-03MH. N/U DSA & Risers.

N/U 18 3/4" BOP 15K. N/U Overshot mandrel, Overshot packer & Diverter. While BOP test, try to open 5 1/2" Fix Top Pipe Ram, no success. Work on same, rectify the problem. Perform BOP test again, Ok. Install Wear Bushing. RIH w/ 8 1/2" Rotary BHA#22 f/ surface to 2m.

Cont. RIH w/ 8 1/2" Rotary BHA#22 f/ 2m to 1450m. W/D f/ 1450m & tag CMT &@ 1470m. D/O CMT f/ 1470m to 1580m. Wash & R/D f/ 1580m to 1756.5m, tag 7" L.L @ 1756.5m. CBU. POOH f/ 1756.5m to surface. RIH w/ BHA#23 (7" Polish Mill + 9 5/8" Scraper) f/ surface to 124m.

Cont. RIH w/ BHA#23 (7" Polish Mill + 9 5/8" Scraper) f/ 124m to 1756.5m (7" L.L). CBU. W/D f/ 1756.5m to 1758.5m (Tie back sleeve). Polish inside Tie back sleeve while scrap Packer area inside 9 5/8" CSG. POOH f/ 1758.5m to surface. RIH w/ 9 5/8" Top Packer BHA# 24 f/ surface to 1150m.

Cont. RIH f/ 1150m to 1757.7m (Tie-back sleeve). Set 9 5/8" Top Packer. Pressure test the packer from annulus to 1500 psi, Ok. POOH to surface. RIH w/ 6 1/8" Rotary BHA#25 f/ surface to 1756m. D/O Packer POB @ 1756m & 7" Liner Hanger POB @ 1759m. Sweep the hole. Perform 9 5/8" Top Packer positive test to 1500 psi, Ok. RIH f/ 1750m to 1759m. Displace the hole by 90 pcf OBM. Try to RIH, take weight. Wash & R/D f/ 1759m to 1950m.

Cont. Wash & R/D f/ 1950m to 2024.5m. D/O 5 1/2" Pump Down Plug, 7" Wiper Plug, 7" LDC, Hard CMT, 7" Float Collar & 7" Float Shoe f/ 2024.5m to 2061.5m while clear rat hole f/ 2061.5m to 2063m. Drill 3m new formation f/ 2063m to 2066m. CBU. Recover junks. Perform FIT. POOH 6 1/8" Slick BHA#25 to surface. RIH w/ 7" Scraper BHA#26 f/ surface to 635m.

Cont. RIH w/ 7" Scraper BHA#26 f/ 635m to 2019m, scrape last std while CBU. POOH 7" Scraper BHA f/ 2019m to surface. Retrieve wear bushing. Run Wireline logging BHA#01 (7" CAST-CBL-VDL-GR-CCL) f/ surface to 2015m. Start log up f/ 2015m to 1674m. Cont. POOH Wireline BHA#01 f/ 1674m to surface. Run Wireline logging BHA#02 (9 5/8" CAST-CBL-VDL-GR-CCL) f/ surface to 17m.

Cont. Running Wireline logging BHA#02 (9 5/8" CAST-CBL-VDL-GR-CCL) f/ 17m to 1750m. Start log up f/ 1750m to 65m, Cont. POOH Wireline to surface. Set 11" Wear bushing in THS. RIH w/ 6 1/8" Directional BHA#27 f/ surface to 2066m (BTM). Start Directional Drilling formation f/ 2066m to 2068m.NL/NG.

Cont. Directional Drilling 6 1/8" hole section f/ 2068m to 2092m, 0-1 bph DHL. Stop operation Due to Rig Air Compressors Cooling System Failure, POOH BHA f/ 2092m to 2030m. Rectify the problem. Run back to 2092m (BTM). Resume Drilling formation f/ 2092m to 2118m, 0-1 bph DHL.

Cont. Directional Drilling 6 1/8" hole section f/ 2118m to 2133m (TD), 0-1 bph DHL. Sweep the hole. Wash & B/R f/ 2133m (BTM) to 2061.5m (7" Liner shoe depth). Run back to 2133m (BTM) on elevator in good hole condition. Sweep the hole. POOH BHA f/ 2133m (BTM) to surface in good hole condition. Retrieve Wear Bushing. R/U Sarvak Co. 4" Pre-packed screen handling tools. Run 4" Pre-packed screen f/ surface to 24m.

Cont. Run 4" Pre-packed screen f/ 24m to 107m ((Totally run 5 jts 4" Pre-packed screen + 4 jts 4" Blank liner + 1 No. 4" Pup Jt.+ 4 3/4" Double poppet wash down shoe + 4 3/4" O-ring seal sub). Run 2 3/8" Wash pipes string f/ surface to 95m (Totally run 2 3/8" Polished stinger + 10 jts 2 3/8" Wash pipes + 1 No. 2 3/8" Pup jt 1.2m). M/U KSA Co. 4" * 7" Hydro set permanent packer assembly. RIH w/ 4" Pre-packed screen string f/ 107m to 1864m, take weight. Try to pass same, not possible. POOH 4" Pre-packed screen string f/ 1864m to 400m.

Cont. POOH 4" Pre-packed screen to 107m. Visual Check Packer assembly components. B/O same. Add 4 1/2" Pup jt to string. M/U packer assembly. RIH w/ 4" Pre-packed screen string followed by 3 1/2" & 5 1/2" Dps f/ 107m to 2132.5m (4" Pre-packed screen shoe depth). Set permanent packer 4" * 7", pressure test same. OK. Release setting tools.

POOH Setting tools of packer assy. to 97m. R/U KSA Co. 2 3/8" wash pipe handling tools. L/D packer setting tools. POOH 2 3/8" wash pipes f/ 97m to surface while L/D same jt by jt. RIH w/ 6 1/8"

Slick BHA#28 f/ surface to 2018m. Displace OBM in well by NaCl Brine 68 pcf as per plan. Flow check while cleaning surface lines, static. Establish circulation.

Cont. Circulation @ 2018m. POOH 6 1/8" Slick BHA#28 f/ 2018m to surface. Retrieve wear bushing. RIH w/ Jet sub & wash inside BOP stack & wellhead area. R/U Sarvak Co. 4 1/2" Handling Tools. Run 4 1/2" Upper completion f/ surface to 722m (Totally run 59 jts 4 1/2" Tubing, 12.6 PPF, L-80, TPCQ Thread, PSL2, R-3)

Cont. Run 4 1/2" Upper completion f/ 722m to 1897m (Totally run 157 jts 4 1/2" Tubing). R/U Top Select Co. Slickline equipment. Set 3.125" plug & prong inside NO-GO landing nipple. Pressure test 4 1/2" tubing string, OK. Retrieve prong & 3.125" plug. R/D Top Select Co. Slickline equipment. P/U & M/U KSA Co. 3.813" Landing Nipple Assy. (DHSV already in-place).

Cont. Run 4 1/2" Upper completion f/ 1897m to 2020.9m (Totally Run 164 Jts 4 1/2" Tubing), tag top of 4" Packer @ 2020.9m, perform space out. Displace NaCl brine in hole w/ 68 pcf inhibited NaCl Brine. POOH string to 1983m, R/B 5 1/2" DPs. Resume Run 4 1/2" Upper completion f/ 1983m to 2023.3m (2.4m sting in) while land Tubing hanger in place. Install BPV. N/D 18 3/4" BOP. N/U 4 1/16" * 11" XMT

The directional data of this well are presented in Table 17 and the trajectory data are tabulated in , and . The plan view of drilled well is presented in .

Table 17: Directional data of the F-15-01DT-Re1H, F-15-01DT-Re1H-ST1 and F-15-01DT-Re1H-ST2 Wells

Well name	Important Points	Depth (m)			Coordinates		Deviation		Formation/Member/Zone
		MD	TVD	TVDSS	Easting(m)	Northing(m)	Inc. (deg)	Az. (deg)	
F-18-03PH	Surface	0.0	0.0	36.2	365203.2	3168525.3	0.0	0.0	Fars Group
	K.O.P.	478.0	478.0	-441.7	365203.4	3168525.1	1.7	167.4	Fars Group
	T.D.	3018.0	3017.1	-2980.8	365195.8	3168535.6	1.5	115.0	Arab/Arab-D
F-18-03MH	S.T.P.	1855.0	1853.7	-1817.5	365188.0	3168537.8	1.6	333.9	Kazhdumi/Mauddud
	T.D.	2133.0	2096.4	-2060.1	365160.7	3168651.7	51.0	346.0	Arab/Arab-D

4 Casing, Liner, Screen and Cementing Reports

4.1 20″ Casing

The 26″hole section in the F-18-03PH well was drilled vertically from the 88 mMD (-51.7mTVDss) in Fars Group to 458 mMD (-421.7 mTVDss) (T.D. of 26″ hole section) in Fars Group with 1° inclination in azimuth of 176.4° at T.D. The 20″ casing was run in to the hole and it was set at 453.7 mMD (-417.4 mTVDss) The cement job was performed successfully.

4.2 13 3/8" Casing

The 17 1/2″ hole section in the F-18-03PH well was drilled vertically from the458 mMD (-421.8mTVDss) in Fars Group to 922 mMD (-884.6 mTVDss) (T.D. of 17 1/2″ hole section) in Jahrum Formation with 0.4° inclination in azimuth of 226° at T.D. The13 3/8″ casing was run in to the hole and it was set at 920 mMD (-882.6 mTVDss) The cement job was performed successfully.

4.3 9 5/8" Casing

The12 1/4″hole section in the F-18-03PH well was drilled vertically from the 922 mMD (-884.6 mTVDss) in Jahrum Formation to 1830 mMD (-1792.5 mTVDss) (T.D. of 17 1/2″ hole section) in Ahamdi member with 0.4° inclination in azimuth of 232.7° at T.D. The 9 5/8″ casing was run in to the hole and it was set at 1826 mMD (-1788.5 mTVDss) .The cement job was performed successfully.

4.4 7" Liner

The8 1/2″ hole section in the F-18-03MH well was drilled directionally from the 1855 mMD (-1817.5 mTVDss) in Mauddud member to 2063 mMD (-2010.4 mTVDss) (T.D. of 8 1/2″ hole section) in Upper Burgan-A with 38° inclination in azimuth of 346.2° at T.D. The 7″ liner was run in to the hole and it was set at 2061.5 mMD (-2009.2 mTVDss) .The cement job was performed successfully.

4.5 4" P.P. Screen

Directional drilling in the main hole was started at 2063 mMD (-2010.4 mTVDss) and continued to 2133 mMD (-2060.1 mTVDss) (T.D. of 6 1/8″ hole section) in Lower Burgan-A member (L-B-A-4 zone). The 4″pre-packed screen was run to hole and due to stuck it was set at 2132.5 mMD (-2059.8 mTVDss).

Note: The detailed information of casing and pre-packed screen and completion data are tabulated in Table 18 and Table 19.

Table 18: The F-18-03PH and MH Wells Casing & Liner Data

Well	Casing/ liner shoe	Depth			Easting	Northing	Formation/Member/Unit/Zone
		mMD	mTVD	mTVDss	m	m	
F-18-03PH	20"	453.7	453.7	-417.4	365203.3	3168525.7	Fars Group
	13 3/8"	920.0	918.8	-882.6	365198.1	3168545.0	Jahrum Formation
	9 5/8"	1826.0	1824.7	-1788.5	365188.3	3168537.6	Sarvak/Ahmadi Mbr.
F-18-03MH	7"	2061.5	2045.4	-2009.2	365172.9	3168603.2	Kaz/Burgan/Burgan-A/U.B.A-3

Table 19: The F-18-03MH Well Completion Data

Well	Completion String	Size	Depth (m)			Remark
			From	To	Length	
F-18-03MH	Lower Completion	4" Pre Pack Screen	2132.5mMD -2059.8 mTVDss	2020mMD -1974.6 mTVDss	112.5 m	41.5 mMD left to 7" Liner shoe
	Upper Completion	4 1/2" Tubing	2020mMD -1974.6 mTVDss	Surface	2020 m	On top of 4" P.P. Screen

4.6 Mud Summary & Losses

The following table shows the drilling mud properties used in each hole section and the mud loss/gain values which were occurred during drilling in each interval.

Table 20: Mud Properties and Mud Losses Data of the F-18-03PH and MH Wells

Depth Interval				Mud Properties				Mud Loss & Gain		Liner & Screen		Formation/
Well	Hole Size	From	To	Type	Weight	Viscosity	Salinity	Loss	Gain	Size	Depth	Member/
	Inch	(mMD)	(mMD)		(PCF)	(Sec.)	(Mg/l)	(BPH)	(BPH)	(Inch)	(mMD)	Zone
F-15-01DT-Re1H	8 1/2"	1877	1931	OBM	75	52		0		Was Liner 7" Remained as fish	depth Fish (2434-2057mMD)	Gurpi
		1931	1980		75	48		1-2				Sarvak
		1980	2040		75	48		1-2				U.Sarvak
		2040	2215		78	47		1-2				Mauddud
		2215	2340		88-92	57	348500	1-2				U.kazhdumi
		2340	2785		92-97	56-82	358000	1-2				Dair
		2785	2810		97-99	60-88	415000	1-2				U.Burgan A
		2810	2810		77	40-42	320000	0				
F-15-01DT-Re1H-ST1	8 1/2"	1915	1924		77	42	344000	0		7" Liner	2543-1749 mMD	Gurpi (ST-1)
		1924	1988		96	56-57	449000	0				Ilam (ST-1)
		1988	2059		96	50	449000	0				U.Sarvak (ST-1)
		2059	2129		96	50	438000	2-3				U.Ahmadi (ST-1)
		2129	2230		96	51-53	444000	1-2				Mauddud (ST-1)
		2230	2449		97	52-55	452000	1-2				Kazhdumi (ST-1)
		2449	2550		97	51	452000	2-3				Dair (ST-1)
		2550	2825		97-98	49-53	530000	1-2				U.Burgan A (ST-1)
F-15-01DT-Re1H-ST2	6 1/8"	2544	2612	OBM	97-98	54-91	304000	2-3		4" Pre-Pack Screen	3288-2435 mMD	U.Burgan (ST-2)
		2557	3458		97	52-59	275000	1-2				

4.7 Time Analysis

The details of this delays and remedial action is presented in EOWR of the F-15-01DT-Re1H-ST2 well. Also, the table of NPT data is attached as appendix IV.

