SUBSEA KICK SHEET EXERCISE No. 6

Complete the Subsea vertical kill sheet provided on pages 2 and 3. Then answer questions 1 to 11. Please round calculations as per good well control practice.

Well data:
- Hole size: 12 ¼ inch
- Measured hole depth (Below RKB): 9,580 feet
- Vertical hole depth (Below RKB): 9,020 feet
- RKB to mean sea level (MSL): 80 feet
- MSL to sea bed: 570 feet
- Casing (Below RKB): 13 ¾ inch, 5180 feet MD, 4800 feet TVD

Internal capacities:
- Drill pipe: 5 inch (S-135-NC50), capacity 0.01776 bbl/ft
- Heavy wall drill pipe: 5 inch, length 690 ft, capacity 0.0088 bbl/ft
- Drill collars: 8 inch x 2 13/16 inch, length 820 ft, capacity 0.0077 bbls/ft
- Choke line: 3 inch ID, length 665 ft, capacity 0.0087 bbls/ft
- Marine riser: length 650 feet, capacity 0.3892 bbls/ft

Annulus capacities:
- Drill collars in open hole: 0.0836 bbl/ft
- Drill pipe and HWDP in open hole: 0.1202 bbl/ft
- Drill pipe and HWDP in casing: 0.1242 bbl/ft
- Drill pipe in Marine riser: 0.3638 bbl/ft

Mud pump data:
- Pump output at 98% volumetric efficiency: 0.12 bbl/stroke

Slow circulation rate data:
- @ 45 spm through the riser: 690 psi
- @ 45 spm through the choke line: 830 psi

Other relevant information:
- Active surface fluid volume: 230 bbl
- Drill pipe, 5 inch closed end displacement: 0.0254 bbl/ft

Formation strength test data:
- Surface leak-off pressure with 10.0 ppg mud: 1080 psi

Kick Data:
- The well kicked at 9580 feet MD
- Shut in drill pipe pressure: 475 psi
- Shut in Casing pressure: 580 psi
- Recorded pit gain: 20 bbl
- Recorded mud density: 10.5 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.
International Well Control Forum
Subsea BOP Vertical Well Kill Sheet (Field Units)

**Formation Strength Data:**
- Surface Leak-off Pressure from Formation Strength Test: \((A)\) psi
- Drilling Fluid Density at Test: \((B)\) ppg
- Max. Allowable Drilling Fluid Density: \(\frac{(B)}{(A)}\) ppg
- Initial MAASP: \((\frac{(C)}{(D)} - \text{Current Density}) \times \text{Shoe T.V. Depth} \times 0.052\)

**Current Well Data:**
- Subsea BOP Data:
  - Marine Riser Length
  - Choke Line Length
- Drilling Fluid Density: \(\_\) ppg
- Casing Shoe Data:
  - Size
  - M. Depth
  - T.V. Depth
- Hole Data:
  - Size
  - M. Depth
  - T.V. Depth

**Slow Pump Rate Data:**
- SPM
- (Pump No. 1 Displ.) bbls / stroke
- (Pump No. 2 Displ.) bbls / stroke
- Initial (P) Dynamic Pressure Loss: [psi]

**Pre-Recorded Volume Data:**
- Drill Pipe: \(x = \_\) barrells
- Hevi Wall Drill Pipe: \(x = \_\) barrells
- Drill Collar: \(x = \_\)

**Drill String Volume:**
- \((D)\) barrells

**DC x Open Hole:**
- \(x = \_\) barrells

**DP / HWDP x Open Hole:**
- \(x = +\) barrells

**Open Hole Volume:**
- \((F)\) barrells

**DP x Casing:**
- \(x = (G) +\) barrells

**Choke Line:**
- \(x = (H) +\) barrells

**Total Annulus/Choke Line Volume:**
- \((F+G+H) = (I)\) barrells

**Total Well System Volume:**
- \((D+I) = (J)\) barrells

**Active Surface Volume:**
- \((K)\) barrells

**Total Active Fluid System:**
- \((J+K)\) barrells

**Marine Riser x DP:**
- \(x = \_\) barrells

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

Revised March 2012
# IWCF Combined Surface & Subsea Well Control

## Kick Sheet Exercise No. 6

**API (Field) Units**

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**International Well Control Forum**

