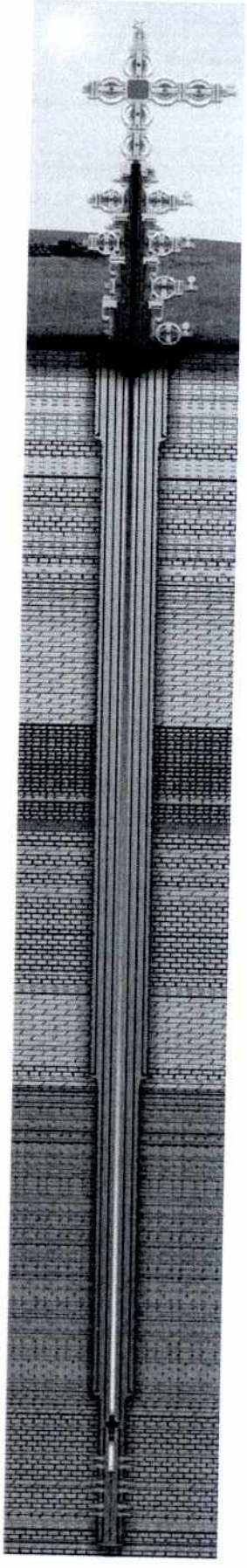
Hayan Petroleum Company



PRIMARY DRILLING PROJECT
FOR THE DEVELOPMENT WELL

AL MAHR - 6

Hayan Contract
Syria

2026

AL MAHR - 6

The primary drilling program for the deep development well **AL MAHR -6** onshore Syria, Hayan Concession has been made in HAYAN PETROLEUM COMPANY Damascus, closely coordinated with SPC and INA-NAFTAPLIN Divisions, on the basis of document issued by HPC Damascus, Development Department. Presented materials are confidential and no information should be distributed without former consent of HAYAN PETROLEUM COMPANY.

1. GENERAL DATA SUMMARY

1.1 BASIC WELL DATA

Well Name	:	**AL MAHR – 6**
Block	:	Hayan Block
Country	:	Syria
Licensee	:	HAYAN PETROLEUM COMPANY
Operator	:	HAYAN PETROLEUM COMPANY
Well Classification	:	Development
Objectives	:	Kurrachine Dolomite - C2
Surface Location	:	Y= 305125N X= 333621.62E
Elevations/Depths	:	All depths in this program are referenced to the RT elevation, which is 6 m above ground level.
Elevation	:	GL 702 m above MSL (KB level 6 m)
Total Depth	:	2,468 m MD BRT
Casing Program	:	20" (508 mm) casing at 349 m MD BR 13 3/8" (339 mm) casing at 1,965 m MD BRT 9 5/8" (245 mm) casing at 2,328 m MD BRT 7" (178 mm) casing at 2,468 m MD BRT
Days Dry Hole	:	120