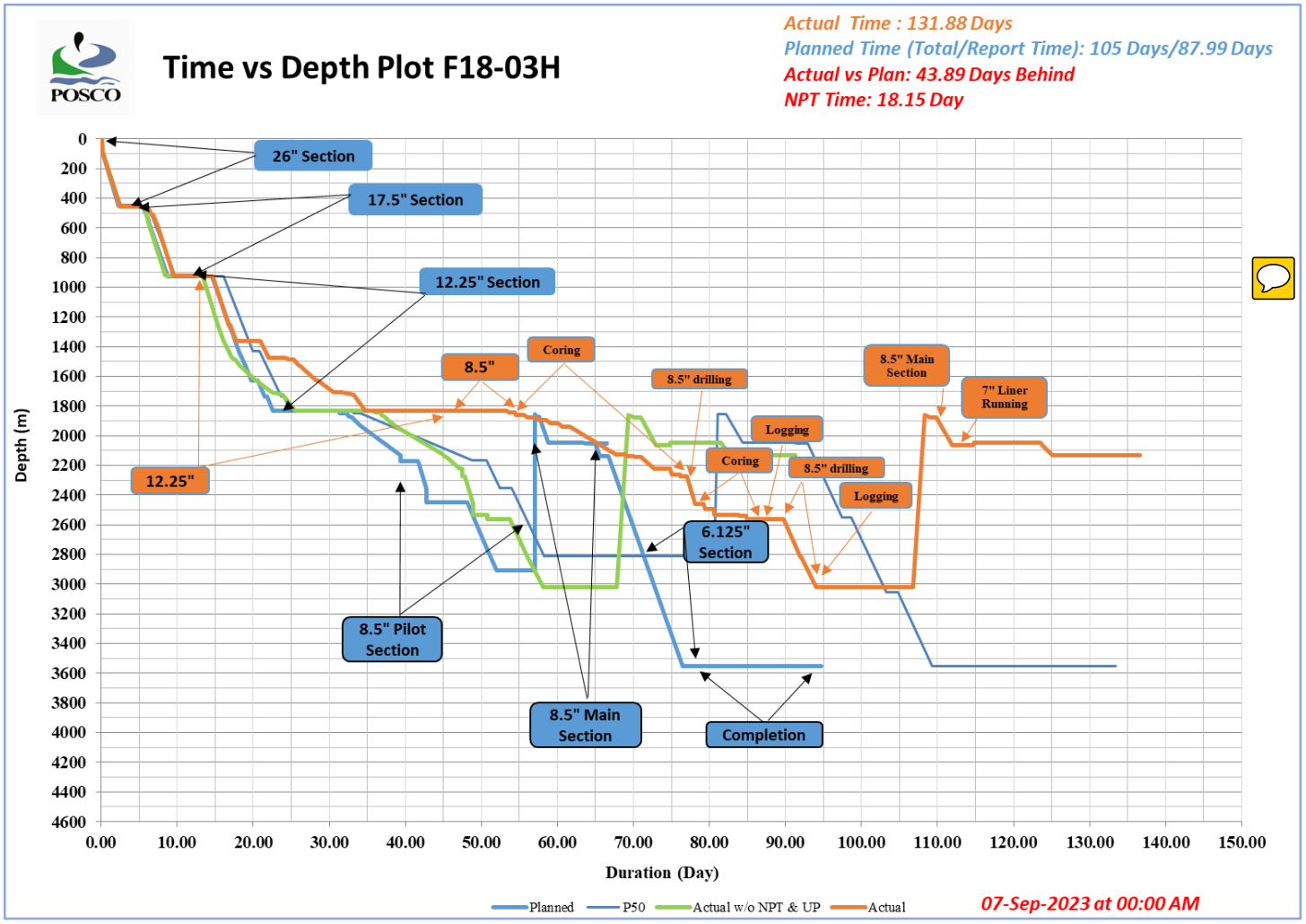

Figure 10: Time vs. Depth Plot of F-18-03PH and MH Wells

4.8 Directional Drilling and Survey Data

PKOK Company was the contractor for MWD and directional drilling operation of the F-18-03MH well and the reading data interval of the D & I (Direction and Inclination) were around 30 mMD. All survey data of F-18-03PH and MH wells are calculated and referenced to rotary table elevation of 36.24m and tabulated in and respectively. The illustrates the plan view of boreholes and the well intersection of F-15-01DT-Re1H and F-15-01DT-Re1H-ST2 is available in .

4.8.1 8 1/2″ Hole section in the F18-03MH well [From 1845mMD (-1807.5mTVDss) 2063 mMD (-2010.4mTVDss)]

8 1/2″ bit was run into the hole to side track the well according to changed plan at 1855 mMD (-1817.5mTVDss) and then it drilled the formations to 2063 mMD (-2010.4mTVDss) toward azimuth of 324.5°-346.2° with building deviation angle to maximum 38° at 2063 mMD (-2010.4 mTVDss).

Survey of 8 1/2″ section TD is: 2063 mMD, Inc.:38. ° Az.: 346.2°, TVDss: -2010.4 m, TVD: 2046.6 m

4.8.2 6 1/8″ Hole section in the F-18-03MH well [2063 mMD (-2010.4mTVDss) to 2133 mMD (-2060.1 mTVDss)]

6 1/8″ bit was run into the hole to continue drill the reservoir section. it was started at 2063 mMD (-2010.4mTVDss) and continued to 2133 mMD (-2060.1 mTVDss) toward azimuth of 345.8°-346.2° with building inclination from 38° to 51°.

According to static model the horizon were updated by actual data of F-18-03PH and MH wells data and the well intersection of the F-18-03PH and MH wells well is illustrated in .

Table 34: Flowing data for Choke size 40/64" (in 27-May-24 period) in the F-18-03MH Well

Date Time	Choke Size	WHP	WHT	WHDCP	BSW	PH	Description
HH:mm	(1/64 in)	(psia)	(°C)	(psia)	(%)		
02:32	40	155.4	38.1	110.2	1	5	Transfer pump got out of service. Fixed transfer pump and turn back to operation.
03:32	40	146.3	39.1	105.6	1	5	
04:32	40	155.4	39.3	106.2	1	5	Sampled at choke manifold, H2S: 0 ppm, CO2: 0.6%.
05:32	40	155.4	39.7	111.9	1	5	Sampled at choke manifold, Oil gravity: 0.896@32 C, API: 24.4.
06:32	40	155.4	39.9	109.7	1	5	
07:32	40	152.5	40.2	107.7	1	5	
08:32	40	155.4	40.5	107	1	5	
09:32	40	158.3	40.7	110.2	1	5	

Final Bs &W value during this period was 1% and Sampled choke manifold Oil gravity was 0.896 at 32°C, API: 24.4 and CO2, H2S content were 0.6%, 0 ppm respectively

Table 35: Flowing data for Choke size 32/64" (in 27May-24 period) in the F-18-03MH Well

Date Time	Choke Size	WHP	WHT	WHDCP	BSW	PH	Description
HH:mm	(1/64 in)	(psia)	(°C)	(psia)	(%)		
11:01	32	178.7	40.1	98.3	1	5	
12:01	32	181.9	40.1	95.8	1	5	Sampled at choke manifold, H2S: 0 ppm, CO2: 0.5%.
13:01	32	179.2	40.3	99.7	1	5	
14:01	32	179	39.9	99.4	1	5	
15:01	32	178.8	42.5	95.8	1	5	
16:01	32	179.5	44.4	95.4	1	5	Sampled at choke manifold, Oil gravity: 0.894@34 C, API: 24.5.
17:01	32	179.3	40.6	98.7	1	5	
18:01	32	179.4	40.1	101	1	5	Sampled at choke manifold, H2S: 0 ppm, CO2: 0.5%, Oil gravity: 0.897@33 C, API: 24.

Final Bs &W value during this period was 1% and Sampled choke manifold Oil gravity was 0.894 at 34°C, API: 24.5 and 0.897 at 33°C, API: 24.5 and CO2, H2S content were 0.5%, 0 ppm respectively.

Table 36: Flowing data for Choke size 24/64" (in 27,28 May-24 period) in the F-18-03MH Well

Date Time	Choke Size	WHP	WHT	WHDCP	BSW	PH	Description
HH:mm	(1/64 in)	(psia)	(°C)	(psia)	(%)		
19:01	24	199.7	39.3	84.1	1	5	
20:01	24	202.6	38.2	84.1	1	5	
21:01	24	202.5	37.7	86.9	1	5	
22:01:	24	202.3	37.3	86.9	1	5	
23:01	24	202.5	37.2	86.9	1	5	
00:01	24	205.5	36.8	83.9	1	5	Sampled at choke manifold, Oil gravity: 0.895@33 C, API: 24.5.
01:01	24	205.5	36.9	84.1	1	5	
02:01	24	205.3	36.6	83.9	1	5	

Final Bs &W value during this period was 1% and Sampled choke manifold Oil gravity was 0.895 at 33°C, API: 24.5.

After that, the well was closed at choke manifold, then close master valve and start to rig down Coiled Tubing and RIH slick line for retrieving protection sleeve, then well-testing equipment flushed and rigged down finally.

Table 37: Summary result for cleanup and flowing data of F-18-03MH Well

Period	Start Time	Duration	Choke Size	Whp	Wht	Whdcp	Csgp	BSW	PH
			(1/64 in)	(psia)	(°C)	(psia)	(psia)	(%)	
Clean up on various choke sizes	26-May-24 04:42:00	21h19'	80	168.3	37.2	94.8	61.5	1	3
Flow on 40/64" fixed choke	27-May-24 02:02:00	08h03'	40	161.3	40.9	110.3	61.7	1	5
Flow on 32/64" fixed choke	27-May-24 10:16:00	08h15'	32	179.2	39.9	101.2	61.3	1	5
Flow on 24/64" fixed choke.	27-May-24 18:46:00	07h55'	24	205.3	36.6	85.2	62.3	1	5

Table 39: Deviation Survey Data of the F-18-03PH Well

X	Y	Z	MD	INC	AZ	DX	DY	TVD	DL	HD	Remark
365203.2	3168525.3	36.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
365203.2	3168525.5	-63.8	100.0	0.2	0.0	0.0	0.2	100.0	0.1	0.2	
365203.2	3168526.2	-163.8	200.0	0.5	0.0	0.0	0.9	200.0	0.1	0.9	
365203.3	3168526.8	-263.8	300.0	0.3	0.0	0.0	1.6	300.0	0.1	1.6	
365203.3	3168526.5	-363.8	400.0	0.4	175.3	0.0	1.2	400.0	0.3	1.2	
365203.3	3168525.7	-417.4	453.7	1.1	176.4	0.1	0.5	453.7	0.3	0.5	20" CSG
365203.4	3168525.1	-441.7	478.0	1.7	167.4	0.2	-0.1	478.0	0.9	0.2	KOP
365203.7	3168524.4	-463.7	500.0	2.1	165.1	0.4	-0.8	500.0	0.9	0.9	
365204.0	3168523.7	-483.7	520.0	2.2	150.9	0.7	-1.5	520.0	0.5	1.7	Asmari/Ghar (CP)
365204.5	3168523.4	-511.7	548.0	1.4	64.8	1.3	-1.8	547.9	2.7	2.2	Asmari/Ghar
365205.1	3168524.4	-563.7	600.0	1.4	10.2	1.9	-0.9	599.9	0.6	2.1	
365204.9	3168526.1	-617.1	653.4	2.9	344.0	1.7	0.9	653.3	2.5	1.9	Jahrum (Eocene)
365203.6	3168529.9	-663.5	700.0	6.4	341.0	0.4	4.6	699.7	1.9	4.6	
365199.7	3168541.5	-762.7	800.0	5.4	340.2	-3.5	16.3	799.0	2.2	16.7	
365198.3	3168545.1	-862.6	900.0	0.6	304.9	-5.0	19.8	898.8	0.7	20.4	
365198.1	3168545.0	-882.6	920.0	0.4	249.1	-5.1	19.8	918.8	0.5	20.4	13 3/8" CSG
365197.1	3168544.9	-962.6	1000.0	0.8	264.3	-6.1	19.7	998.8	0.0	20.6	
365195.4	3168544.4	-1062.6	1100.0	1.3	255.5	-7.9	19.2	1098.8	0.5	20.7	
365193.0	3168544.0	-1162.6	1200.0	1.2	256.4	-10.3	18.7	1198.8	0.4	21.4	
365191.3	3168543.0	-1262.5	1300.0	1.0	228.3	-12.0	17.7	1298.8	0.2	21.4	
365190.4	3168542.2	-1362.5	1400.0	0.7	246.7	-12.8	17.0	1398.8	0.5	21.3	
365190.1	3168542.1	-1389.4	1426.9	0.6	245.3	-13.1	16.8	1425.7	0.6	21.4	Tarbur(Tayarat)
365189.7	3168541.5	-1462.5	1500.0	0.6	208.3	-13.5	16.2	1498.8	0.1	21.1	
365189.3	3168540.0	-1562.5	1600.0	1.0	193.1	-14.0	14.8	1598.7	0.1	20.3	
365189.2	3168539.9	-1571.9	1609.4	1.0	193.1	-14.0	14.6	1608.1	0.1	20.2	Gurpi(Qurna)
365189.1	3168539.0	-1612.5	1650.0	1.2	189.1	-14.1	13.8	1648.7	0.1	19.8	
365188.9	3168538.0	-1661.0	1698.5	1.1	208.9	-14.3	12.8	1697.2	1.7	19.2	Ilam(Gudair)
365188.9	3168538.0	-1662.5	1700.0	1.1	208.9	-14.4	12.8	1698.7	1.7	19.2	
365188.5	3168537.9	-1692.2	1729.7	0.5	267.5	-14.8	12.6	1728.4	2.2	19.4	U.Sarvak Erosinal Zone
365188.5	3168537.9	-1695.0	1732.5	0.5	267.5	-14.8	12.6	1731.2	2.2	19.4	U. Sarvak-Mishrif
365188.6	3168537.9	-1712.5	1750.0	1.0	86.1	-14.6	12.6	1748.7	2.2	19.3	
365188.5	3168537.7	-1752.2	1789.7	0.8	239.9	-14.8	12.5	1788.4	1.7	19.3	Ahmadi
365188.4	3168537.7	-1762.5	1800.0	0.6	241.8	-14.8	12.4	1798.7	0.3	19.4	
365188.3	3168537.6	-1788.5	1826.0	0.4	232.7	-15.0	12.3	1824.7	0.3	19.4	9 5/8" CSG
365188.2	3168537.6	-1793.7	1831.2	0.4	232.7	-15.0	12.3	1829.9	0.3	19.4	Mauddud Erosional Zone
365188.2	3168537.5	-1809.1	1846.6	0.3	212.3	-15.1	12.2	1845.3	0.3	19.4	Mauddud
365187.8	3168537.3	-1862.5	1900.0	0.5	252.6	-15.5	12.1	1898.7	0.1	19.6	
365187.7	3168537.2	-1893.6	1931.1	0.4	168.8	-15.6	11.9	1929.8	0.6	19.6	Kazhdumi Shale
365187.7	3168537.2	-1912.5	1950.0	0.2	4.7	-15.5	11.9	1948.7	1.0	19.6	