**Subsea BOP Vertical Well Kill Sheet (Field Units)**

<table>
<thead>
<tr>
<th>KICK DATA:</th>
<th>SIDP</th>
<th>PSI</th>
<th>SICP</th>
<th>PSI</th>
<th>PIT GAIN</th>
<th>BARRELS</th>
</tr>
</thead>
</table>

**KILL FLUID DENSITY**

\[
\text{KMD} = \frac{\text{CURRENT DRILLING FLUID DENSITY}}{\text{TVD} \times 0.052} \times 0.052
\]

**INITIAL CIRCULATING PRESSURE**

\[
\text{ICP} = \text{DYNAMIC PRESSURE LOSS} + \text{SIDP}
\]

**FINAL CIRCULATING PRESSURE**

\[
\text{FCP} = \frac{\text{CURRENT DRILLING FLUID DENSITY} \times \text{DYNAMIC PRESSURE LOSS}}{\text{(L)} \times 100} \times 100
\]

**INITIAL DYNAMIC CASING PRESSURE AT KILLPUMP RATE**

\[
\text{SICP - CHOKE LINE FRICTION} = \text{STROKES PRESSURE}
\]

---

**Strokes Pressure**

<table>
<thead>
<tr>
<th>[psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Static & Dynamic Drill Pipe Pressure**

<table>
<thead>
<tr>
<th>[psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

---

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

---

Revised March 2012
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.
   Answer________________ psi
   4 points

2. How many strokes are required to pump from surface to bit?
   Answer________________ strokes
   4 points

3. How many strokes are required to pump from the bit to casing shoe?
   Answer________________ strokes
   4 points

4. How much time is required to circulate from surface to choke manifold?
   Answer________________ minutes
   4 points

5. How many strokes are required to displace the marine riser to kill fluid before opening the BOP?
   Answer________________ strokes
   4 points

6. What is the kill mud density?
   Answer________________ ppg
   4 points

7. What is the Initial Circulating Pressure?
   Answer________________ psi
   4 points

8. What is the Final Circulating Pressure?
   Answer________________ psi
   4 points
9. What is the Initial dynamic casing pressure at kill pump rate?

Answer____________ psi

4 points

10. What is the MAASP after circulation of the kill mud?

Answer____________ psi

4 points

11. Calculate the pressure drop per 100 strokes of kill mud fluid pumped inside the drill string.

Answer____________ psi/100 strokes

4 points

12. If all the influx is at the bottom of the hole, calculate the gradient of the influx.

Answer____________ psi/ft

4 points
Before attempting to fill in the kill sheet, draw a simple sketch of the well to determine the total annulus lengths. An example is shown below. Only use measured depths and remember that total annulus length (including the choke line) may not equal measured depth if the choke line length is greater than the Riser length.

![Diagram of well control exercise](image-url)

**TOTAL ANNULUS LENGTH**

\[
\text{TOTAL ANNULUS LENGTH} = 820 \text{ ft} + 3580 \text{ ft} + 4530 \text{ ft} + 665 \text{ ft} + 4650 \text{ ft} + 820 \text{ ft}
\]

**CHECK:**

\[
\text{MD} - \Delta L = 9595 - 15 = 9580 \text{ ft} = \text{MD}
\]
## Subsea Kill Sheet Exercise No. 6 - Answers

### API (Field) Units

#### Well Control

<table>
<thead>
<tr>
<th>FORMATION STRENGTH DATA:</th>
<th>CURRENT WELL DATA:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFACE LEAK-OFF PRESSURE FROM</td>
<td>MARINE RISER LENGTH</td>
</tr>
<tr>
<td>FORMATION STRENGTH TEST</td>
<td>650 feet</td>
</tr>
<tr>
<td>DRILLING FLUID DENSITY AT TEST</td>
<td>CHOKELINE LENGTH</td>
</tr>
<tr>
<td>(A)</td>
<td>665 feet</td>
</tr>
<tr>
<td>MAX. ALLOWABLE DRILLING FLUID DENSITY</td>
<td>ΔL = 15'</td>
</tr>
<tr>
<td>(B)</td>
<td></td>
</tr>
<tr>
<td>SHOE TV. DEPTH x 0.052</td>
<td></td>
</tr>
<tr>
<td>(14.3 - 10.5) x 4800 x 0.052</td>
<td></td>
</tr>
<tr>
<td>=</td>
<td>948 psi</td>
</tr>
</tbody>
</table>

