كلية الهندسة – جامعة مصراتة

فصل الربيع 2013 / 2014 — القسم / الهندسة النفطية

المقرر / إختياري تخصصي — الإمتحان النهائي — الزمن / 3 ساعات

التاريخ /26 / 04 / 2014 م — أستاذ المادة / د . علي إنبية

عدد الأسئلة (أربعة)

أجب عن ثلاثة (*السؤال الرابع إجباري*)

ملاحظات:

1. **كل طالب يتأكد من إستلام نموذج (Kill Sheet) من لجنة الإمتحانات**
2. **يسمح لكل الطلاب إحضار (Formula Sheet)**
3. **يسمح لكل طالب إحضار (Conversion Factors Sheet)**

Question 1: (15%)

1. What is the main reason for calculating the influx gradient?
2. What is the important reason for knowing the location of the influx in the annulus?
3. When should shear ram be used?
4. Why will a 20 bbl kick in small annulus be more significant than a 20 bbl in a large annulus?
5. What is the reason of SICP usually higher than SIDPP?
6. On a surface stack rig what would happen if when bringing the pump up to kill rate speed you allowed the casing pressure to increase above SICP?
7. What is SIDPP with the pit on bottom used to calculate?
8. "A large pit gain will give a higher SICP but SIDPP will remain the same regardless of kick size" is it true or false?
9. After shutting in on a kick the SIDPP & SICP have been stable for a while. Both have now started to slowly increase by the same amount. What is the probable cause?
10. If a gas kick is taken in a horizontal well what would you expect SICP to read?

Question 2: (15%)

Draw your own well diagrams to help you

1. *Well Data*
   - Well depth 15500 ft
   - 9 5/8 inch casing (ID 8.681 inch) set at 11500 ft
   - 7 inch Liner (ID 6.276 inch) set at 13000 ft
   - Liner top set 500 feet inside 9 5/8 inch casing
   - Hole size 6 inch

2. *Drill string data*
   - 4 ½ inch drill collars (ID 2inch) length = 500 ft
   - 3 ½ inch drill collars (ID 2.764 inch) length = 7000 ft
   - 5 inch drill pipe (ID 4.276 inch)

Calculate:

1. Drill string Capacity (bbl)
2. Annular volume (bbl)
3. Total Volume (bbl)

Question 3: (15%)

Using the following information;

1. *Well Data*
   - Well depth (MD / TVD) 13570 / 13570 ft
   - 13 3/8 (12.615) inch casing set at 10780 ft
   - Hole size 11 inch
   - 7 ¾ (2.812 inch) Drill Collars 858 ft
   - 5 (4.276 inch) Drill pipe === ft

2. *Internal Capacities*

• Drill Collars	0.0077 bbl/ft
• Drill Pipe	0.0177 bbl/ft

3. *Annulus Capacities*

• Drill pipe in casing	0.1303 bbl/ft
• Drill pipe in open hole	0.0934 bbl/ft
• Drill Collars in open hole	0.0592 bbl/ft

4. *Pump Details*

• Pump output	0.118 bbl/stroke
• Slow Circulating Rate Pressure @ 38 spm	880 psi

5. *Fracture data*

• Leak Off Test Pressure	1900 psi
• Mud Weight in hole at test	11 ppg

6. *Kill Data*

• Present Mud Weight	11.3 ppg
• SIDPP	600 psi
• SICP	800 psi
• Pit Gain	23 bbls

Calculate:

1. Kill mud weight
2. The fracture mud weight
3. MAASP with present mud in hole
4. Surface to bit strokes and time

5. Total Circulation Strokes
6. Gradient of the influx
7. ICP and FCP
8. A Step Down Chart

Question 4: (35%)

Complete the Subsea vertical kill sheet attached. Then answer questions 1 to 12. Please round calculations as per good well control practice.