X	Y	Z	MD	INC	AZ	DX	DY	TVD	DL	HD	Remark
365187.9	3168537.5	-1956.3	1993.8	0.6	46.0	-15.4	12.3	1992.5	0.5	19.7	Kazhdumi Lst.(Dair Lst.)
365187.9	3168537.5	-1962.5	2000.0	0.4	67.0	-15.3	12.3	1998.7	0.8	19.7	
365187.8	3168537.6	-2024.0	2061.5	0.4	329.6	-15.4	12.3	2060.2	1.0	19.7	7" LNR
365188.0	3168537.5	-1995.9	2033.4	0.1	187.4	-15.3	12.2	2032.1	1.0	19.5	Burgan-A
365188.0	3168537.9	-2062.5	2100.0	0.7	26.1	-15.2	12.7	2098.7	0.3	19.8	
365188.0	3168538.0	-2066.5	2104.0	0.7	26.1	-15.2	12.7	2102.7	0.3	19.9	Burgan-B
365188.2	3168538.1	-2092.5	2130.0	0.4	84.9	-15.1	12.9	2128.7	1.0	19.8	
365188.3	3168538.1	-2113.4	2150.9	0.2	119.6	-15.0	12.8	2149.6	1.2	19.7	U. Dariyan Clastic
365188.2	3168538.1	-2132.5	2170.0	0.7	296.4	-15.1	12.9	2168.7	1.2	19.8	
365188.1	3168538.3	-2154.4	2191.9	0.6	351.0	-15.2	13.1	2190.6	0.9	20.0	U. Dariyan
365188.1	3168538.4	-2160.9	2198.4	0.8	12.4	-15.2	13.2	2197.1	0.9	20.1	Kazhdumi Tongue
365188.1	3168538.4	-2162.5	2200.0	0.8	12.4	-15.2	13.2	2198.7	0.9	20.1	
365188.0	3168538.8	-2199.5	2237.0	0.5	318.2	-15.3	13.6	2235.7	0.8	20.4	L. Dariyan
365187.6	3168538.8	-2262.5	2300.0	0.4	223.2	-15.7	13.5	2298.7	0.3	20.7	
365187.5	3168538.8	-2274.4	2311.9	0.3	264.0	-15.8	13.5	2310.6	0.5	20.8	U. Gadvan
365187.4	3168538.8	-2302.5	2340.0	0.2	129.3	-15.8	13.5	2338.7	1.0	20.8	
365187.6	3168538.7	-2328.3	2365.8	0.5	89.7	-15.6	13.5	2364.5	0.6	20.6	Khalij
365187.7	3168538.7	-2332.5	2370.0	0.5	89.7	-15.6	13.5	2368.7	0.6	20.6	
365187.7	3168538.7	-2336.4	2373.9	0.5	89.7	-15.5	13.5	2372.6	0.6	20.6	L. Gadvan
365187.8	3168538.8	-2347.5	2385.0	0.6	59.8	-15.5	13.5	2383.7	0.6	20.5	
365187.8	3168538.8	-2360.3	2397.8	0.2	234.4	-15.5	13.5	2396.5	1.3	20.5	U. Ratawi
365187.8	3168538.8	-2362.5	2400.0	0.2	234.4	-15.5	13.5	2398.7	1.3	20.5	
365186.5	3168538.4	-2451.7	2489.3	1.1	300.8	-16.8	13.1	2488.0	1.6	21.3	L. Ratawi
365186.3	3168538.5	-2462.4	2500.0	1.4	321.4	-16.9	13.3	2498.7	1.6	21.5	
365186.2	3168538.7	-2488.4	2526.0	0.2	312.9	-17.1	13.4	2524.7	1.6	21.7	Yamama
365187.6	3168538.3	-2562.4	2600.0	1.6	85.2	-15.7	13.1	2598.7	0.4	20.4	
365189.8	3168538.4	-2662.4	2700.0	1.3	100.3	-13.4	13.1	2698.6	0.4	18.8	
365191.7	3168538.0	-2759.4	2797.0	1.0	96.8	-11.5	12.8	2795.6	0.1	17.2	Manifa
365191.8	3168538.0	-2762.4	2800.0	1.0	98.5	-11.5	12.7	2798.6	0.1	17.2	
365192.1	3168537.9	-2784.3	2821.9	0.9	110.2	-11.1	12.6	2820.5	0.5	16.8	Hith
365192.5	3168537.6	-2812.4	2850.0	1.0	118.9	-10.7	12.4	2848.6	0.3	16.4	
365193.1	3168537.3	-2848.8	2886.4	1.1	126.3	-10.1	12.0	2885.0	0.2	15.7	Arab-A
365193.4	3168537.1	-2862.4	2900.0	1.1	126.3	-9.9	11.9	2898.6	0.2	15.5	
365193.4	3168537.1	-2864.8	2902.4	1.2	125.7	-9.8	11.9	2901.0	0.2	15.4	Arab-B
365193.6	3168536.9	-2877.6	2915.2	1.2	125.7	-9.6	11.7	2913.8	0.2	15.1	Arab-C
365194.0	3168536.7	-2895.9	2933.5	1.3	119.9	-9.3	11.5	2932.1	0.2	14.8	Arab-D
365195.4	3168535.8	-2962.3	3000.0	1.6	115.4	-7.9	10.6	2998.6	0.5	13.2	
365195.8	3168535.6	-2980.8	3018.5	1.5	115.0	-7.4	10.4	3017.1	0.1	12.8	TD

Table 40: Deviation Survey Data of the F-18-03MH Well

X	Y	Z	MD	INC	AZ	DX	DY	TVD	DL	HD	Remark
365203.2	3168525.3	36.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
365203.2	3168525.5	-63.8	100.0	0.2	0.0	0.0	0.2	100.0	0.1	0.2	
365203.2	3168526.2	-163.8	200.0	0.5	0.0	0.0	0.9	200.0	0.1	0.9	
365203.3	3168526.8	-263.8	300.0	0.3	0.0	0.0	1.6	300.0	0.1	1.6	
365203.3	3168526.5	-363.8	400.0	0.4	175.3	0.0	1.2	400.0	0.3	1.2	
365203.3	3168525.7	-417.4	453.7	1.1	176.4	0.1	0.5	453.7	0.3	0.5	20" CSG
365203.4	3168525.1	-441.7	478.0	1.7	167.4	0.2	-0.1	478.0	0.9	0.2	KOP
365203.7	3168524.4	-463.7	500.0	2.1	165.1	0.4	-0.8	500.0	0.9	0.9	
365204.0	3168523.7	-483.7	520.0	2.2	150.9	0.7	-1.5	520.0	0.5	1.7	Asmari/Ghar (CP)
365204.5	3168523.4	-511.7	548.0	1.4	64.8	1.3	-1.8	547.9	2.7	2.2	Asmari/Ghar
365205.1	3168524.4	-563.7	600.0	1.4	10.2	1.9	-0.9	599.9	0.6	2.1	
365204.9	3168526.1	-617.1	653.4	2.9	344.0	1.7	0.9	653.3	2.5	1.9	Jahrum (Eocene)
365203.6	3168529.9	-663.5	700.0	6.4	341.0	0.4	4.6	699.7	1.9	4.6	
365199.7	3168541.5	-762.7	800.0	5.4	340.2	-3.5	16.3	799.0	2.2	16.7	
365198.3	3168545.1	-862.6	900.0	0.6	304.9	-5.0	19.8	898.8	0.7	20.4	
365198.1	3168545.0	-882.6	920.0	0.4	249.1	-5.1	19.8	918.8	0.5	20.4	13 3/8" CSG
365197.1	3168544.9	-962.6	1000.0	0.8	264.3	-6.1	19.7	998.8	0.0	20.6	
365195.4	3168544.4	-1062.6	1100.0	1.3	255.5	-7.9	19.2	1098.8	0.5	20.7	
365193.0	3168544.0	-1162.6	1200.0	1.2	256.4	-10.3	18.7	1198.8	0.4	21.4	
365191.3	3168543.0	-1262.5	1300.0	1.0	228.3	-12.0	17.7	1298.8	0.2	21.4	
365190.4	3168542.2	-1362.5	1400.0	0.7	246.7	-12.8	17.0	1398.8	0.5	21.3	
365190.1	3168542.1	-1389.4	1426.9	0.6	245.3	-13.1	16.8	1425.7	0.6	21.4	Tarbur(Tayarat)
365189.7	3168541.5	-1462.5	1500.0	0.6	208.3	-13.5	16.2	1498.8	0.1	21.1	
365189.3	3168540.0	-1562.5	1600.0	1.0	193.1	-14.0	14.8	1598.7	0.1	20.3	
365189.2	3168539.9	-1571.9	1609.4	1.0	193.1	-14.0	14.6	1608.1	0.1	20.2	Gurpi(Qurna)
365189.1	3168539.0	-1612.5	1650.0	1.2	189.1	-14.1	13.8	1648.7	0.1	19.8	
365188.9	3168538.0	-1661.0	1698.5	1.1	208.9	-14.3	12.8	1697.2	1.7	19.2	Ilam(Gudair)
365188.9	3168538.0	-1662.5	1700.0	1.1	208.9	-14.4	12.8	1698.7	1.7	19.2	
365188.5	3168537.9	-1692.2	1729.7	0.5	267.5	-14.8	12.6	1728.4	2.2	19.4	U.Sarvak Erosinal Zone
365188.5	3168537.9	-1695.0	1732.5	0.5	267.5	-14.8	12.6	1731.2	2.2	19.4	U. Sarvak-Mishrif
365188.6	3168537.9	-1712.5	1750.0	1.0	86.1	-14.6	12.6	1748.7	2.2	19.3	
365188.5	3168537.7	-1752.2	1789.7	0.8	239.9	-14.8	12.5	1788.4	1.7	19.3	Ahmadi
365188.4	3168537.7	-1762.5	1800.0	0.6	241.8	-14.8	12.4	1798.7	0.3	19.4	
365188.3	3168537.6	-1788.5	1826.0	0.4	232.7	-15.0	12.3	1824.7	0.3	19.4	9 5/8" CSG
365188.2	3168537.6	-1793.7	1831.2	0.4	232.7	-15.0	12.3	1829.9	0.3	19.4	Mauddud Erosional Zone
365188.2	3168537.5	-1809.1	1846.6	0.3	212.3	-15.1	12.2	1845.3	0.3	19.4	Mauddud
365188.1	3168537.5	-1817.5	1855.0	0.4	235.7	-15.1	12.2	1853.7	0.3	19.4	S.T.P.