#### Initial MAASP =

(14.3 - 10.5) x 4800 x 0.052

<table>
<thead>
<tr>
<th>PUMP NO. 1 Displ.</th>
<th>PUMP NO. 2 Displ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.12 bbls / stroke</td>
<td>0.12 bbls / stroke</td>
</tr>
</tbody>
</table>

#### Slow Pump Rate Data:

<table>
<thead>
<tr>
<th>PUMP NO. 1</th>
<th>PUMP NO. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 RPM</td>
<td>45 RPM</td>
</tr>
<tr>
<td>690 x 830</td>
<td>690 x 830</td>
</tr>
<tr>
<td>820 x 610</td>
<td>820 x 610</td>
</tr>
</tbody>
</table>

#### Pre-Recorded Volumes Data:

| DRILL PIPE | 8070 x 0.01776 | 143.3322 |
| HEW WALL DRILL PIPE | 690 x | 6.072 |
| DRILL COLLAR | 820 x | 6.814 |

#### Drill String Volume:

| DC x OPEN HOLE | 820 x 0.0836 | 68.552 |
| OPEN HOLE VOLUME | 3.580 x 0.0202 | 430.736 |
| DP x CASING | 4530 x 0.042 | 1562.612 |
| CHOKELINE | 665 x 0.00874 | 5.785 |

#### Total Annulus/Chokeline Volume:

(10 + H1) x (i) 1667.281 8894 strokes 976 minutes

#### Total Well System Volume:

(△H1 + H2) x (i) 222.99 10192 strokes 266 minutes

#### Active Surface Volume:

(A) 230 |

#### Total Active Fluid System:

(U + H) |

#### Marine Riser x DP

| 650 x 0.3628 | 236.47 | 197 strokes |
Revised March 2012

WELLTRAIN™

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

**KICK DATA:**
- **SIDPP:** 475 psi
- **SICP:** 580 psi
- **PIT GAIN:** 20 bbls

**KILL FLUID DENSITY (KFD):**
- **Current Drilling Fluid Density:** \( \frac{10.5}{9.020} \times \frac{475}{0.052} = 11.6 \) redbull

**Initial Circulating Pressure (ICP):**
- **Dynamic Pressure Loss + SIDPP:** 690 + 475 = 1165 psi

**Final Circulating Pressure (FCP):**
- **KILL FLUID DENSITY:** \( \frac{11.6}{10.5} \times \frac{690}{0.052} = 763 \) psi

- **(L) = ICP - FCP:** 1165 - 763 = 402 psi
- **(L) x 100:** \( \frac{402}{763} \times 100 = 52.7 \) psi

**Initial Dynamic Casing Pressure at Kill Pump Rate (ICP - Choke Line Friction):** 580 - 140 = 440 psi

**STROKES PRESSURE (psi):**

- 0: 1165
- 100: 1174
- 200: 1183
- 300: 1192
- 400: 1201
- 500: 1210
- 600: 1219
- 700: 1228
- 800: 1237
- 900: 1246
- 1000: 1255
- 1100: 1264
- 1200: 1273
- 1293: 1282

**STATIC & DYNAMIC DRILL PIPE PRESSURE (psi):**

**STROKES:**

- **IF No.50Y 01/02 (Field Units):** 21/01/2060

**DATE:** 6th June 2009

**NAME:** Instructor
**WELL CONTROL PRE-KICK SHEET**  
**(SUBSEA ONLY)**

**Name:** Instructor  
**Date:** 29 March 2012  
**Level:** Exercise No. 6

(All depths measured from RKB)

