UNIVERSITI
TEKNOLOGI
PETRONAS

FINAL EXAMINATION
MAY 2022 SEMESTER

COURSE	:	**DAM5253 – WELL CONSTRUCTION**
DATE	:	**14 AUGUST 2022 (SUNDAY)**
TIME	:	**9:00 AM – 12.00 PM (3 HOURS)**

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the Answer Booklet.
2. Begin **EACH** answer on a new page in the Answer Booklet.
3. Indicate clearly answers that are cancelled, if any.
4. Where applicable, show clearly steps taken in arriving at the solutions and indicate **ALL** assumptions, if any.
5. **DO NOT** open this Question Booklet until instructed.

Note :

i. There are **NINE (9)** printed pages in this **double-sided** Question Booklet including the cover page.

1. The challenge with a multi discipline project is managing risk across many activities over a long project duration. This is especially a challenge for field development that spans over multiple years, from early concept, to engineering, installation, drilling and production. You are a drilling engineer part of this multi discipline field development team, tasked with rig selection, and mobilizing a rig to execute a drilling campaign in Malaysia, water depth of 60m. After selecting a 3 legged 400 ft jack-up rig, and reviewing the soil report, leg penetration analysis, shallow hazard assessment and risk assessment, you then authorize sailing the rig alongside the newly installed platform, only to discover that rig positioning is impossible during preloading phase, with excessive forces on the jack-up legs (rack phase differential) and spud can sliding occurring. Further investigation reveals that the shallow hazard assessment did not identify the existence of extensive shallow channels, 5-10m below the mud line throughout the platform area. With the rig struggling to position now for 30 days, the team is asking for a way forward and another **THREE (3)** recommendations to be done post event, to return and ensure continuation of the Drilling project.

   a. Recommend your next steps to be executed during this campaign.

   [15 marks]

   b. Suggest **THREE (3)** actions to be done post event in order to return and ensure continuation of the Drilling project?

   [15 marks]

2. a. Before rigs and crews are moved to the well location to start the drilling campaign, Project Management Team (PMT) required to perform a "Drill Well On Paper" (DWOP). All of the technical decision-makers, stakeholders and service providers will get together to brainstorm in details the drilling and completion plan.

i. Provide **FOUR (4)** examples of activities involved during Drill Well on Paper.

[4 marks]

ii. List **TWO (2)** example of offline activities on a jack-up rig in a batch drilling well campaign.

[2 marks]

iii. Propose **FOUR (4)** Technical Limit activities during execution stage.

[4 marks]

b. One of the critical activities during Technical Limit planning is to develop the opportunity register which could optimize the well duration and execution plan. It should be tracked during the execution stage. Suggest the optimization opportunities for the drilling phase activities given in **TABLE Q1b** that can be proposed for the sample well as shown in **FIGURE Q1b**. Please note that it is a 2 wells campaign which will be drilled using a jack-up rig.

[15 marks]

TABLE Q1b: Activity breakdown

Drill 12-1/4" hole section
Make up 12-1/4" bit & rotary steerable BHA.
Perform Shallow Test
Run in hole to 13-3/8" casing shoe on drill pipe
Wash down last stand, tag top of cement and perform kick drill
Drill out shoe track. Meanwhile, dump and clean sand traps and trip tank. Lock all dump valves and walk the lines prior to start displacing to 11.3ppg SBM.
Displace well to 11.3ppg SBM.
Continue drilling rathole and 3m new formation (ensure more than 50% formation)
Circulate hole clean & condition mud.
Make up pumping assembly. Pull back BHA to inside casing & space out, Perform Leak off test. Rig down pumping assembly.
Continue drilling 12-1/4" hole to section TD. Interval : 989.71m Inclination :28 deg - 75.5 deg, Project team target Gross ROP : 30 m/hr, Max Flow : 1000 GPM, Mud weight: 11.3 ppg SBM Note: Backream full stand after stand down. Take survey every stand drilled
Pump 50 bbl Hivis Pill and circulate hole clean at bottom (6x Bottoms up)
Pump out of hole 12-1/4" drilling BHA to previous casing shoe and flow check
Pull out of hole 12-1/4" drilling BHA to surface
Lay down 12-1/4" drilling BHA
Run 9-5/8" Casing
Make up wear bushing running tool. Run in hole and retrieve wear bushing to surface.
Rig down Drilling Bail. Rig up casing running equipment.
Pick up and make up float shoe, intermediate and float collar joint. Test Float
Pick up and make up 9-5/8" Casing and install centralisers as per casing tally to 13-3/8" casing shoe.
Break circulation at 13-3/8" casing shoe. Take Pick up and Slack off weight data.
Continue pick up, make up and run in hole 9-5/8" Casing and centraliser as per casing tally.
Make up casing hanger assembly with running tool.
Wash down and land hanger.
Circulate 1.2x casing volume with SBM
Prepare for cement job. Rig up cement head.