1.2 GEOLOGICAL SUMMARY

The Al Mahr field is discovered in 2002 by exploration well Al Mahr-1, on the northwestern part of the Hayan Block in central Syria (approximately 60 km northwest from town Palmyra).
Reservoir is formed inside Triassic Kurrachine Dolomite formation (C2 unit). It is retrograde gas bearing reservoir. In February 2004 appraisal well Al Mahr-2 was drilled. According to Development Plan for Al Mahr field (issued in March, 2006), two development wells have been proposed to fulfill the planned production rates. Preliminary, both of them are placed at the eastern part of field toward structural high and closer to Jihar fault zone where better reservoir quality is expected according to seismic attribute analysis. The development well Al Mahr-3 was drilled in the last quarter of 2008. Although it was placed approx. 1 km from well Al Mahr-1, the targeted reservoir (C2) was drilled 151 m deeper than it was forecasted from the latest seismic interpretation. The development well Al Mahr-4 was drilled in the first quarter of 2009. Although it was placed approx. 1 km from well Al Mahr-1, the targeted reservoir (C2) was drilled 151 m deeper than it was forecasted from the latest seismic interpretation.
Assumption from Development Plan about better reservoir characteristics in the zone between Jihar fault and northern "en echelon" fault, that was derived then from seismic attribute analysis, missed to be proved because testing of primary target (C2) on Al Mahr-3 has been postponed to be done prior gas & condensate production start-up. Thus, the assumption regard to reservoir quality continues.
According to hard data from previous HPC wells, revision of 3D seismic and surface geological map (1:50 000, issued by Syrian Geological Establishment for Petroleum and
Mineral Resources), a sequence of deposits from Upper Cretaceous Shiranish formation down to targeted Middle Triassic Kurrachine Dolomite formation C2 unit should be expected.
Problems with mud losses are highly possible from lower Soukhne fm. On wells Al Mahr-1 and Al Mahr-2, total mud losses were not stopped and long section of blind drilling down to Butmah fm was done that had an impact on cost and time schedule (additional water supply, tool stuck and tool fishing, side tracking). On Al Mahr-3, total mud losses in Soukhne Rmah Chert Mb were promptly treated with several cement plugs and drilling through Judea was continued with mud circulation (additional partial mud losses were controlled with LCM pills).
Therefore, it is strongly recommended to apply the same strategy when total mud losses occur. Further, water supply has to be organized to avoid a lack of water (large water pit of 10000 m3 is proposed).

The goal of development well Al Mahr-6 is:

- **To reach and drill through Kurrachine Dolomite C2 reservoir, to test and complete it for production**
- **Planned TD is 2468 m at the bottom part of Kurrachine Dolomite C2 unit.**