<table>
<thead>
<tr>
<th>Measured Depth: 9,580 ft</th>
<th>True Vertical Depth: 9,020 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured Depth to Casing Shoe: 5,180 ft</td>
<td>Casing Shoe TVD: 4,800 ft</td>
</tr>
<tr>
<td>Water Depth: 570 ft</td>
<td>Air Gap: 80 ft</td>
</tr>
</tbody>
</table>

**CAPACITIES AND VOLUMES**

<table>
<thead>
<tr>
<th>DRILL STRING DATA</th>
<th>O.D. (in)</th>
<th>I.D. (in)</th>
<th>Wt. (lb/ft)</th>
<th>CAPACITY (bbl/ft)</th>
<th>LENGTH (ft)</th>
<th>VOLUME (bbls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRILL PIPE</td>
<td></td>
<td></td>
<td></td>
<td>0.01776</td>
<td>8070</td>
<td>143.32</td>
</tr>
<tr>
<td>HWDP</td>
<td></td>
<td></td>
<td></td>
<td>0.0088</td>
<td>690</td>
<td>6.07</td>
</tr>
<tr>
<td>DRILL COLLARS</td>
<td></td>
<td></td>
<td></td>
<td>0.0077</td>
<td>820</td>
<td>6.31</td>
</tr>
</tbody>
</table>

**CHECK THAT TOTAL LENGTH = MEASURED DEPTH**

- Total Length: 9,580 ft  
- Total Drilling: 155.7 ft

**ANNULUS DATA**

<table>
<thead>
<tr>
<th>ANNULUS DATA</th>
<th>CAPACITY (bbl/ft)</th>
<th>LENGTH (ft)</th>
<th>VOLUME (bbls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHoke LINE</td>
<td>0.0087</td>
<td>665</td>
<td>5.78</td>
</tr>
<tr>
<td>DP/HWDP IN CASING</td>
<td>0.1242</td>
<td>4580</td>
<td>562.63</td>
</tr>
<tr>
<td>DP/HWDP IN OPEN HOLE</td>
<td>0.1202</td>
<td>3580</td>
<td>430.32</td>
</tr>
<tr>
<td>COLLARS IN OPEN HOLE</td>
<td>0.0836</td>
<td>820</td>
<td>68.55</td>
</tr>
</tbody>
</table>

**Note:** Total Length may not equal Measured Depth if choke line is longer than the riser.

- Bit to Shoe Volume: 498.87 bbls

**TOTAL SYSTEM VOLUME**

<table>
<thead>
<tr>
<th>TOTAL DRILLSTRING (SURFACE TO BIT)</th>
<th>TOTAL ANNULUS (BIT TO SURFACE)</th>
<th>TOTAL SYSTEM VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>155.7 (bbls)</td>
<td>1067.28 (bbls)</td>
<td>1222.98 (bbls)</td>
</tr>
</tbody>
</table>

**RISER DATA**

<table>
<thead>
<tr>
<th>RISER DATA</th>
<th>CAPACITY (DP/RISER) (bbl/ft)</th>
<th>LENGTH (ft)</th>
<th>VOLUME (bbls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP/RISER ANNULUS VOLUME</td>
<td>0.3638</td>
<td>650</td>
<td>236.47</td>
</tr>
</tbody>
</table>
## Read and record SLOW CIRCULATING RATES

<table>
<thead>
<tr>
<th>B.C.R</th>
<th>CHOOSE LINE</th>
<th>RISER</th>
<th>CHOOSE LINE FRICTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2</td>
<td>830 [psi]</td>
<td>690 [psi]</td>
<td>140 [psi]</td>
</tr>
<tr>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Drill String Data

- **Drill String Volume (bbls)**: 155.7
- **Pump Output (bbls/blk)**: 0.12
- **Surface to Bit Strokes**: 1298

### Surface to Bit Time

- **Surface to Bit Strokes**: 1298
- **Slow Circulating Rate (spm)**: 45
- **Surface to Bit Time**: 28.8 [min]

### Open Hole Data

- **Bit to Shoe Volume (bbls)**: 498.87
- **Pump Output (bbls/blk)**: 0.12
- **Bit to Show Strokes**: 458

- **Bit to Shoe Time**: 92.4 [min]