X	Y	Z	MD	INC	AZ	DX	DY	TVD	DL	HD	Remark
365187.9	3168538.2	-1827.5	1865.0	3.2	344.4	-15.4	13.0	1863.7	4.7	20.1	
365187.8	3168538.9	-1837.4	1875.0	3.9	349.3	-15.5	13.6	1873.7	4.7	20.6	
365187.6	3168539.8	-1847.4	1885.0	6.1	349.1	-15.7	14.6	1883.6	4.7	21.4	
365187.3	3168541.0	-1857.3	1895.0	7.2	349.1	-15.9	15.8	1893.6	4.7	22.4	
365187.0	3168542.5	-1867.2	1905.0	8.3	349.1	-16.2	17.3	1903.4	4.7	23.7	
365186.6	3168544.3	-1877.0	1915.0	11.1	346.8	-16.6	19.1	1913.3	5.8	25.3	
365186.1	3168546.4	-1886.8	1925.0	12.5	346.0	-17.1	21.2	1923.0	5.8	27.2	
365185.6	3168548.3	-1894.5	1933.0	13.9	345.4	-17.6	23.1	1930.8	5.8	29.0	Kazhdumi Shale (KZ_1)
365185.5	3168548.8	-1896.5	1935.0	15.4	346.1	-17.8	23.6	1932.7	6.3	29.5	
365184.8	3168551.6	-1906.1	1945.0	17.0	346.7	-18.4	26.4	1942.3	6.3	32.2	
365184.1	3168554.7	-1915.5	1955.0	18.5	347.1	-19.1	29.5	1951.8	6.3	35.2	
365183.4	3168558.2	-1924.9	1965.0	21.1	347.3	-19.9	32.9	1961.1	4.6	38.5	
365182.5	3168561.8	-1934.2	1975.0	22.2	347.2	-20.7	36.6	1970.4	4.6	42.1	
365181.6	3168565.7	-1943.3	1985.0	23.3	347.0	-21.6	40.5	1979.6	4.6	45.9	
365180.7	3168569.8	-1952.4	1995.0	25.3	347.0	-22.6	44.6	1988.6	3.8	50.0	
365179.7	3168574.2	-1961.4	2005.0	26.2	347.1	-23.6	48.9	1997.6	3.8	54.3	
365179.5	3168574.9	-1962.8	2006.6	26.2	347.1	-23.7	49.6	1999.0	3.8	55.0	Kazhdumi Lst.(Dair Lst.)
365178.7	3168578.6	-1970.2	2015.0	28.1	347.3	-24.6	53.4	2006.5	3.8	58.8	
365177.6	3168583.4	-1979.0	2025.0	29.6	347.1	-25.7	58.2	2015.2	6.2	63.6	
365176.4	3168588.5	-1987.5	2035.0	31.1	346.9	-26.8	63.2	2023.7	6.2	68.7	
365175.2	3168593.5	-1995.4	2044.5	34.1	346.6	-28.0	68.3	2031.7	6.2	73.8	U. Burgan-A (U_B_A_1)
365175.1	3168593.8	-1995.9	2045.0	34.1	346.6	-28.1	68.5	2032.1	6.2	74.1	
365173.8	3168599.4	-2004.0	2055.0	35.4	346.4	-29.5	74.2	2040.3	6.3	79.8	
365172.9	3168603.2	-2009.2	2061.5	36.7	346.3	-30.4	78.0	2045.4	6.3	83.7	7" LNR
365172.3	3168605.3	-2011.9	2065.0	38.0	346.2	-30.9	80.1	2048.2	6.3	85.9	
365170.8	3168611.5	-2019.7	2075.0	39.4	346.0	-32.5	86.3	2055.9	6.3	92.2	
365169.2	3168617.9	-2027.1	2085.0	41.9	345.9	-34.1	92.7	2063.4	4.9	98.8	
365167.5	3168624.6	-2034.4	2095.0	43.1	345.8	-35.7	99.3	2070.7	4.9	105.6	
365166.7	3168627.9	-2037.9	2099.9	44.2	345.8	-36.6	102.6	2074.2	4.9	109.0	L. Burgan_A_1(Sand-1)
365165.8	3168631.4	-2041.6	2105.0	45.4	345.8	-37.5	106.1	2077.8	4.9	112.5	
365164.0	3168638.4	-2048.4	2115.0	47.1	346.0	-39.2	113.2	2084.7	6.5	119.8	
365162.2	3168645.7	-2055.0	2125.0	49.0	346.1	-41.0	120.5	2091.3	5.4	127.3	
365160.8	3168651.3	-2059.8	2132.5	50.0	346.0	-42.4	126.1	2096.1	5.4	133.0	4" P.P Screen
365160.7	3168651.7	-2060.1	2133.0	51.0	346.0	-42.5	126.4	2096.4	5.4	133.4	TD

PETROPARS OIL FIELDS SERVICES

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Fax: +98 21 23035800
Web Site: www.PETROPARS.com Email: infoatpetropars.com

Appendix I

MASTER LOG
Well: F-18-03-PH

Scale: 1/1000

WELL DATA

Country:	IRAN
Area:	Persian Gulf-Kharg
Company Name:	POSCO
Field:	Foroozan
Well:	F-18-03-PH
Platform/ Slot No.:	F18/03
Well Type:	Pilot
Target Res:	Surmeh (Arab-D)
Formation @ TD:	
Coordinates System:	UTM
Datum/Zone:	WGS 84/39N
Easting:	365203.25m
Northing:	3168525
RKB-MSL :	36.24m
Water Depth :	50.5mTMD
TD Depth MD:	3018.5
TD Depth TVDss:	-2980.86
Rig Name :	WRT-1
Spud Date :	1400/05/07(07/29/2021)
Drilling end date:	1401/10/14(04/01/2023)
Drilling contractor :	POSCO
Mudlogging Co.:	Petro Gostaran

GEOLOGICAL SAMPLING

Depth: 89-3018.5 mTMD

Sampling Rate :

5m

4m

2m

1m

Geologists:

D.Etemadi Magham

R.Rezaei

K.Aminzadeh

A.Mahmoudi

Area Superintendent:

HOLE SIZE

26":	89-458 mTMD
17 1/2":	458-922 mTMD
12 1/4":	922-1830 mTMD
8 1/2":	1830-3018.5 mTMD

CASING & LINER SIZE

30" CSG Shoe:	101.5 mTMD
20" CSG Shoe:	453 mTMD
13 3/8" CSG Shoe:	920 mTMD
9 5/8" CSG Shoe:	1826 mTMD

MUD TYPE

26" :	SW(WBM) 64 pcf
17 1/2" :	Salt Polymer 64-70pcf
12 1/4" :	Bentonite Mud(WBM) 68-74pcf
8 1/2" :	OBM 79.5-82pcf

LITHOLOGY SYMBOLS

Brec, Sh, Cht Lst, Cht Dol, Cgl, Calc Sh, Arg Lst, Salt, Sst, Sd Sh, Arg Cht Lst, Anhy, L. Sd, Mrl, Pyr Lst, Gyp, Calc Sst, Rd Mrl, Dol Lst, Cht, Stst, Lst, Dol, Pyr, Sd Clst, Sd Lst, Calc Dol, Glauc, Clst, ool Lst, Sd Dol, Lignite, Rd Clst, chky Lst, Arg Dol, Cmt., Calc Clst, Anhy Lst, Anhy Dol, Metal, Free quartz, Glauc Lst

ABBREVIATION

PDC: Polycristalline Diamond Cutter
INS: BIT Insert BIT
CP: Conductor Pipe
CSG: Casing
KOP: Kick Off Point
MD: Measured Depth
TVD: True Vertical Depth
TVDss: True Vertical Depth Subsea
INC: Inclination
AZM: Azimuth
RKB: Rotary Kelly Bushing
ROP: Rate Of Penetration
RPM: Rotation Per Minute
WOB: Weight On Bit
TRQ: Torque
GPM: Gallon Per Minute
SPP: Stand Pipe Pressure
GR: Gamma Ray
RD: Deep Resistivity
RS: Shallow Resistivity
NPHI: Neutron Porosity Log
RHOB: Density Log
DT: Delta Time Sonic log
ECD: Equivalent Circulating Density
MW: Mud Weight
Vis: Viscosity
PV: Plastic Viscosity
YP: Yield Point
WBM: Water Base Mud
OBM: Oil Base Mud
TG: Trip Gas
BGG: BackGround Gas
FLUOR: Fluorescence
Fm. / Mbr: Formation/Member

SYMBOLS

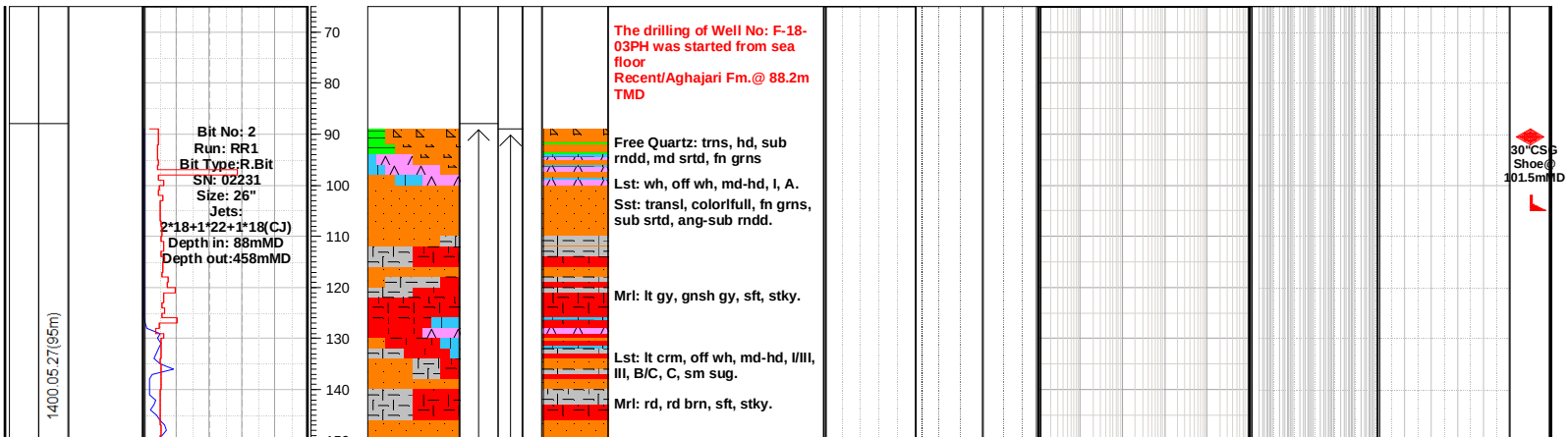
Deviation Survey
Trip
Casing/Liner Shoe
Liner Lap
Cement Plug
Poor Oil Stain
Good Oil Stain
Pressure Test By RCT Logging
Fresh Water
Dead Oil / Asph
Gas
CO2
H2S
Core Interval
Perforation Interval
Res. Test
Perforated liner
Slotted Liner
Wire Wrapped/ Pre-Packed Screen
Stylolite

GAS CHAIN STANDARD

Gas Trap Type :	Degasser
Gas Normalization Parameters :	GPM, ROP, Hole Size
Gas Detector Means. Cell Type :	FID
Gas Chromatograph Cell Type :	C8 Agilent 7890A

REMARKS: Coring Operation: Conventional Coring f/ 1846m to 1998.4m TMD (152.4m) Conventional Coring f/ 2032m to 2169.4m TMD (137.4m)
Oriented Coring f/ 2222m to 2223.6m TMD (1.6m) Conventional Coring f/ 2223.6m to 2274.19m TMD (50.19m) Oriented Coring f/ 2460m to 2560m TMD (100m)

GEOLOGIST | DATE & PROGRESS | MUD DATA (TYPE, MW (pcf), Vis (Sec.), Chloride (mg/l), LOSS -(bph), GAIN +(bph)) | ROP (min/m) 0–100 | MWD-GR (GAPI) 0–100 | WOB (Klbs) 0–60 | DEPTH (mMD) | LITHOLOGY CUTTING % | FORMATION | AGE | CORING INTERVAL | INTERPRETED LITHOLOGY | CUTTING DESCRIPTION & FORMATION TOP | CALCIMETRY (CaCo3 0–100, CaMg(Co3)2 0–100, Impurity 0–100, Caving 0–100) | FLUORESCENCE: DIRECT FLUOR (WEAK, FAIR, GOOD) | CUT FLUOR (WEAK, FAIR, GOOD) | GAS CHROMATOGRAPHY (TG (ppm) 10–1000000, C1(ppm) 10–1000000, C2(ppm) 10–1000000, C3(ppm) 10–1000000, iC4(ppm) 10–1000000, nC4(ppm) 10–1000000, iC5(ppm) 10–1000000, nC5(ppm) 10–1000000, C6(ppm) 10–1000000, Bz(ppm) 10–1000000, C7(ppm) 10–1000000, mBz(ppm) 10–1000000, C8(ppm) 10–1000000, H2S(ppm) 10–1000000, Co2(ppm) 10–1000000) | RD (Ohm.m) 0.2–200000.0 | RS (Ohm.m) 0.2–200000.0 | SURVEY DATA: NPHI (pu) 45–-15 | RHOB (gr/cm³) 1.95–2.95 | Survey, Casing & Liner Shoe, L.Lap



D.Etemadi Magham

1400.05.28(203m)

SW(WBM)
64pcf
26Sec.
- - - mg/l
- - - bph

WOB: 0-8klbs
RPM: 35-60rpm
TRQ: 0-4klb.f
GPM: 700-1200gpm
SPP: 450-1350psi

WOB: 0-15klbs
RPM: 40-90rpm
TRQ: 0-5klb.f
GPM: 1200gpm
SPP: 1400psi

1400.05.29(72m)

SW(WBM)
64pcf
26Sec.
- - - mg/l
- - - bph

WOB: 0-18klbs
RPM:60-90rpm
TRQ: 0-5klb.f
GPM: 1200gpm
SPP: 1450psi

14

Bit No:3
Run: R1
Bit Type:Insert Bit
SN: 2103639JH
Size: 17 1/2"
Jets: 3*20
Depth in: 461mMD
Depth out:922

1400.08.14(53m)

Salt
Polymer
70pcf
41Sec.
- - - mg/l
- - - bph

WOB: 4-25klbs
RPM:100-147rpm
TRQ: 0-3klb.f
GPM: 605-855gpm
SPP: 750-1580psi

150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490 500 510 520 530 540

Fars Group

pliocene

Sample quality was not good due to catching sample from conductor pipe in the whole section

Gyp: transp, mh hd, xln.

Lst: lt gy, lt gn, sft, ll, B, arg

Sst: transl, colorlfull, fn grns, sub srtd, ang, calc cmt.

Lst: cr gr, lt gr, sft, md sft, ll, I, B, B/A, pt.

Gyp: transp, sm trnsl, mh hd, xln.

Lst: lt crm, wh, sft-mdhd, I/II, A, sm arg.

Lst: lt crm, wh, lt gy, sft-mdhd, sft, I/II, A, sm dol.

Sst: transl, yell, trnsp, fn grns, sub srtd, sub srtd

Clst: gy, gn gy, sft.

Anhy: wh, transp, trnsl, sft, mh hd, putty, washable.

Anhy (Gyps): wh, trnsl, mh hd, xln

Lst: lt cr, wh, sft, md hd, ll, I/II, B, B/A, pt. sm dolomitic

Clst: rd, rd brn, sft, sm stky. Sm calc

Anhy (Gyps): trnsp, trnsl, mh hd, xln

Lst: lt gn, lt gy, lt cr, sft, md hd, I/III, I/II, B, B/C, sm sug, dolomitic

Clst: rd, rd brn, sft, sm stky. Sm calc

All Gamma Ray Curve is Base On Wireline Data

Lst: lt gn, off wh, lt cr, sft, md hd, I/II, B, sm sug, dolomitic

Anhy: wh, trnsl, sft, mh hd, xln, pt.