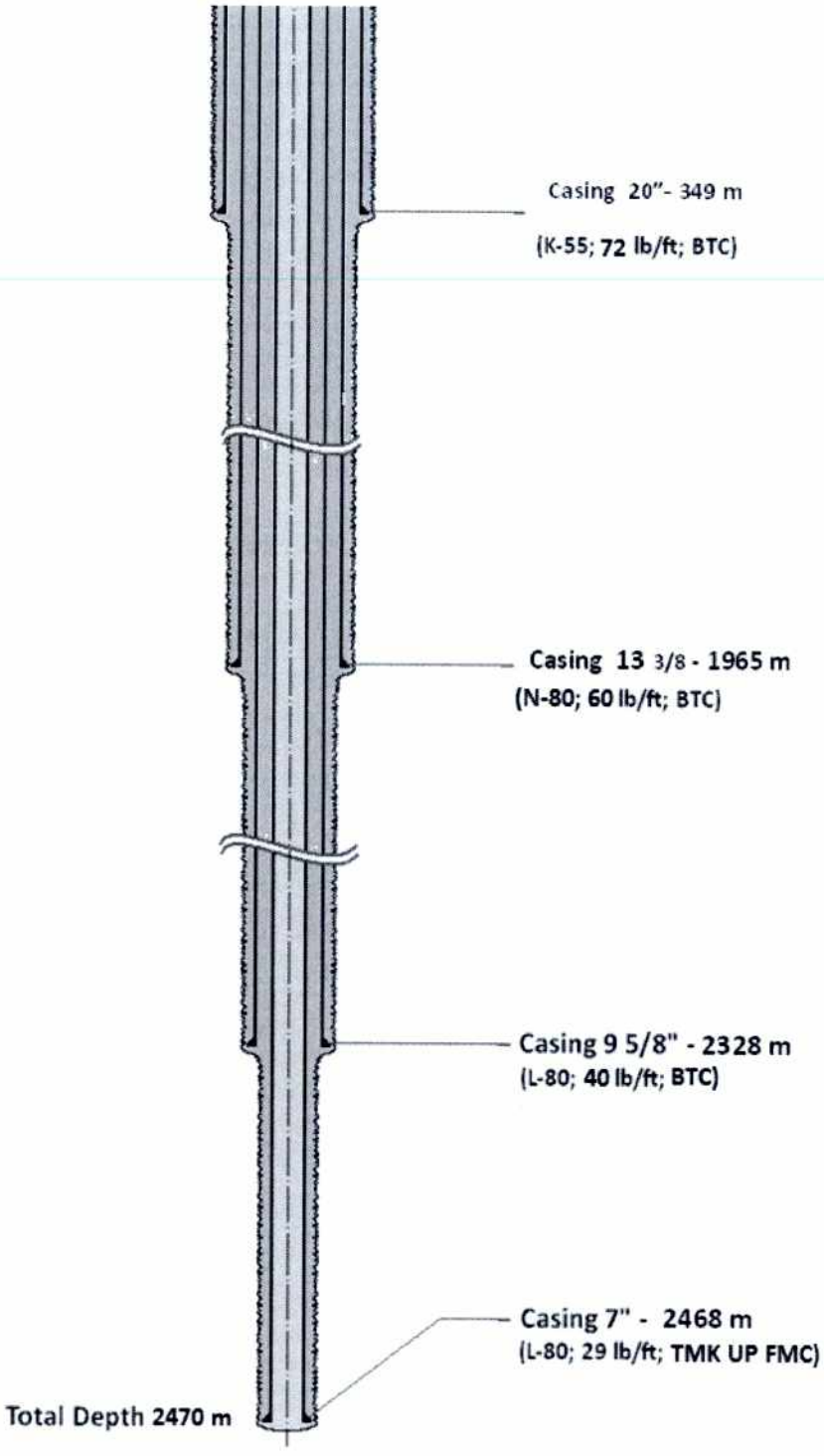
1.3 EXPECTED DRILLING PROBLEMS

Mainly foreseen drilling problems are connected with total mud losses in Judea Formation during drilling 17 ½" hole section. On the offset wells Al Mahr-1 and Al Mahr-2 total mud losses could not be solved by LCM and cement plugs, hence blind drilling with water had been applied. Although on Al Mahr-3 well total mud losses were successfully solved with LCM pills and cement plugs, it could be necessary to apply blind drilling on the Al Mahr-5 well.

1.4 DRILLING PROGRAM OUTLINE

Step	Operation	Duration (Days)	Total (Days)	Depth (m)	Section Thickness (m)
1.	Drill 26" hole	8	8	349	349
2.	Run & cement 20" casing, NU BOP	7	15		
3.	Drill 17 ½"hole, well logging	38	53	1965	1616
4.	Run & cement 13 ⅜ casing, NU BOP	7	60		
5.	Drill 12 ¼" hole, well logging	20	80	2328	363
6.	Run & cement 9 ⅝" casing, NU BOP	8	88		
7.	Drill 8 ½" hole, well logging	7	95	2468	140
8.	Run & cement 7" casing, NU BOP	8	103		
9.	Perforation & Run tubing	7	110		
10.	Completion till rig down	10	120		

1.8 WELLBORE SCHEMATIC



2. DRILLING PROGRAM

The subsequent paragraphs of the drilling program are contingent on anticipated conditions and are subject, therefore, to change at any time to overcome any problems in the best possible manner in view of the safety of the well, equipment and operating personnel.

2.1 CASING PROGRAM

3

Depth Interval (m)	Bit Size (in)	Size (in)	Type	Grade	Casing Weight (lb/ft)
349	26	20	Casing	K - 55	106.5
1965	17 ½	13 ⅜	Casing	K - 55	68
2,328	12 ¼	9 ⅝	Casing	C-95 (2328-1965)	53.5
				L-80 (1965-0)	47
2,468	8 ½	7	Casing	L - 80	29

The above-mentioned casing program is designed based on geological data provided by HPC Development Department and

DRILLING PROGRAM BY HOLE SECTIONS

3.1.1 SURFACE CASING 20"

ANTICIPATED PROBLEMS

Drilling for surface casing 20" will be done through unconsolidated fluvial deposits and Shiranish Formation. Loss of circulation is expected immediately below 36" stove pipe. Flow rate and rate of penetration have to be adjusted to avoid overloading of annular, due to prevent induced loss of circulation. Mud weight has to be maintenance as low as possible. Special care has to be taken while tripping to prevent swabbing.