### Annulus Data

- **Bit to Surface Volume (bbls)**: 1067.28
- **Pump Output (bbls/blk)**: 0.12
- **Bit to Surface Strokes**: 8894

- **Bit to Surface Time**: 197.6 [min]

### Riser Data

- **Riser Volume (bbls)**: 236.47
- **Pump Output (bbls/blk)**: 0.12
- **BOP to Surface Strokes**: 1971

- **BOP to Surface Time**: 43.8 [min]
WELL CONTROL KICK SHEET (SUBSEA ONLY)

Name: INSTRUCTOR

Read and record SIDPP, SICP and PIT GAIN

**S.I.D.P.P.**

4.75 psi

**PIT GAIN**

20 bbls

**S.I.C.P.**

5.80 psi

Day: THURSDAY

Date: 29 MAY

Time: 1600 HRS

---

**Max. Mud Wt.**

Surface Leak Off Test

\[
\begin{align*}
\text{Max. Mud Wt.} &= \text{Casing T.V.D. from RKB} + \text{Formation Breakdown Gradient} \\
&= \frac{1080 \text{ psi}}{14.3 \text{ (ppg)}} + 0.052 \\
&= 14.3 \text{ (ppg)}
\end{align*}
\]

**OR**

\[
\begin{align*}
\text{Max. Mud Wt.} &= \text{Casing Yield \times Safety Factor} \\
&= \frac{14.3 \text{ (ppg)}}{10.5} \times 0.8 \\
&= 9.48 \text{ (psi)}
\end{align*}
\]

---

**M.A.A.S.P.**

Maximum Mud Weight

\[
\begin{align*}
\text{M.A.A.S.P.} &= \text{Drilling Mud Weight} \times \frac{\text{Casing T.V.D. from RKB}}{\text{Formation Breakdown Gradient}} \\
&= 10.5 \text{ (ppg)} \times 4.800 \text{ (ft)} \\
&= 94.8 \text{ (psi)}
\end{align*}
\]

---

**M.A.C.P.**

Casing Burst

\[
\begin{align*}
\text{M.A.C.P.} &= \text{Casing Yield} \times \text{Safety Factor} \\
&= 4.75 \text{ psi} \times 0.8 \\
&= 11.6 \text{ (ppg)}
\end{align*}
\]

---

**Kill Mud Wt.**

\[
\begin{align*}
\text{Kill Mud Wt.} &= \text{S.I.D.P.P.} + \text{T.V.D. from RKB} + \text{Drilling Mud Weight} \\
&= 4.75 \text{ psi} + 9.020 \text{ (ft)} + 10.5 \text{ (ppg)} \\
&= 11.6 \text{ (ppg)}
\end{align*}
\]

---

**NEW M.A.A.S.P.**

Maximum Mud Weight

\[
\begin{align*}
\text{NEW M.A.A.S.P.} &= \text{Kill Mud Weight} \times \frac{\text{Casing T.V.D. from RKB}}{\text{Formation Breakdown Gradient}} \\
&= 11.6 \text{ (ppg)} \times 4.800 \text{ (ft)} \\
&= 673 \text{ (psi)}
\end{align*}
\]

---

**K3 Vertical API Field Units**

Revised December 2011

**Kill mud hydrostatic:**

\[
\text{Kill mud hydrostatic} = 11.6 \text{ (ppg)} \times 0.052 \times 9.020 \text{ ft} = 5440 \text{ psi}
\]

**Formation Pressure:**

\[
\text{Formation Pressure} = 4.75 \text{ psi} + (10.5 \times 0.052 \times 9.020 \text{ ft}) \\
= 5399 \text{ psi}
\]

---

Revised March 2012
### WELL CONTROL KICK SHEET
**SUBSEA ONLY**

#### Pressure Step Down Chart
1. Calculate I.C.P.
2. Calculate F.C.P.
3. Calculate Step-down.
4. In the left column record strokes in 100 stroke intervals, until final circulating pressure is reached.
5. Record I.C.P. in top right column, and deduct the pressure step down ΔP until F.C.P. is reached.
6. Calculate adjusted choke line friction (using Kill Mud).
7. Calculate complete circulation, in strokes and time.