Clst: dk gy, gy, dk gn, sft.

Clst: gy, ltgy, sft, washable.

Anhy: wh, colorless, glssy, xln, md hd.

Lst: wh, ltcrm, md hd, I, I/III, A/B, dolomitic.

Lst: wh, ltcrm, md hd, I, I/III, A/B, dolomitic.

Clst: gy, ltgy, sft, stky.

MD:184
INC:0.5

0.5

MD:300
INC:0.25

0.25

MD:445
INC: 0.5

0.5

20"CSG
Shoe@
453mMD

MD:453
INC:1.05
AZI:176.44
TVDss:-416.76

1.05

MD:488
INC:2.07
AZI:165.09
TVDss:-452.15

2.07

MD:519
INC:2.23
AZI:150.90
TVDss:-482.72

2.23

R.Rezaei

1400.08.15(153m)

Salt Polymer 70pcf 41Sec. Mud Loss: 10-15 bph

Obs. 75 bbl loss f/ 600m to 604m.

1400.08.16(174m)

Salt Polymer 70pcf 41Sec. Mud Loss: 7-10 bph

Gradually loss increased to 40 BPH f/ 814m

1400.08.17(81m)

Salt Polymer 70pcf 40Sec. Mud Loss: 10-25 bph

R 14

Bentonite Mud 70pcf 33Sec. Mud Loss:0 bph

WOB: 0-20klbs
RPM:60-160rpm
TRQ: 0-3klb.f
GPM: 425-855gpm
SPP: 740-1620psi

WOB: 0-26klbs
RPM:65-160rpm
TRQ: 0-4klb.f
GPM: 340-855gpm
SPP: 620-1740psi

WOB: 2-26klbs
RPM:110-160rpm
TRQ: 0-6klb.f
GPM: 650-855gpm
SPP: 1050-1730psi

WOB: 5-15klbs
RPM:20-60rpm
TRQ: 3-6klb.f
GPM: 600-800gpm
SPP: 720-760psi

Bit No:5
Run: R
Bit Type:PDC bit
SN: 6006005
Size: 12 1/4"
Jets: 9 x 13/32"
Depth in: 925mTMD
Depth out: 1360mTMD

Asmari/Ghar

Oligocene

Top of Asmari/Ghar Formation @ TMD: 548m, TVD: 547.95m, TVDss: -511.7m

Sst: colorless, glssy, xln, fn grn, well srtd, sub rndd, lse.

Sst: colorless, glssy, xln, fn grn, well srtd, sub rndd, lse.

Clst: gnshgy, ltgy, sft.

Lst: ltgy, ltcrm, md hd, hd, I, I/III, A/B, dolomitic.

Top of jahrum Formation @ TMD: 653.5m, TVD: 653.4m, TVDss: -617.16 m

Dol Lst: buf, lt crm, crm, I/III, III, B/C, md hd, hd, sm sugr

mmm

Dol Lst: ltgy, lt crm, I/III, III, B/C, md hd, hd, pros, sm sugr, dd oil.

Dol: lt brn, brn, buf, I, I/III, A, B, hd.

Dol: brn, buf, I/III, III, B/C, mdhd, hd, pros, sugr, dd oil.

Dol: brn, buf, crm, I/III, III, B/C, mdhd, hd, sm sugr.

Clst: gy, lt gy, sft.

Anhy: wh, colorless, glssy, trnsl, md hd, hd.

Dol Lst: lt crm, crm, buf, I/II, I/III, B, md hd

Anhy: wh, colorless, glssy, trnsl, md hd, hd.