DRILLING AND SETTING DEPTH OF SURFACE CASING

This section will be drilled with 26" bit up to ± 349 m. Fresh water bentonite spud gel will be used during drilling for casing 20". Objectives of surface casing are to cover unconsolidated fluvial deposits and to provide the base for BOP Stack for safe drilling to the next casing point. If necessary use high viscosity sweeps to guarantee a good hole cleanliness. Casing shoe will be set at ± 349 m at the top of Arak marl Formation. Final section TD should be picked to suit the casing tally in conjunction with the geological conditions.

WELL LOGGING PROGRAM:

BHC/GR/CAL

3.2 DRILLING FLUID PROGRAM

26" Hole Section (0 - 349 m) – Spud Mud

Interval	0 - 349 m
Meters Drilled	349 m.
Hole Size	26"
Mud Type	Spud Mud

Recommended Mud properties:

Mud Density	< 1.08	**kg/l**
Funnel Viscosity	60 – 80	sec/qt
Plastic Viscosity	As Low As Possible	cP.
Yield Point	20 – 30	lb/100 ft^2
API Fluid Loss	< 15	mls/30 min
Gel Strength 10"/10'	5 / 15	lb/100 ft^2
MBT	65 – 70	kg/m^3
PH	9.5 – 10.5	

Mud Properties Discussion:

A) Mud Weight:

The mud weight should be kept as low as possible while drilling surface section to prevent mud losses to the unconsolidated formation. This can be achieved by running all available solids control equipment's with maximum efficiency and dilution if needed.

B) Rheology And Hydraulics:

Yield point is recommended to be in proposal range to improve carrying capacity due to low annular velocity in surface hole, increasing of yield point can be achieved by adding freshly Prehydrated Bentonite Pills.

C) API Fluid Loss:

Control of fluid loss will be carried out with Bohramyle – BR (Carboxy Methyl Starch).

D) MBT:

MBT to be kept between (65 - 70 kg/m^3). This will cake off porous formation in surface section, consequently minimizing seepage losses.

E) General Recommendations:

- Sweeping hole regularly with high viscous Bentonite Pills is essential to assure good hole cleaning.
- Make up water should be treated first with Caustic Soda and Soda Ash prior mixing Bentonite in order to get maximum yield of said product, treatment dosage is based on water hardness values.
- At casing point the hole sweeping with 15 m^3 high Viscous pill and spotting same on bottom is essential prior running 20" Casing.

SURVEYS

Run Deviation survey 150 m or at bit trip, and section TD. If tendency towards increase of deviation is observed, decrease WOB/increase RPM.

3.2.1 I - INTERMEDIATE CASING 13 ⅜"

ANTICIPATED PROBLEMS

The 17 ½" borehole for casing 13 $^3/_8$" will be drilled through carbonate (limestone and dolomite) interbedded with anhydrite shale/claystone and chert of Upper Cretaceous (Shiranish, Soukhne, Judea and Hayane Formations), sandstone, claystone and shale of Lower Cretaceous (Rutbah Formation), carbonate (limestone and dolomite) interlayed with claystone of Jurassic (Hara Moun Formation) and dolomite interbedded with claystone, shale and anhydrite of Upper Triassic (Butmah Formation).

According to the experience from previous wells in this area, partial to total mud losses are expected during drilling through this section, especially in Judea Formation.

DRILLING AND SETTING DEPTH OF I - INTERMEDIATE CASING

Drilling for 13 $^3/_8$" casing perform with 17 ½" bits to approximately 1,965 m. Casing shoe will be set at ± 1,965 m at the top of Kurrachine Anhydrite Formation, which will be determined by wellsite geologist. The final determination of casing seat will be decided on the basis of mud logging data and well logging interpretation.

Objective of this casing is to cover main thief zones in the area and to ensure as safety as possible drilling through shale, anhydrite and salt of the next section.

In the case of blind drilling with water casing will be set at the top of Butmah Formation (approx. 1584m) which will be determined by well logging.