1. *Well Data*

- Well depth (below RKB)
  - MD — 6080 ft
  - TVD — 6040 ft
- 9 5/8 inch casing set at (MD / TVD) — 5000 ft
- Hole size — 8 ½ inch
- RKB to mean sea level (MSL) — 50 ft

2. *Internal Capacities*

- 6 ½ inch drill collars (600 ft) — 0.0077 bbl/ft
- 5 inch HWDP (400 ft) — 0.0088 bbl/ft
- 5 inch drill pipe — 0.0178 bbl/ft
- 3 inch Choke line (515 ft) — 0.0087 bbl/ft
- Marine riser (500 ft) — 0.3892 bbl/ft

3. *Annulus Capacities*

- Drill Collars in open hole — 0.0292 bbl/ft
- Drill pipe / HWDP in open hole — 0.0459 bbl/ft
- Drill pipe / HWDP in casing — 0.0505 bbl/ft
- Drill pipe in Marine riser — 0.3638 bbl/ft

4. *Pump Details*

• Pump output at 98% efficiency	0.102 bbl/stroke

5. *Slow Circulation Rate Data*

• @ 45 spm through the riser	400 psi
• @ 45 spm through the choke line	500 psi

6. *Other relevant information*

• Active surface fluid volume	460 bbl
• Drill pipe, 5 inch closed and displacement	0.0254 bbl/ft
• Seawater density	8.6 ppg
• Surface line volume	14 bbl

7. *Formation strength test data*

• Surface leak-off pressure with 10.0 ppg mud	1500 psi

8. *Kick data*

The well kicked at 6040 vertical depth

• Shut in drill pipe pressure	600 psi
• Shut in casing pressure	870 psi
• Recorded pit gain	19 bbls
• Mud weight in hole	10.4 ppg

The well will be killed using the Wait and Weight method

Answer the following TWELVE questions from the data above. The attached kill sheet may be used to assist you with your calculations.

1. Calculate the pressure safety margin at the casing shoe in this static condition, assuming the top of the kick is below the casing shoe.
2. How many strokes are required to pump from pump to bit?
3. How many strokes are required to pump from the bit to casing shoe?
4. How much time is required to circulate the total well system volume?
5. How many strokes are required to displace the marine riser to kill fluid before opening the BOP?
6. What is the kill mud density?
7. What is the Initial Circulating Pressure?
8. What is the Final Circulating Pressure?
9. What is the Initial dynamic casing pressure at kill pump rate?
10. What is the MAASP after circulation of the kill mud?
11. Calculate the pressure drop per 100 strokes of kill mud fluid pumped inside the drill string
12. If all the influx is at the bottom of the hole, calculate the gradient of the influx.

إنتهت الأسئلة

بالتوفيـــــــــــــــــق

International Well Control Forum
Subsea BOP Vertical Well Kill Sheet (API Field Units)

DATE : _____

NAME : _____

FORMATION STRENGTH DATA:

SURFACE LEAK -OFF PRESSURE FROM FORMATION STRENGTH TEST (A) psi

MUD WEIGHT AT TEST (B) ppg

MAXIMUM ALLOWABLE MUD WEIGHT =

(B) + $\frac{\text{(A)}}{\text{SHOE T.V. DEPTH x 0.052}}$ = (C) ppg

INITIAL MAASP =

((C) - CURRENT MUD WEIGHT) x SHOE T.V. DEPTH x 0.052)

= _____ psi

CURRENT WELL DATA:

SUBSEA BOP DATA:

MARINE RISER LENGTH _____ feet

CHOKELINE LENGTH _____ feet

DRILLING MUD:

WEIGHT _____ ppg

CASING SHOE DATA:

SIZE _____ inch

M. DEPTH _____ feet

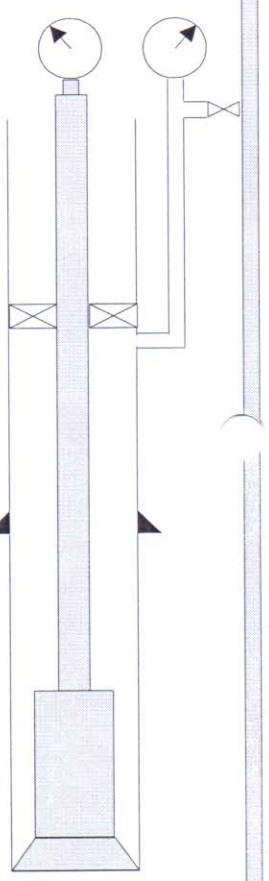
T.V. DEPTH _____ feet

HOLE DATA:

SIZE _____ inch

M. DEPTH _____ feet

T.V. DEPTH _____ feet



PUMP NO. 1 DISPL.	PUMP NO. 2 DISPL.
bbls / stroke	bbls / stroke

SLOW PUMP RATE DATA:	(PL) DYNAMIC PRESSURE LOSS [psi]					
	PUMP NO. 1			PUMP NO. 2		
	Riser	Choke Line	***Choke Line Friction***	Riser	Choke Line	***Choke Line Friction***
SPM						
SPM						

PRE-RECORDED VOLUME DATA:	LENGTH feet	CAPACITY bbls / feet	VOLUME barrels	PUMP STROKES Strokes	TIME Minutes
DRILL PIPE	x	=		VOLUME / PUMP DISPLACEMENT	
HEVI WALL DRILL PIPE	x	=			
DRILL COLLAR	x	=			
DRILL STRING VOLUME			(D) bbls	(E) strokes	Min
DC x OPEN HOLE	x	=			
DP / HWDP x OPEN HOLE	x	=	+		
OPEN HOLE VOLUME			(F) bbls	strokes	Min
DP x CASING	x	= (G)	+	strokes	Min
CHOKELINE	x	= (H)	+	strokes	Min
TOTAL ANNULUS/CHOKELINE VOLUME		(F+G+H) = (I)	bbls	strokes	Min
TOTAL WELL SYSTEM VOLUME		(D+I) = (J)	bbls	strokes	Min
ACTIVE SURFACE VOLUME		(K)	bbls	strokes	
TOTAL ACTIVE FLUID SYSTEM		(J+K)	bbls	strokes	
MARINE RISER x DP	x	=	bbls	strokes	

Dr No SSV 04/01
(Field Units)
27-01-2000

International Well Control Forum

Subsea BOP Kill Sheet - Vertical Well (API Field Units)

DATE : _____

NAME : _____

KICK DATA : SIDPP _____ psi SICP _____ psi PIT GAIN _____ barrels

KILL MUD WEIGHT

KMW

CURRENT MUD WEIGHT + $\frac{\text{SIDPP}}{\text{TVD x 0.052}}$

..... + $\frac{\qquad}{\text{X 0.052}}$ = ppg

INITIAL CIRCULATING PRESSURE

ICP

DYNAMIC PRESSURE LOSS + SIDPP

..... + ... = psi

FINAL CIRCULATING PRESSURE

FCP

$\frac{\text{KILL MUD WEIGHT}}{\text{CURRENT MUD WEIGHT}}$ x DYNAMIC PRESSURE LOSS

_____ x ..... = psi

(L) = ICP - FCP = ... - ..... = ... psi

$\frac{\text{(L) x 100}}{\text{(E)}}$ = $\frac{\text{X 100}}{\qquad}$ = $\frac{\text{psi}}{\text{100 strokes}}$

INITIAL DYNAMIC CASING PRESSURE AT KILL PUMP RATE

SICP - CHOKE LINE FRICTION ..... - ..... = psi

STROKES	PRESSURE [psi]

STATIC & DYNAMIC DRILL PIPE PRESSURE [psi] ↑

STROKES →

Dr No SSV 04/02 (Field Units) 27-01-2000