Dol Lst: lt crm, crm, buf, I/II, I/III, B, md hd, sm sug

MD:547
INC:1.38
AZI:64.80
TVDss:-510.71

MD:582
INC:1.27
AZI:21.10
TVDss:-545.71

MD:611
INC:1.50
AZI:0.90
TVDss:-574.70

MD:640.50
INC:2.10
AZI:348.10
TVDss:-604.18

MD:670
INC:4.52
AZI:340.20
TVDss:-633.63

MD:699.5
INC:6.40
AZI:341
TVDss:-663

MD:728
INC:7.56
AZI:341.10
TVDss:-691.28

MD:757
INC:8.1
AZI:343.5
TVDss:-720.01

MD:786
INC:6.11
AZI:340.3
TVDss:-748.79

MD:815
INC:3.96
AZI:340
TVDss:-777.68

MD:844
INC:2.24
AZI:342.2
TVDss:-806.63

MD:874
INC:0.92
AZI:318.50
TVDss:-836.62

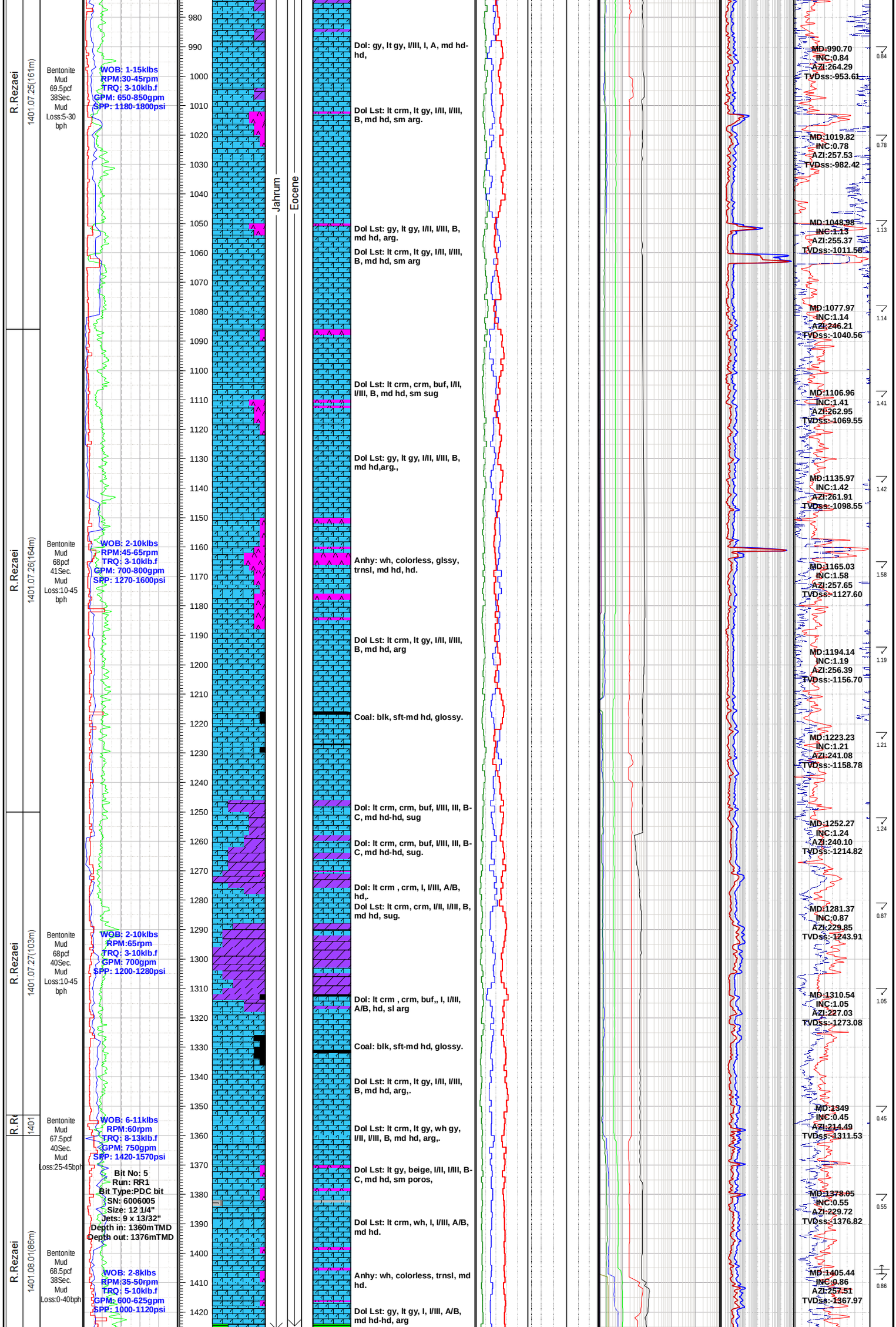
MD:904
INC:0.4
AZI:272.30
TVDss:-866.62

13 3/8" CSG Shoe@ 920mMD

MD:922
INC:0.4
AZI:226
TVDss:-884.61

MD:932.53
INC:0.55
AZI:266.26
TVDss:-895.14

MD:961.63
INC:0.86
AZI:264.81
TVDss:-924.24


R.Rezaei
1401.07.25(161m)
Bentonite Mud 69.5pcf 38Sec. Mud Loss:5-30 bph
WOB: 1-15klbs
RPM:30-45rpm
TRQ: 3-10klb.f
GPM: 650-850gpm
SPP: 1180-1800psi
R.Rezaei
1401.07.26(164m)
Bentonite Mud 68pcf 41Sec. Mud Loss:10-45 bph
WOB: 2-10klbs
RPM:45-65rpm
TRQ: 3-10klb.f
GPM: 700-800gpm
SPP: 1270-1600psi
R.Rezaei
1401.07.27(103m)
Bentonite Mud 68pcf 40Sec. Mud Loss:10-45 bph
WOB: 2-10klbs
RPM:65rpm
TRQ: 3-10klb.f
GPM: 700gpm
SPP: 1200-1280psi
R.Rezaei
1401.08.01(86m)
Bentonite Mud 67.5pcf 40Sec. Mud Loss:25-45bph
WOB: 6-11klbs
RPM:60rpm
TRQ: 8-13klb.f
GPM: 750gpm
SPP: 1420-1570psi
Bit No: 5
Run: RR1
Bit Type:PDC bit
SN: 6006005
Size: 12 1/4"
Jets: 9 x 13/32"
Depth in: 1360mTMD
Depth out: 1376mTMD
Bentonite Mud 68.5pcf 38Sec. Mud Loss:0-40bph
WOB: 2-8klbs
RPM:35-50rpm
TRQ: 5-10klb.f
GPM: 600-625gpm
SPP: 1000-1120psi
980
990
1000
1010
1020
1030
1040
1050
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1070
1080
1090
1100
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1120
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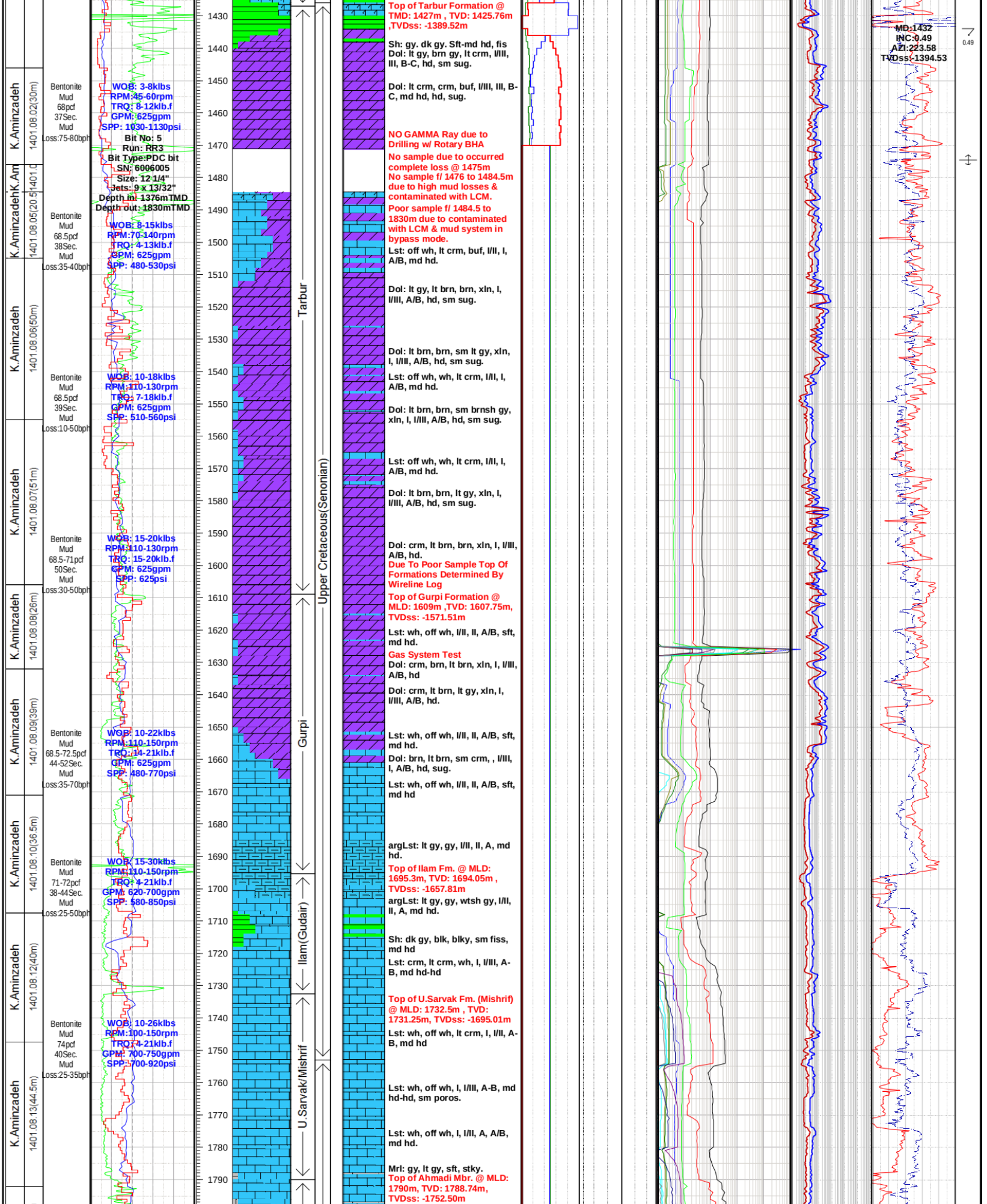
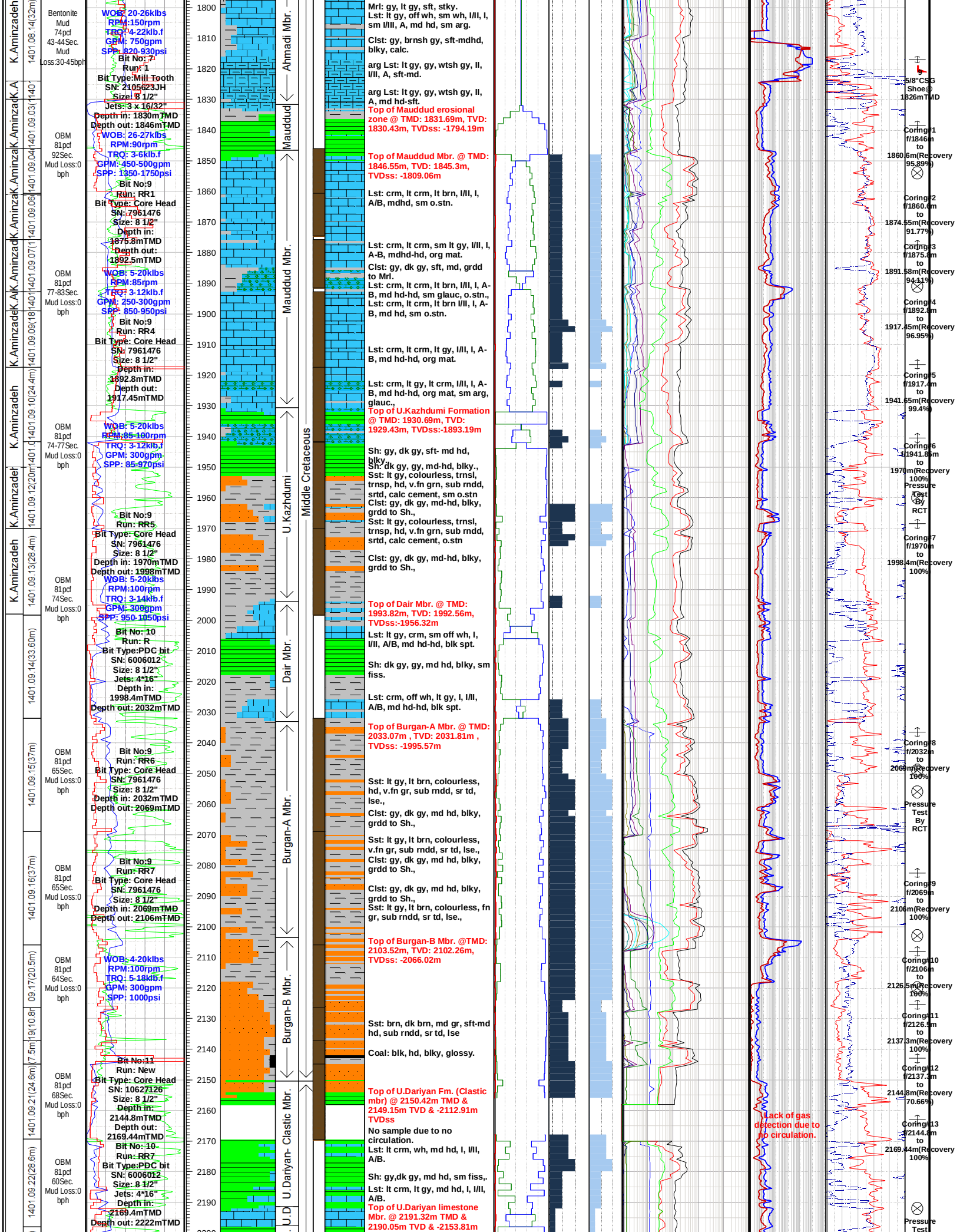
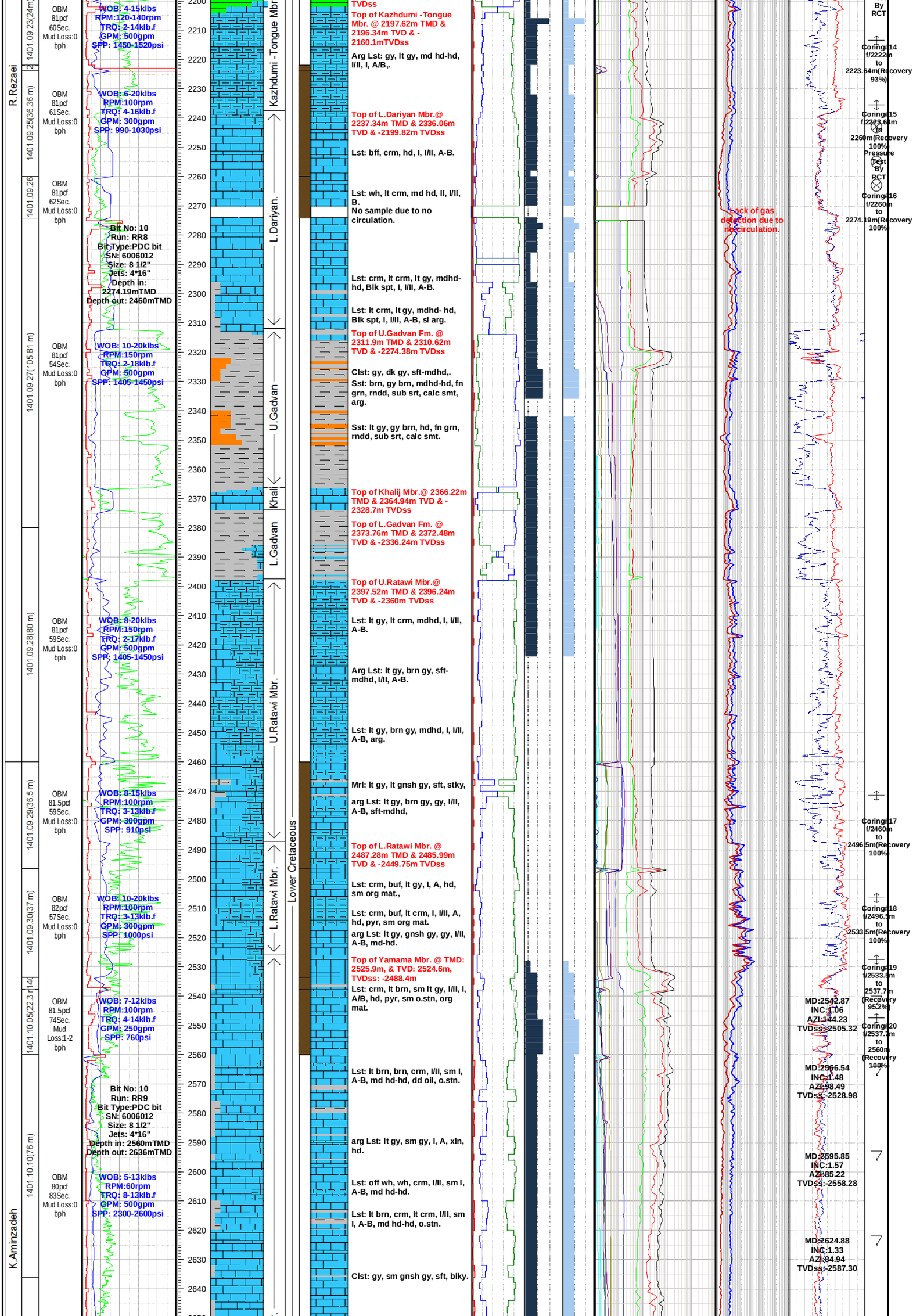
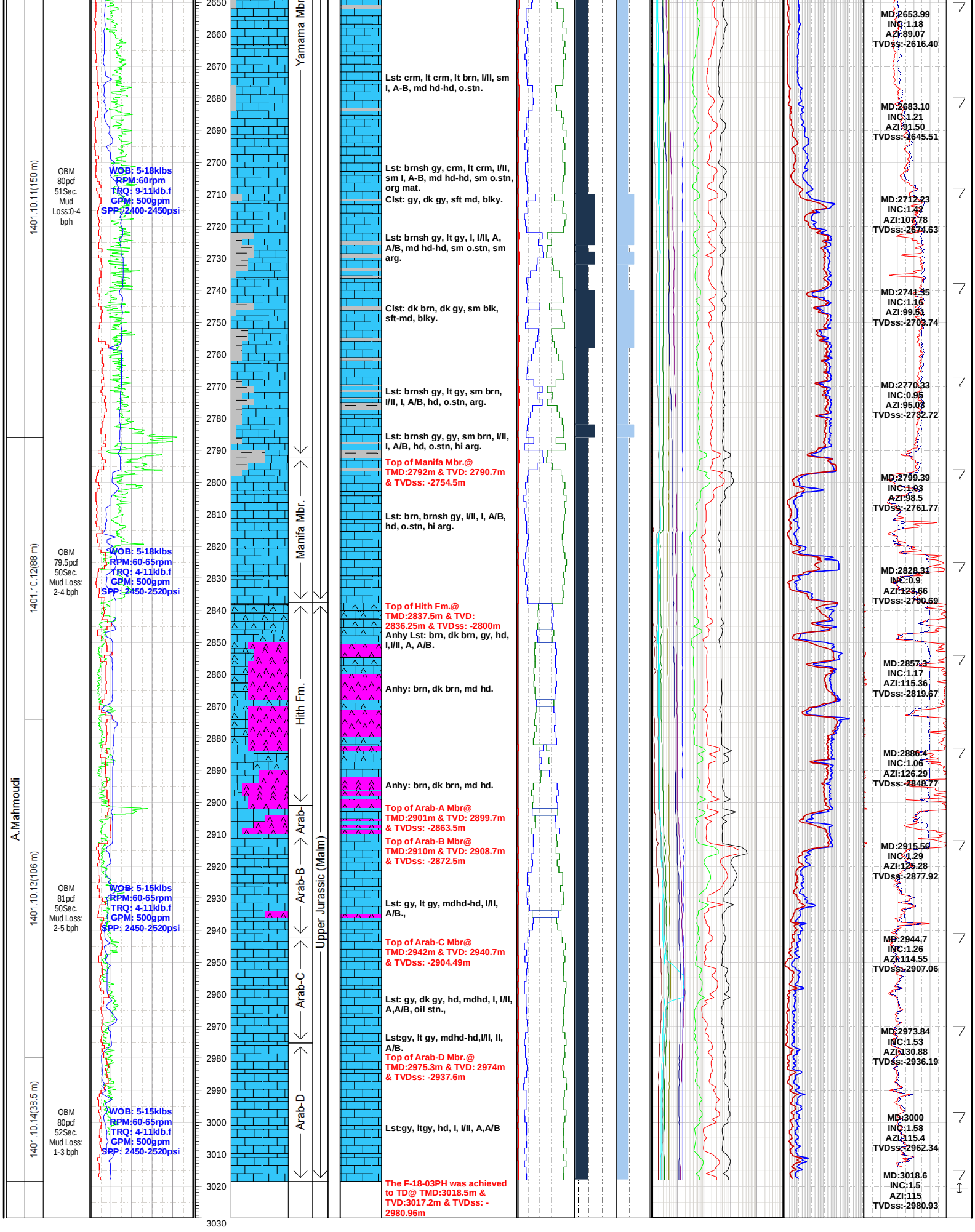
1390
1400
1410
1420
Jahrum
Eocene
Dol: gy, lt gy, I/III, I, A, md hd-hd,
Dol Lst: lt crm, lt gy, I/II, I/III, B, md hd, sm arg.
Dol Lst: gy, lt gy, I/II, I/III, B, md hd, arg.
Dol Lst: lt crm, lt gy, I/II, I/III, B, md hd, sm arg
Dol Lst: lt crm, crm, buf, I/II, I/III, B, md hd, sm sug
Dol Lst: gy, lt gy, I/II, I/III, B, md hd,arg.,
Anhy: wh, colorless, glssy, trnsl, md hd, hd.
Dol Lst: lt crm, lt gy, I/II, I/III, B, md hd, arg
Coal: blk, sft-md hd, glossy.
Dol: lt crm, crm, buf, I/III, III, B-C, md hd-hd, sug
Dol: lt crm, crm, buf, I/III, III, B-C, md hd-hd, sug.
Dol: lt crm , crm, I, I/III, A/B, hd,.
Dol Lst: lt crm, crm, I/II, I/III, B, md hd, sug.
Dol: lt crm , crm, buf,, I, I/III, A/B, hd, sl arg
Coal: blk, sft-md hd, glossy.
Dol Lst: lt crm, lt gy, I/II, I/III, B, md hd, arg,.
Dol Lst: lt crm, lt gy, wh gy, I/II, I/III, B, md hd, arg,.
Dol Lst: lt gy, beige, I/II, I/III, B-C, md hd, sm poros,
Dol Lst: lt crm, wh, I, I/III, A/B, md hd.
Anhy: wh, colorless, trnsl, md hd.
Dol Lst: gy, lt gy, I, I/III, A/B, md hd-hd, arg
MD:990.70
INC:0.84
AZI:264.29
TVDss:-953.61
0.84
MD:1019.82
INC:0.78
AZI:257.53
TVDss:-982.42
0.78
MD:1048.98
INC:1.13
AZI:255.37
TVDss:-1011.58
1.13
MD:1077.97
INC:1.14
AZI:246.21
TVDss:-1040.56
1.14
MD:1106.96
INC:1.41
AZI:262.95
TVDss:-1069.55
1.41
MD:1135.97
INC:1.42
AZI:261.91
TVDss:-1098.55
1.42
MD:1165.03
INC:1.58
AZI:257.65
TVDss:-1127.60
1.58
MD:1194.14
INC:1.19
AZI:256.39
TVDss:-1156.70
1.19
MD:1223.23
INC:1.21
AZI:241.08
TVDss:-1158.78
1.21
MD:1252.27
INC:1.24
AZI:240.10
TVDss:-1214.82
1.24
MD:1281.37
INC:0.87
AZI:229.85
TVDss:-1243.91
0.87
MD:1310.54
INC:1.05
AZI:227.03
TVDss:-1273.08
1.05
MD:1349
INC:0.45
AZI:214.49
TVDss:-1311.53
0.45
MD:1378.05
INC:0.55
AZI:229.72
TVDss:-1376.82
0.55
MD:1405.44
INC:0.86
AZI:257.51
TVDss:-1367.97
0.86