<table>
<thead>
<tr>
<th>I.C.P.</th>
<th>SCR Riser</th>
<th>SIDPP</th>
<th>Initial Circulating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>690 (psig)</td>
<td>4.75</td>
<td>1165 (psig)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F.C.P.</th>
<th>SCR Riser</th>
<th>Kill Mud</th>
<th>Drilling Mud</th>
<th>Final Circulating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>690 (psig)</td>
<td>11.6 (ppg)</td>
<td>10.5 (ppg)</td>
<td>763 (psig)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ΔP</th>
<th>ICP</th>
<th>FCP</th>
<th>Surface to Bit strokes</th>
<th>Pressure Step-down</th>
</tr>
</thead>
<tbody>
<tr>
<td>1165 (psig)</td>
<td>763 (psig)</td>
<td>1298 (stks)</td>
<td>0.309 (stks/stk)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I.D.C.P.</th>
<th>SIDC</th>
<th>Choke Line Friction</th>
<th>Initial Dynamic Casing Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>580 (psig)</td>
<td>14.0</td>
<td>440 (psig)</td>
<td></td>
</tr>
</tbody>
</table>

#### Adjusted Choke Line Friction

<table>
<thead>
<tr>
<th>Choke Line Friction</th>
<th>Kill Mud</th>
<th>Drilling Mud</th>
<th>Adjusted Choke Line Friction</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.0 (psig)</td>
<td>11.6 (ppg)</td>
<td>10.5 (ppg)</td>
<td>15.4 (psig)</td>
</tr>
</tbody>
</table>

**Complete Circulation Data**

<table>
<thead>
<tr>
<th>Bit Strokes to Kill</th>
<th>Bit to Surface strokes</th>
<th>Total Strokes to Kill Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1298 (stks)</td>
<td>889.4 (stks)</td>
<td>10192 (stks)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit Time to Kill</th>
<th>Total Time to Kill Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.8 (min)</td>
<td>226.4 (min)</td>
</tr>
</tbody>
</table>

**Riser Data**

<table>
<thead>
<tr>
<th>DPR/Riser Volume</th>
<th>Pump Output</th>
<th>Riser Strokes</th>
</tr>
</thead>
<tbody>
<tr>
<td>236.47 (bbl)</td>
<td>0.12 (bbl/stk)</td>
<td>197.1</td>
</tr>
<tr>
<td>Riser strokes</td>
<td>Slow Circulating Rate</td>
<td>Time to Displace Riser</td>
</tr>
<tr>
<td>197.1</td>
<td>4.5 (st/min)</td>
<td>43.8 (min)</td>
</tr>
</tbody>
</table>

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K3 Vertical API Field Units
Revised December 2011
1. Pressure Safety Margin = MAASP – SICP
   = 948 psi – 580 psi
   = 368 psi

2. 1296 -1300 strokes

3. 4138 - 4178 strokes

4. 226 - 228 minutes

5. 1968 - 1973 strokes

6. 11.6 ppg

7. 1165 psi

8. 763 psi

9. 440 psi

10. 673 psi
    New MAASP = (Max. Allowable Mud Density – Kill Mud Density) x 0.052 x TVDshoe
            = (14.3 – 11.6) x 0.052 x 4800
            = 673 psi

11. 30 – 30.97 psi/100 strokes

12. Height of Influx = Pit Gain (bbls) ÷ DC/OH annular capacity (bbls/ft)
    = 20 bbls ÷ 0.0836 bbls/ft
    = 239.2 feet
Formation Pressure = SIDD + HP string
   = 475 + (10.5 x 0.052 x 9020)
   = 5400 psi

HSP mud in annulus = 10.5 x 0.052 x (9020 -239.2)
   = 0.546 psi/ft x (8780.8 feet)
   = 4794.3 psi

Kick Hydrostatic = Formation Pressure – SICP – HSP mud in annulus
   = 5400 – 580 -4794.3
   = 25.7 psi

Gradient of Influx = Kick Hydrostatic (psi) ÷ Height of Influx (ft)
   = 25.7 psi ÷ 239.2 feet
   = 0.107 psi/ft