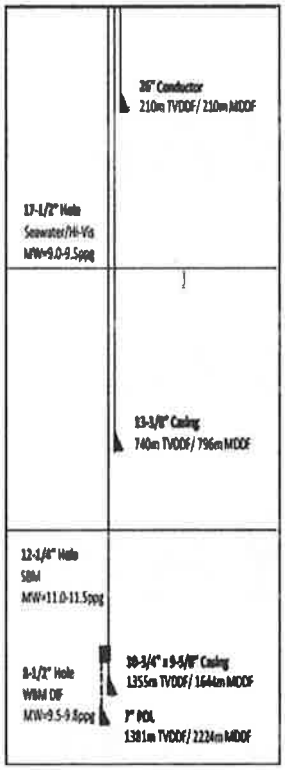

FIGURE Q1b: Sample well with 2 wells campaign

c. During the planning stage, technical limit engineer would need to analyze the offset well stick chart and review the possible risk that may take place. Subsequently the engineer needs to propose the mitigation plan to avoid those risk from happening and at the same time optimizing operational steps and procedure. The plan is to drill Well A. **FIGURE Q1c** shows the stick chart of the offset wells that was drilled prior Well A as reference. As the drilling engineer in charged, propose the mitigation plan for the listed issue and cause as given in **TABLE Q1c** in order to drill for Well A successfully.

[15marks]

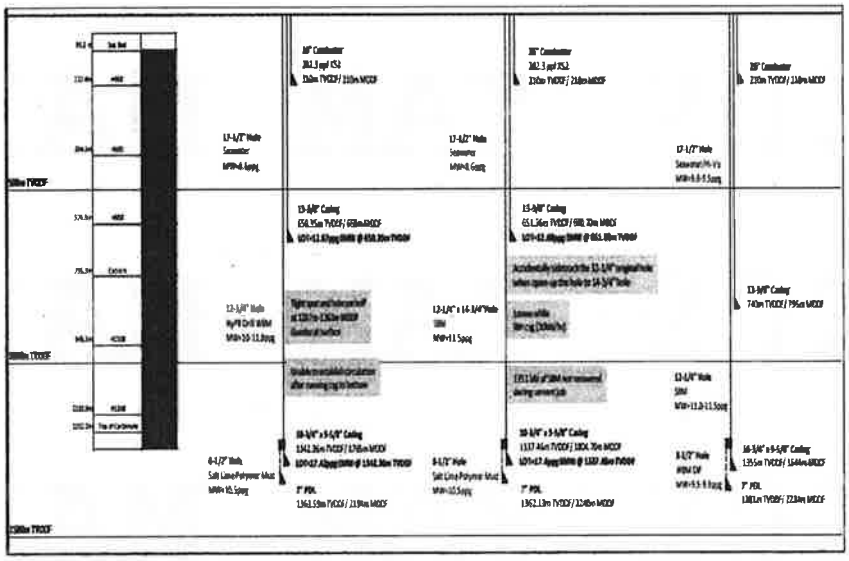

FIGURE Q1c: Stick chart of the offset wells

TABLE Q1c: Issues and causes

Risk	Hole Section	Cause
Hole pack off	12-1/4" and 8-1/2"	Improper hole cleaning
Losses while running in hole casing	12-1/4"	Excessive tripping speed when running in hole
Losses when drilling into carbonate	12-1/4"	Uncertainty on top of carbonate depth and karst
Wireline tool stuck	12-1/4"	High overbalance
Losses during cementing	9-5/8" casing cementing	Weak formation , low fracture gradient

3. a. You are the sole Well Integrity engineer in a small independent Oil & Gas Operator which had just acquired an oil producing brownfield asset after the previous foreign operator divested all its assets in Malaysia. The wells mostly comprises of wells aged 25-30 years and have experienced increased water and sand production. The previous operator had prescribed to a very comprehensive well integrity management system, however your management is seeking to subscribe to a more fit-for-purpose well integrity management system. Using ISO 16530 as your primary reference, identify and briefly discuss the purpose of all elements that should be included in the proposed Well Integrity Management Systems (WIMS).