K.Aminzadeh
1401.08.02(30m)
K.Aminzadeh
1401.08.05(20.5m)
K.Aminzadeh
1401.08.06(50m)
K.Aminzadeh
1401.08.07(51m)
K.Aminzadeh
1401.08.08(26m)
K.Aminzadeh
1401.08.09(39m)
K.Aminzadeh
1401.08.10(36.5m)
K.Aminzadeh
1401.08.12(40m)
K.Aminzadeh
1401.08.13(44.5m)
Bentonite Mud 68pcf 37Sec. Mud Loss:75-80bph
WOB: 3-8klbs
RPM:45-60rpm
TRQ: 8-12klb.f
GPM: 625gpm
SPP: 1030-1130psi
Bit No: 5
Run: RR3
Bit Type:PDC bit
SN: 6006005
Size: 12 1/4"
Jets: 9 x 13/32"
Depth in: 1376mTMD
Depth out: 1830mTMD
Bentonite Mud 68.5pcf 38Sec. Mud Loss:35-40bph
WOB: 8-15klbs
RPM:70-140rpm
TRQ: 4-13klb.f
GPM: 625gpm
SPP: 480-530psi
Bentonite Mud 68.5pcf 39Sec. Mud Loss:10-50bph
WOB: 10-18klbs
RPM:110-130rpm
TRQ: 7-18klb.f
GPM: 625gpm
SPP: 510-560psi
Bentonite Mud 68.5-71pcf 50Sec. Mud Loss:30-50bph
WOB: 15-20klbs
RPM:110-130rpm
TRQ: 15-20klb.f
GPM: 625gpm
SPP: 625psi
Bentonite Mud 68.5-72.5pcf 44-52Sec. Mud Loss:35-70bph
WOB: 10-22klbs
RPM:110-150rpm
TRQ: 14-21klb.f
GPM: 625gpm
SPP: 480-770psi
Bentonite Mud 71-72pcf 38-44Sec. Mud Loss:25-50bph
WOB: 15-30klbs
RPM:110-150rpm
TRQ: 14-21klb.f
GPM: 620-700gpm
SPP: 580-850psi
Bentonite Mud 74pcf 40Sec. Mud Loss:25-35bph
WOB: 10-26klbs
RPM:100-150rpm
TRQ: 14-21klb.f
GPM: 700-750gpm
SPP: 700-920psi
1430
1440
1450
1460
1470
1480
1490
1500
1510
1520
1530
1540
1550
1560
1570
1580
1590
1600
1610
1620
1630
1640
1650
1660
1670
1680
1690
1700
1710
1720
1730
1740
1750
1760
1770
1780
1790
Tarbur
Gurpi
Ilam(Gudair)
U.Sarvak/Mishrif
Upper Cretaceous(Senonian)
Top of Tarbur Formation @ TMD: 1427m , TVD: 1425.76m ,TVDss: -1389.52m
Sh: gy. dk gy. Sft-md hd, fis
Dol: lt gy, brn gy, lt crm, I/III, III, B-C, hd, sm sug.
Dol: lt crm, crm, buf, I/III, III, B-C, md hd, hd, sug.
NO GAMMA Ray due to Drilling w/ Rotary BHA
No sample due to occurred complete loss @ 1475m
No sample f/ 1476 to 1484.5m due to high mud losses & contaminated with LCM.
Poor sample f/ 1484.5 to 1830m due to contaminated with LCM & mud system in bypass mode.
Lst: off wh, lt crm, buf, I/II, I, A/B, md hd.
Dol: lt gy, lt brn, brn, xln, I, I/III, A/B, hd, sm sug.
Dol: lt brn, brn, sm lt gy, xln, I, I/III, A/B, hd, sm sug.
Lst: off wh, wh, lt crm, I/II, I, A/B, md hd.
Dol: lt brn, brn, sm brnsh gy, xln, I, I/III, A/B, hd, sm sug.
Lst: off wh, wh, lt crm, I/II, I, A/B, md hd.
Dol: lt brn, brn, lt gy, xln, I, I/III, A/B, hd, sm sug.
Dol: crm, lt brn, brn, xln, I, I/III, A/B, hd.
Due To Poor Sample Top Of Formations Determined By Wireline Log
Top of Gurpi Formation @ MLD: 1609m ,TVD: 1607.75m, TVDss: -1571.51m
Lst: wh, off wh, I/II, II, A/B, sft, md hd.
Gas System Test
Dol: crm, brn, lt brn, xln, I, I/III, A/B, hd
Dol: crm, lt brn, lt gy, xln, I, I/III, A/B, hd.
Lst: wh, off wh, I/II, II, A/B, sft, md hd.
Dol: brn, lt brn, sm crm, , I/III, I, A/B, hd, sug.
Lst: wh, off wh, I/II, II, A/B, sft, md hd
argLst: lt gy, gy, I/II, II, A, md hd.
Top of Ilam Fm. @ MLD: 1695.3m, TVD: 1694.05m , TVDss: -1657.81m
argLst: lt gy, gy, wtsh gy, I/II, II, A, md hd.
Sh: dk gy, blk, blky, sm fiss, md hd
Lst: crm, lt crm, wh, I, I/III, A-B, md hd-hd
Top of U.Sarvak Fm. (Mishrif) @ MLD: 1732.5m , TVD: 1731.25m, TVDss: -1695.01m
Lst: wh, off wh, lt crm, I, I/II, A-B, md hd
Lst: wh, off wh, I, I/III, A-B, md hd-hd, sm poros.
Lst: wh, off wh, I, I/II, A, A/B, md hd.
Mrl: gy, lt gy, sft, stky.
Top of Ahmadi Mbr. @ MLD: 1790m, TVD: 1788.74m, TVDss: -1752.50m
MD:1432
INC:0.49
AZI:223.58
TVDss:-1394.53
0.49


K.Aminzadeh
1401.08.14(32m)
Bentonite Mud 74pcf 43-44Sec. Mud Loss:30-45bph
WOB: 20-26klbs
RPM:150rpm
TRQ: 4-22klb.f
GPM: 750gpm
SPP: 820-930psi
Bit No: 7
Run: 1
Bit Type:Mill Tooth
SN: 2105623JH
Size: 8 1/2"
Jets: 3 x 16/32"
Depth in: 1830mTMD
Depth out: 1846mTMD
OBM 81pcf 92Sec. Mud Loss:0 bph
WOB: 26-27klbs
RPM:90rpm
TRQ: 3-6klb.f
GPM: 450-500gpm
SPP: 1350-1750psi
Bit No:9
Run: RR1
Bit Type: Core Head
SN: 7961476
Size: 8 1/2"
Depth in: 1875.8mTMD
Depth out: 1892.5mTMD
OBM 81pcf 77-83Sec. Mud Loss:0 bph
WOB: 5-20klbs
RPM:85rpm
TRQ: 3-12klb.f
GPM: 250-300gpm
SPP: 850-950psi
Bit No:9
Run: RR4
Bit Type: Core Head
SN: 7961476
Size: 8 1/2"
Depth in: 1892.8mTMD
Depth out: 1917.45mTMD
OBM 81pcf 74-77Sec. Mud Loss:0 bph
WOB: 5-20klbs
RPM:85-100rpm
TRQ: 3-12klb.f
GPM: 300gpm
SPP: 85-970psi
Bit No:9
Run: RR5
Bit Type: Core Head
SN: 7961476
Size: 8 1/2"
Depth in: 1970mTMD
Depth out: 1998mTMD
OBM 81pcf 74Sec. Mud Loss:0 bph
WOB: 5-20klbs
RPM:100rpm
TRQ: 3-14klb.f
GPM: 300gpm
SPP: 950-1050psi
Bit No: 10
Run: R
Bit Type:PDC bit
SN: 6006012
Size: 8 1/2"
Jets: 4*16"
Depth in: 1998.4mTMD
Depth out: 2032mTMD
OBM 81pcf 65Sec. Mud Loss:0 bph
Bit No:9
Run: RR6
Bit Type: Core Head
SN: 7961476
Size: 8 1/2"
Depth in: 2032mTMD
Depth out: 2069mTMD
OBM 81pcf 65Sec. Mud Loss:0 bph
Bit No:9
Run: RR7
Bit Type: Core Head
SN: 7961476
Size: 8 1/2"
Depth in: 2069mTMD
Depth out: 2106mTMD
OBM 81pcf 64Sec. Mud Loss:0 bph
WOB: 4-20klbs
RPM:100rpm
TRQ: 5-18klb.f
GPM: 300gpm
SPP: 1000psi
Bit No:11
Run: New
Bit Type: Core Head
SN: 10627126
Size: 8 1/2"
Depth in: 2144.8mTMD
Depth out: 2169.44mTMD
OBM 81pcf 68Sec. Mud Loss:0 bph
Bit No: 10
Run: RR7
Bit Type:PDC bit
SN: 6006012
Size: 8 1/2"
Jets: 4*16"
Depth in: 2169.4mTMD
Depth out: 2222mTMD
OBM 81pcf 60Sec. Mud Loss:0 bph
1800
1810
1820
1830
1840
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
2110
2120
2130
2140
2150
2160
2170
2180
2190
Ahmadi Mbr.
Mauddud Mbr.
U.Kazhdumi
Dair Mbr.
Burgan-A Mbr.
Burgan-B Mbr.
U.Dariyan- Clastic Mbr.
Middle Cretaceous
Mrl: gy, lt gy, sft, stky.
Lst: lt gy, off wh, sm wh, l/II, I, sm l/III, A, md hd, sm arg.
Clst: gy, brnsh gy, sft-mdhd, blky, calc.
arg Lst: lt gy, gy, wtsh gy, II, l/II, A, sft-md.
arg Lst: lt gy, gy, wtsh gy, II, A, md hd-sft.
Top of Mauddud erosional zone @ TMD: 1831.69m, TVD: 1830.43m, TVDss: -1794.19m
Top of Mauddud Mbr. @ TMD: 1846.55m, TVD: 1845.3m, TVDss: -1809.06m
Lst: crm, lt crm, lt brn, l/II, I, A/B, mdhd, sm o.stn.
Lst: crm, lt crm, sm lt gy, l/II, I, A-B, mdhd-hd, org mat.
Clst: gy, dk gy, sft, md, grdd to Mrl.
Lst: crm, lt crm, lt brn, l/II, I, A-B, md hd-hd, sm glauc, o.stn.,
Lst: crm, lt crm, lt brn l/II, I, A-B, md hd, sm o.stn.
Lst: crm, lt crm, lt gy, l/II, I, A-B, md hd-hd, org mat.
Lst: crm, lt gy, lt crm, l/II, I, A-B, md hd-hd, org mat, sm arg, glauc.,
Top of U.Kazhdumi Formation @ TMD: 1930.69m, TVD: 1929.43m, TVDss:-1893.19m
Sh: gy, dk gy, sft- md hd, blky.,
Sh: dk gy, gy, md-hd, blky.,
Sst: lt gy, colourless, trnsl, trnsp, hd, v.fn grn, sub rndd, srtd, calc cement, sm o.stn
Clst: gy, dk gy, md-hd, blky, grdd to Sh.,
Sst: lt gy, colourless, trnsl, trnsp, hd, v.fn grn, sub rndd, srtd, calc cement, o.stn
Clst: gy, dk gy, md-hd, blky, grdd to Sh.,
Top of Dair Mbr. @ TMD: 1993.82m, TVD: 1992.56m, TVDss:-1956.32m
Lst: lt gy, crm, sm off wh, I, l/II, A/B, md hd-hd, blk spt.
Sh: dk gy, gy, md hd, blky, sm fiss.
Lst: crm, off wh, lt gy, I, l/II, A/B, md hd-hd, blk spt.
Top of Burgan-A Mbr. @ TMD: 2033.07m , TVD: 2031.81m , TVDss: -1995.57m
Sst: lt gy, lt brn, colourless, hd, v.fn gr, sub rndd, sr td, lse.,
Clst: gy, dk gy, md hd, blky, grdd to Sh.,
Sst: lt gy, lt brn, colourless, v.fn gr, sub rndd, sr td, lse.,
Clst: gy, dk gy, md hd, blky, grdd to Sh.,
Clst: gy, dk gy, md hd, blky, grdd to Sh.,
Sst: lt gy, lt brn, colourless, fn gr, sub rndd, sr td, lse.,
Top of Burgan-B Mbr. @TMD: 2103.52m, TVD: 2102.26m, TVDss: -2066.02m
Sst: brn, dk brn, md gr, sft-md hd, sub rndd, sr td, lse
Coal: blk, hd, blky, glossy.
Top of U.Dariyan Fm. (Clastic mbr) @ 2150.42m TMD & 2149.15m TVD & -2112.91m TVDss
No sample due to no circulation.
Lst: lt crm, wh, md hd, I, l/II, A/B.
Sh: gy,dk gy, md hd, sm fiss,.
Lst: lt crm, lt gy, md hd, I, l/II, A/B.
Top of U.Dariyan limestone Mbr. @ 2191.32m TMD & 2190.05m TVD & -2153.81m
Lack of gas detection due to no circulation.
5/8"CSG Shoe@ 1826mTMD
Coring#1 f/1846m to 1860.6m(Recovery 95.89%)
Coring#2 f/1860.6m to 1874.55m(Recovery 91.77%)
Coring#3 f/1875.6m to 1891.58m(Recovery 94.31%)
Coring#4 f/1892.8m to 1917.45m(Recovery 96.95%)
Coring#5 f/1917.4m to 1941.65m(Recovery 99.4%)
Coring#6 f/1941.8m to 1970m(Recovery 100%)
Pressure Test By RCT
Coring#7 f/1970m to 1998.4m(Recovery 100%)
Coring#8 f/2032m to 2069m(Recovery 100%)
Pressure Test By RCT
Coring#9 f/2069m to 2106m(Recovery 100%)
Coring#10 f/2106m to 2126.5m(Recovery 100%)
Coring#11 f/2126.5m to 2137.3m(Recovery 100%)
Coring#12 f/2137.3m to 2144.8m(Recovery 70.66%)
Coring#13 f/2144.8m to 2169.44m(Recovery 100%)
Pressure Test