WELL LOGGING PROGRAM:

BHC/GR/CAL

3.3 DRILLING FLUID PROGRAM

17 ½" Hole Section (349 - 1,965 m) – Spud Mud

Interval	349 - 1,965 m
Meters Drilled	1616 m
Hole Size	17 ½"
Mud Type	Spud Mud

Recommended Mud properties:

Mud Density	< 1.10	kg/l
Funnel Viscosity	60 - 70	sec/qt
Plastic Viscosity	As Low As Possible	cP
Yield Point	20 – 25	lb/100 ft^2
API Fluid Loss	< 15	mls/30 min
Gel Strength 10″/10′	5 / 15	lb/100 ft^2
MBT	40 – 45	kg/m^3
PH	9.5 – 10	

Mud Properties Discussion:

A) Mud Weight:

The mud weight should be kept at as low as possible to minimize expected formation losses while penetrating this section.

B) Rheology And Hydraulics:

Yield point is recommended to be in proposal range to improve carrying capacity due to low annular velocity in surface hole, increasing of yield point can be achieved by adding freshly treated Prehydrated Bentonite Pills.

C) API Fluid Loss:

Control of fluid loss will be carried out with Bohramyle – BR (Carboxy Methyl Starch)

D) MBT:

MBT to be kept between (40 - 45 kg/m^3), this will cake off porous formation in this surface section, additionally provide salt saturated mud system with required viscosity.

E) General Recommendations :

- Sweeping hole regularly with high viscous Treated Bentonite Pills is essential to assure good hole cleaning.
- Make up water should be treated first with Caustic Soda and Soda Ash prior mixing Bentonite in order to get maximum yield of said product , treatment dosage is based on water hardness.

- FC – 10 Lignosolphonat – Chrome Free will be run to improve mud flow properties.
- At casing point the hole sweeping with 10 m^3 high Viscous pill and spotting same on bottom is essential prior running 13 3/8" casing.

Lost Circulation

In the event that sever lost circulation is encountered following procedure should be applied:

- Spot the pill as described at the mud proposal in each interval across the suspected loss zone and pull pipe out of the zone. Wait three to six hours to receive the maximum healing effect of pill while periodically attempting to fill the annulus.
- Run back to bottom and attempt circulation at a slow rate, if this does not work repeat the process, if sever or total losses continue, we recommend cementing across the loss zone to save time and cost.
- For seepage losses we recommend periodic sweeps of the hole with fine and medium Kwick seal and Mica. If losses occur in potential production zones switch from the conventional LCM to sized Calcium Carbonate bridging particles.
- Alternatively if rate of losses is tolerable simply reduce mud weight as far possible and allow some mud to be lost to the formation. This will avoid the need for an acid job to dissolve the sized Calcium Carbonate particles.

Types of Down Hole Losses

- **Seepage losses**

While drilling any permeable formation if seepage losses encountered treat mud system with 5 – 10 ppb of the fine lost circulation material as Nut Plug and Mica.

Also avoid any excessive circulation to minimize equivalent circulating density (EDC) i.e. it is strongly recommended not to by pass the shale shakers as this will result in rapid increase of the mud weight and consequently this will aggravate the loss.

- **Partial losses**

While drilling any fractured formation if partial losses encountered spot viscous pills comprising 30 – 40 ppb fine and medium LCM as Nut Plug, Mica and K. seal against the loss zone and pull pipe out of the zone. Wait 3 to 6 hours to get the maximum healing effect of the pill while periodically attempting to fill the annulus. Run back to bottom and circulate at slow pump rate.

- **Total losses**

If complete loss occurred spot several pills comprising 70 – 100 ppb of LCM different grades (fine, medium, coarse) against loss zone and allowed to squeeze under hydrostatic. If this does not cure the losses cement plug should be used.

- If drilling into fractured formation it is recommended to set cement across the loss zone.

- If losses occur in potential production zones switch from the conventional LCM to sized Calcium Carbonate bridging particles.