[6 marks]

b. Considering the late field life and aging assets, the management is focused on maximizing production at lowest operational costs. You are asked to present the minimum objectives of the asset well integrity management activities, taking into consideration management direction and ISO 16530 requirements.

i. In the context of sustaining production from the asset while ensuring activities are conducted safely, define the objectives of your well integrity management activities and its minimum requirement with respect to these well intervention activities.

[2 mark]

ii. Discuss at least **FOUR (4)** types of well barrier-related activities relevant to well intervention.

[4 marks]

c. During a routine annulus pressure diagnostic (APD), the result for well XX-01 (currently shut-in oil producer) and its completion properties are shown by **FIGURE Q3 and TABLE Q3,** respectively. During PCP bleed-off, fluid was recovered. The APD was performed over a period of 115 hrs before the digital pressure gauges batteries were depleted. Thereafter the APD was called off due to bad weather.

TABLE Q3: Completion properties for well XX-01

Properties	Tubular Size	Weight	Grade	MIYP (psig)	Collapse (psig)
1. Prod tubing	2-7/8"	6.4	N-80	10570	11160
2. A annulus	9-5/8"	47	N-80	6870	4750
3. B annulus	18-5/8"	87.5	K-55	2250	630

i. Interpret the result of the APD and describe the probable integrity condition of the well with respect to the long string (LS) completion, short string (SS) completion, and A-annulus. Explain the basis of the diagnostic for each and recommend an immediate way forward for further verification by the APD team, include any assumptions made.

[3 marks]

ii. Based on the APD result in **Q3c(i)**, is there potential threat to the integrity of the well secondary barrier envelope? Explain your reasoning based on API RP 90 including any verification required to ensure well integrity is maintained.

[5 marks]

iii. The well surveillance team has requested for confirmation on the integrity of the well. Identify at least **THREE (3)** distinct, reasonably accurate and commercially available diagnostic methods with its description of the basic principles, and discuss the advantages and disadvantages of the methods. Include sufficient technical information to assure that the tool can be run in well XX-01. Prepare a brief recommendation to the management, vis-à-vis rectification plan and briefly explain.

[10 marks]

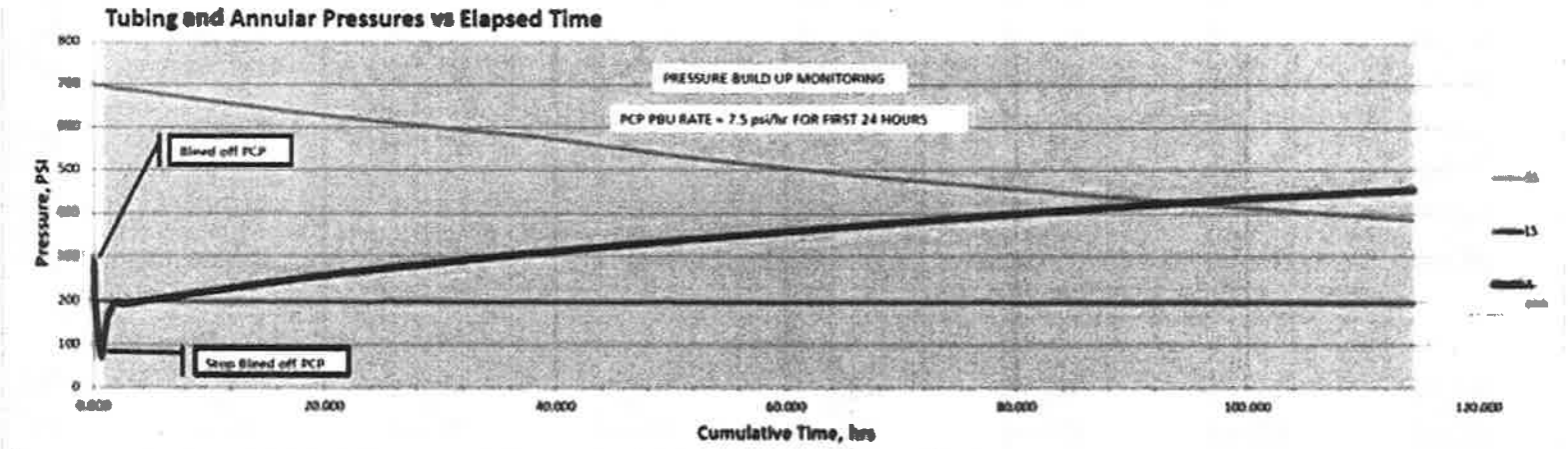

FIGURE Q3: APD Result and well information for XX-01

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