R.Rezaei
K.Aminzadeh
1401.09.23(24m)
1401.09.25(36.36 m)
1401.09.26
1401.09.27(105.81 m)
1401.09.28(80 m)
1401.09.29(36.5 m)
1401.09.30(37 m)
1401.10.05(22.3 m)
1401.10.10(76 m)
OBM
81pcf
60Sec.
Mud Loss:0
bph
WOB: 4-15klbs
RPM:120-140rpm
TRQ: 2-14klb.f
GPM: 500gpm
SPP: 1450-1520psi
WOB: 6-20klbs
RPM:100rpm
TRQ: 4-16klb.f
GPM: 300gpm
SPP: 990-1030psi
Bit No: 10
Run: RR8
Bit Type:PDC bit
SN: 6006012
Size: 8 1/2"
Jets: 4*16"
Depth in: 2274.19mTMD
Depth out: 2460mTMD
WOB: 10-20klbs
RPM:150rpm
TRQ: 2-18klb.f
GPM: 500gpm
SPP: 1405-1450psi
WOB: 8-20klbs
RPM:150rpm
TRQ: 2-17klb.f
GPM: 500gpm
SPP: 1405-1450psi
WOB: 8-15klbs
RPM:100rpm
TRQ: 3-13klb.f
GPM: 300gpm
SPP: 910psi
WOB: 10-20klbs
RPM:100rpm
TRQ: 3-13klb.f
GPM: 300gpm
SPP: 1000psi
WOB: 7-12klbs
RPM:100rpm
TRQ: 4-14klb.f
GPM: 250gpm
SPP: 760psi
Bit No: 10
Run: RR9
Bit Type:PDC bit
SN: 6006012
Size: 8 1/2"
Jets: 4*16"
Depth in: 2560mTMD
Depth out: 2636mTMD
WOB: 5-13klbs
RPM:60rpm
TRQ: 8-13klb.f
GPM: 500gpm
SPP: 2300-2600psi
Kazhdumi -Tongue Mbr
L.Dariyan.
U.Gadvan
Khal
L.Gadvan
U.Ratawi Mbr.
L.Ratawi Mbr.
Lower Cretaceous
TVDss
Top of Kazhdumi -Tongue Mbr. @ 2197.62m TMD & 2196.34m TVD & -2160.1mTVDss
Arg Lst: gy, lt gy, md hd-hd, I/II, I, A/B,.
Top of L.Dariyan Mbr.@ 2237.34m TMD & 2336.06m TVD & -2199.82m TVDss
Lst: bff, crm, hd, I, I/II, A-B.
Lst: wh, lt crm, md hd, II, I/II, B.
No sample due to no circulation.
Lst: crm, lt crm, lt gy, mdhd-hd, Blk spt, I, I/II, A-B.
Lst: lt crm, lt gy, mdhd- hd, Blk spt, I, I/II, A-B, sl arg.
Top of U.Gadvan Fm. @ 2311.9m TMD & 2310.62m TVD & -2274.38m TVDss
Clst: gy, dk gy, sft-mdhd,.
Sst: brn, gy brn, mdhd-hd, fn grn, rndd, sub srt, calc smt, arg.
Sst: lt gy, gy brn, hd, fn grn, rndd, sub srt, calc smt.
Top of Khalij Mbr.@ 2366.22m TMD & 2364.94m TVD & -2328.7m TVDss
Top of L.Gadvan Fm. @ 2373.76m TMD & 2372.48m TVD & -2336.24m TVDss
Top of U.Ratawi Mbr.@ 2397.52m TMD & 2396.24m TVD & -2360m TVDss
Lst: lt gy, lt crm, mdhd, I, I/II, A-B.
Arg Lst: lt gy, brn gy, sft-mdhd, I/II, A-B.
Lst: lt gy, brn gy, mdhd, I, I/II, A-B, arg.
Mrl: lt gy, lt gnsh gy, sft, stky,
arg Lst: lt gy, brn gy, gy, I/II, A-B, sft-mdhd,
Top of L.Ratawi Mbr. @ 2487.28m TMD & 2485.99m TVD & -2449.75m TVDss
Lst: crm, buf, lt gy, I, A, hd, sm org mat.,
Lst: crm, buf, lt crm, I, I/II, A, hd, pyr, sm org mat.
arg Lst: lt gy, gnsh gy, gy, I/II, A-B, md-hd.
Top of Yamama Mbr. @ TMD: 2525.9m, & TVD: 2524.6m, TVDss: -2488.4m
Lst: crm, lt brn, sm lt gy, I/II, I, A/B, hd, pyr, sm o.stn, org mat.
Lst: lt brn, brn, crm, I/II, sm I, A-B, md hd-hd, dd oil, o.stn.
arg Lst: lt gy, sm gy, I, A, xln, hd.
Lst: off wh, wh, crm, I/II, sm I, A-B, md hd-hd.
Lst: lt brn, crm, lt crm, I/II, sm I, A-B, md hd-hd, o.stn.
Clst: gy, sm gnsh gy, sft, blky.
lack of gas detection due to no circulation.
By RCT
Coring#14 f/2222m to 2223.64m(Recovery 93%)
Coring#15 f/2223.64m to 2260m(Recovery 100%
Pressure Test By RCT
Coring#16 f/2260m to 2274.19m(Recovery 100%
Coring#17 f/2460m to 2496.5m(Recovery 100%
Coring#18 f/2496.5m to 2533.5m(Recovery 100%
Coring#19 f/2533.5m to 2537.7m (Recovery 95.2%)
Coring#20 f/2537.7m to 2560m (Recovery 100%
MD:2542.87
INC:1.06
AZI:144.23
TVDss:-2505.32
MD:2566.54
INC:1.48
AZI:98.49
TVDss:-2528.98
MD:2595.85
INC:1.57
AZI:85.22
TVDss:-2558.28
MD:2624.88
INC:1.33
AZI:84.94
TVDss:-2587.30



LOGGING DATA F-18-03 PH				
Hole Size	DATE	From (mMD)	To (mMD)	LOG
17 1/2"	2021-11-05	440m (TMD)	906.9m(TMD)	MWD-Gamma Ray
	2021-11-10	438m (MLD)	922m (MLD)	CDR-DSI-FIAC-NGT
12 1/4"	2022-11-15	922 (TMD)	1459 (TMD)	MWD-Gamma Ray
	2022-11-10	845 (MLD)	1815 (MLD)	MSFL- DLL - GR
	2022-11-10	925 (MLD)	1815 (MLD)	XRMI, CDR, GR
	2022-11-12	943 (MLD)	1785 (MLD)	XMAC- CDR - GR
	2022-11-12	909 (MLD)	1713 (MLD)	ZDL - CNL - DSL - GR
8 1/2"	2022-12-22	1660 (MLD)	2535.5 (MLD)	XMAC-Resistivity-CDR-GR-Caliper
	2022-12-23	1650 (MLD)	2535.5 (MLD)	Density- Neutron- GR- Caliper
	2022-12-23	1826 (MLD)	2535.5 (MLD)	Resistivity- Acoustic- CDR- GR- Caliper
	2022-12-28	1830 (MLD)	2360 (MLD)	RCT-GR

MASTER LOG
Well: F-18-03-MH

Scale: 1/1000

WELL DATA

Country:	IRAN
Area:	Persian Gulf-Kharg
Company Name:	POSCO / IOOC
Field:	Foroozan
Well:	F-18-03-MH
Platform/ Slot No.:	F18/03
Well Type:	Deviate/Oil Producer
Target Res:	Burgan A
Formation @ TD:	L.Burgan-A Mbr. (sand1 zone)
Coordinates System:	UTM
Datum/Zone:	WGS 84/39N
Easting:	365203.25m
Northing:	3168525
RKB-MSL :	36.24m
Water Depth :	50.5mTMD
TD Depth MD:	2133mTMD
TD Depth TVDss:	-2060.17mTMD
Rig Name :	WTR-1
Spud Date :	1400/05/07(07/29/2021)
Drilling end date:	1402/06/09(08/31/2023)
Drilling contractor :	POSCO
Mudlogging Co.:	Petro Gostaran

GEOLOGICAL SAMPLING

Depth: 1845-2133 mTMD

Sampling Rate :

5m 1890-1930/1936-2036/2062-2133mTMD

4m 1864-1890/1930-1936/2036-2062mTMD

2m

1m 1845-1864mTMD

Geologists:

R.Rezaei

K.Aminzadeh

Area Superintendent:

HOLE SIZE

26":	89-458 mTMD
17 1/2":	458-922 mTMD
12 1/4":	922-1830 mTMD
8 1/2":	1830-2063mTMD
KOP MH @1855m TMD	
6 1/8":	2063-2133mTMD

CASING & LINER SIZE

30" CSG Shoe:	101.5 mTMD
20" CSG Shoe:	453 mTMD
13 3/8" CSG Shoe:	920 mTMD
9 5/8" CSG Shoe:	1826 mTMD
7" Liner Lap:	1756.5mTMD
7" Liner Shoe:	2061.5mTMD
4" Pre-Packed Lap:	2019.9mTMD
4" Pre-Packed Shoe:	2132.5mTMD

MUD TYPE

26" :	SW(WBM)
17 1/2" :	Salt Polymer
12 1/4" :	Bentonite Mud(WBM)
8 1/2" :	OBM
6 1/8" :	OBM (90 pcf)

LITHOLOGY SYMBOLS

Brec, Sh, Cht Lst, Cht Dol, Cgl, Calc Sh, Arg Lst, Salt, Sst, Sd Sh, Arg Cht Lst, Anhy, L. Sd, Mrl, Pyr Lst, Gyp, Calc Sst, Rd Mrl, Dol Lst, Cht, Stst, Lst, Dol, Pyr, Sd Clst, Sd Lst, Calc Dol, Glauc, Clst, ool Lst, Sd Dol, Lignite, Rd Clst, chky Lst, Arg Dol, Cmt., Calc Clst, Anhy Lst, Anhy Dol, Metal, Free quartz

ABBREVIATION

PDC Polycristalline Diamond Cutter
INS.BIT Insert BIT
CP Conductor Pipe
CSG Casing
KOP Kick Off Point
MD Measured Depth
TVD True Vertical Depth
TVDss True Vertical Depth Subsea
INC Inclination
AZM Azimuth
RKB Rotary Kelly Bushing
ROP Rate Of Penetration
RPM Rotation Per Minute
WOB Weight On Bit
TRQ Torque
GPM Gallon Per Minute
SPP Stand Pipe Pressure
GR Gamma Ray
RD Deep Resistivity
RS Shallow Resistivity
NPHI Neutron Porosity Log
RHOB Density Log
DT Delta Time Sonic log
ECD Equivalent Circulating Density
MW Mud Weight
Vis Viscosity
PV Plastic Viscosity
YP Yield Point
WBM Water Base Mud
OBM Oil Base Mud
TG Trip Gas
BGG BackGround Gas
FLUOR Fluorescence
FM Formation

SYMBOLS

Deviation Survey
Trip
Casing/Liner Shoe
Liner Lap
Cement Plug
Poor Oil Stain
Good Oil Stain
Salt Water
Fresh Water
Dead Oil / Asph
Gas
CO2
H2S
Core Interval
Perforation Interval
Res. Test
Perforated liner
Slotted Liner
Wire Wrapped/ Pre-Packed Screen
Stylolite

GAS CHAIN STANDARD

Gas Trap Type : Degasser

Gas Normalization Parameters : GPM, ROP, Hole Size

Gas Detector Means. Cell Type : FID

Gas Chromatograph Cell Type : C8 Agilent 7890A

REMARKS:

GEOLOGIST | DATE & PROGRESS | MUD DATA (TYPE, MW (pcf), Vis (Sec.), Chloride (mg/l), LOSS -(bph), GAIN +(bph)) | ROP (min/m) 0–100 | MWD-GR (GAPI) 0–100 | WOB (Klbs) 0–60 | DEPTH (mMD) | LITHOLOGY CUTTING % | FORMATION | AGE | INTERPRETED LITHOLOGY | CUTTING DESCRIPTION & FORMATION TOP | CALCIMETRY (CaCo3 0–100 %, CaMg(Co3)2 0–100 %, Impurity 0–100 %, Caving 0–100 %) | FLUORESCENCE (DIRECT FLUOR, CUT FLUOR: GOOD / WEAK / FAIR / GOOD) | GAS CHROMATOGRAPHY (TG (ppm), C1(ppm), C2(ppm), C3(ppm), iC4(ppm), nC4(ppm), iC5(ppm), nC5(ppm), C6(ppm), Bz(ppm), C7(ppm), mBz(ppm), C8(ppm), H2S(ppm), Co2(ppm)) | RD (Ohm.m) 0.2–2000.0 | RS (Ohm.m) 0.2–2000.0 | SURVEY DATA | NPHI (pu) 45–-15 | RHOB (gr/cm³) 1.95–2.95 | Survey, Casing & Liner Shoe, L.Lap