- **Blind Drilling**

If losses cannot be cured or reduced to a manageable level with LCM pills, usually less than 200 bbl/hour then the only option is to drill blind. In this event following procedures should be adopted:

- Pump 40 – 50 bbl high viscosity sweeps for each 10 meters drilled (hole diameters < 26") to ensure the bit and hole are adequately cleaned.
- Control ROP to prevent cuttings build up in the annulus.
- Spot high viscosity unflocculated gel mud across any unconsolidated sand section prior to tripping, as a precaution against possible caving.
- Fill the hole with high viscosity un flocculated gel mud prior running casing.

SURVEYS

Run Deviation Survey every 150 m or at bit trip, and section TD. Maximum deviation value at section TD is 3°. If tendency towards increase of deviation is observed, decrease WOB/increase RPM. If it will be necessary change BHA (set the first stabiliser at 27 m above bit).

3.3.1 II - INTERMEDIATE CASING 9 ⅝"

ANTICIPATED PROBLEMS

The 12 ¼" borehole for casing 9 ⅝" will be drilled through interbedded salt, anhydrite, claystone, dolomite and limestone of Kurrachine Anhydrite Formation.
In intend to avoid expected claystone, shale and salt problems salt saturated silicate mud sufficient density (approx. 1.75 – 1.85 kg/dm^3) shall be used.

DRILLING AND SETTING DEPTH OF II - INTERMEDIATE CASING

Drilling for 9 ⅝" casing hole with 12 ¼" diameter of rock bits, up to the depth of approximately 2328 m.
The II - intermediate casing shoe depth will be set to the top of Kurrachine Dolomite Formation. The final determination of casing seat will be decided on the basis of mud logging data and well logging interpretation.
Objective of this casing is to cover interbedded lithology of Kurrachine Anhydrite Formation,

particularly salt layers exposed to the high overburden pressure, and to make possible drilling with minimum mud weight through Kurrachine Dolomite Formation.

WELL LOGGING PROGRAM:

BHC/GR/CAL

3.4 DRILLING FLUID PROGRAM

12 1/4" Hole Section (1,965 - 2,328 m) – Salt Saturated Silicate Mud

Interval	1,965 - 2,328 m
Meters Drilled	363 m
Hole Size	12 1/4"
Mud Type	Salt Saturated Silicate Mud

Recommended Mud properties:

Mud Density	1.75 – 1.85	kg/l
Funnel Viscosity	70 – 80	sec/qt
Plastic Viscosity	35 - 40	cP
Yield Point	25 - 30	lb/100 ft^2
API Fluid Loss	< 7	mls/30 min
Gel Strength 10"/10'	15 / 35	lb/100 ft^2
6 RPM Speed	10 – 15	
PH	12 – 12.5	
MBT	< 20	kg/m^3

Mud Properties Discussion:

A) Mud Weight:

Based on technical information from the original well, this interval was drilled previously with mud weight ranged (1.75 - 1.85 kg/l), due to active shale and salt bodies while penetrating K-Anhydrite Formation.

B) Rheology And Hydraulics:

To maintain effective Rheology, light treatment of Biopoly – E (Xanthan Gum) is required. To reduce Rheology, dilution with Silicate pre-mix could be used in this case . After running 9 5/8" casing, the fluid should be thinned to reduce the Yield Point and Gel Strengths prior cementing the casing to achieve good cement bond across casing.

C) API Fluid Loss:

API fluid loss should be kept at proposed value , this can be achieved by Caroxy Methyl Starch And Poly Anionic Cellulose SL / R (Antisol 100 , Antisol 30000).

D) Solids Control:

It is assumed a minimum of tow linear motion shaker unit will be available at the drilling site, initial screen selection will be in the 50 - 100 mesh range to prevent losses on displacement. Once the circulating temperature increases and the fluid shear thins it should be possible to fine up screen size to 120 – 150 mesh.
All secondary solids control equipment (Desilter & Centrifuge) should be employed fully to maintain a minimum LGS in mud system.

E) PH Level:

The pH level of the fluid should be maintained at between 11.8 - 12.5 with additions of Sodium Silicate or with caustic soda when required . The Silicate acts as a buffer and only small changes in pH will be seen with additions of Caustic Soda.

SURVEYS

Run DeviationSurvey every 150 m or at bit trip, and section TD. Maximum deviation value at section TD is 3°. If tendency towards increase of deviation is observed, decrease WOB/ increase RPM. If it will be necessary change BHA (set the first stabiliser at 27 m abovebit).

3.4.1 PRODUCTION CASING 7"

ANTICIPATED PROBLEMS

The 8 ½" borehole for casing 7" will be drilled through Kurrachine Dolomite Formation consist predominantly of dolomite and limestone sediments. The mainly expected difficulties are connected with possible losses in Kurrachine Dolomite C2 layer.

DRILLING AND SETTING DEPTH OF CASING 7"

Drilling for 7" casing hole with 8 ½" bits, up to the depth of approximately 2,468 m. The 7" casing shoe depth will be set to the Kurrachine Dolomite D2 Formation. Final determination of casing seat will be decided on the basis of mud logging data and well logging interpretation.

Objective of 7" casing is to cover pay zones in Kurrachine Dolomite Formation C2.

WELL LOGGING PROGRAM:

Run 1: LDL/NEUTRON/DEN/MSF/CAL/NGS
Run 2: GR/BHC

3.5 DRILLING FLUID PROGRAM

8 ½" Hole Section (2,328 - 2,468 m) – KCl Inhibitive Drill In Fluid

Interval	2,328 - 2,468 m
Meters Drilled	140 m
Hole Size	8 ½"
Mud Type	KCl – Drill In Fluid

Recommended Mud properties:

Mud Density	1.10 – 1.20	kg/l
Funnel Viscosity	45 – 50	sec/qt
Plastic Viscosity	ALAP	cP
Yield Point	15 – 20	lb/100 ft^2
API Fluid Loss	< 7	mls/30 min
Gel Strength 10″/10′	8 / 15	lb/100 ft^2
6 RPM Speed	> 8	
PH	9.5 – 10	
MBT	ALAP	kg/m^3
KCl	8 – 10	%

Mud Properties Discussion:

A) Mud Weight:

The section will be drilled with max mud density 1.10 kg/l, solids control equipment should be run with maximum efficiency. Dilution with fresh mud could be required to control mud weight at proposed value.

B) Rheology and hydraulics:

Yield point is recommended to be in proposal range for improving the carrying capacity. This can be carried out through treating with Xanthan Gum (Biopoly – E).
Plastic viscosity value should be kept minimum by removing undesirable through solids control equipments.

C) API Fluid Loss:

Control of Fluid loss will be required while penetrating this section. This can be achieved by treating mud with Poly Anionic Cellulose SL / R (Antisol 100 / 30000).

D) General Recommendations :

- Sweep hole frequently with Biopoly - E Pills is essential to assure adequate hole cleaning.
- Make up water should be treated first with Soda Ash prior mixing polymers to get maximum yield of said products.

SURVEYS

Run Deviatiion Survey every 150 m or at bit trip. Maximum deviation value at section TD is 5°. If tendency towards increase of deviation is observed, decrease WOB/increase RPM. If it will be necessary change BHA (set the first stabiliser at 18 m above the bit).

3.6 DEVIATION CONTROL

Deviation should be controlled during drilling, either drop-in before pulling out for change bit or at least every 150 m on sandline, whatever will be earlier.

In case of deviation problem BHA, WOB and RPM should be modified and adjusted to control the situation.

	Deviation Limit	
	Maximum Angle	**Maximum Dogleg °/30 m**
Surface Casing 20" 349 m	1°	1°
I - Intermediate Casing 13 $^{3}/_{8}$" 1,965 m	3°	1°
II - Intermediate Casing 9 $^{5}/_{8}$" 2,328 m	3°	1°
Casing 7" 2,468 m	5°	1°

Cased Hole Logs (it may modified by HPC supervisor in accordance of well logging)

For stages before setting reservoir casing:
Run 1: CBL(GR-CCL-CBL) for every stage.
For reservoir casing:
Run 1: CBL(GR-CCL-CBL)
Run 2: GYRO.
Run 3: VSP

Note:

Perforation & completion & stimulation – acid job & coild tubing lifting will be determined based on well logging by HPC