**Subsea Consideration**

**Casing Pressure Decrease when Bringing Well on Choke**

When bringing the well on choke with a subsea stack, the casing pressure

(annulus pressure) must be allowed to decrease by the amount of choke line

pressure loss (friction pressure):

Sample Case : Shut-in casing (annulus) pressure (SICP) = 800 psi  
 Choke line pressure loss (CLPL) = 300 psi

Reduced casing pressure (psi) = 800 psi – 300 psi

= 500 psi

**Pressure Chart for Bringing Well on Choke**

Pressure/stroke, relationship is not a straight line effect. While bringing the well on coke, to maintain a constant bottom hole pressure, the following chart should be used :

**Pressure Chart**

|  |  |  |
| --- | --- | --- |
|  | **Strokes** | **Pressure** |
| Line 1: Reset stroke counter to “0” = | 0 |  |
| Line 2: l/2 stroke rate = 50 x .5 = | 25 |  |
| Line 3: 3/4 stroke rate = 50 x .75 = | 38 |  |
| Line 4: 7/8 stroke rate = 50 x .875 = | 44 |  |
| Line 5: Kill rate speed = | 50 |  |

Strokes side :

Sample Case : kill rate speed = 50 spm

Pressure side :

Sample Case : Shut-in casing pressure (SICP) = 800 psi  
 Choke line pressure loss (CLPL) = 300 psi

Divide choke line pressure loss (CLPL) by 4, because there are 4 steps on the chart :

**Pressure Charti**

|  |  |  |
| --- | --- | --- |
|  | **Strokes** | **Pressure** |
| Line 1: Shut-in casing pressure (psi) = |  | 800 |
| Line 2: Subtract 75 psi from Line 1 = |  | 725 |
| Line 3: Subtract 75 psi from Line 2 = |  | 650 |
| Line 4: Subtract 75 psi from Line 3 = |  | 575 |
| Line 5: Reduced casing pressure = |  | 500 |

**Maximum Allowable Mud Weight (ppg) Subsea Stack as Derived Fr**

**om Leak-Off Test Data**

Sample Case : Leak-off test pressure = 800 psi

TVD from rotary bushing to casing shoe = 4000 ft

Mud weight in use = 9.2 ppg

Maximum allowable mud weight (ppg) = 800 : 0.052 : 4000 + 9.2

= 13.0 ppg

**Maximum Allowable Shut-in Casing (Annulus) Pressure**

Sample Case : Maximum allowable mud weight = 13.3 ppg  
 Mud weight in use = 11.5 ppg

TVD from rotary kelly bushing to casing shoe = 4000 ft

MASICP = (13.3 ppg — 11.5 ppg) x 0.052 x 4000 ft

= 374

**Casing Burst Pressure — Subsea Stack**

**Step 1**

Determine the internal yield pressure of che casíng from the “Dimensions  
and Strengths” section of cement company’s service handbook.

**Step 2**

Correct internat yield pressuæ for safety factor. Some operators use 80% ; some use 75%, and others use 70%:

*Correct internal yield pressure (psi) = internal yield pressure (psi) x SF*

**Step 3**

Determine the hydrostatic pressure of the mud in use :

NOTE : The depth is from the rotary kelly bushing (RKB) to the mud line and

includes the air gap plus the depth of seawater.

**Step 4**

Determine the hydrostatic pressure exerted, by the seawater :

*HPsw = [seawater weight (ppg)] x [(0.052 x depth of seawater (ft)]*

**Step 5**

Determine casing burst pressure (CBP):

Sample Case : Determine the casing burst pressure, subsea stack, using the

following data :

DATA : Mud weight = l0.0 ppg  
 Weight of seawater = 8.7 ppg  
 Air gap = 50 ft  
 Water depth = 1500 ft  
 Correction (safety) factor = 80%

**Step 1**

Determine the internal yield pressure of the casing from the ‘Dimension and  
Strengths’ section of a cement company handbook :

9-5/8” casing — C-75, 53.5 lb/ft  
Internal yield pressure = 7430 psi

**Step 2**

Correct internal yield pressure for safety factor :

Corrected internal yield pressure = 7430 psi x 0.80

= 5944 psi

**Step 3**

Determine the hydrostatic pressure exerted by the mud in use :

HP of mud (psi) = 10.0 ppg x 0.052 x (50 ft + 1500 ft)

= 806 psi

**Step 4**

Determine the hydrostatic pressure exerted by the seawater :

HPsw = 8.7 ppg x 0.052 X 1500 ft

= 679 psi

**Step 5**

Determine the casing burst pressure :

Casino burst pressure (psi) = 5944 psi — 806 psi + 679 psi

= 5817 psi

**Calculate Choke Line Pressure Loss (CLPL) (Psi)**

Sample Case : Determine the choke line pressure loss (CLPL)(psi), using the

following data :

DATA : Mud weight = 14.O ppg  
 Choke line length = 2000 ft  
 Circulation rate = 225 gpm  
 Choke line ID = 2.5 in.

**Velocity (Ft/Min) Through the Choke Line**

Sample Case : Determine the velocity (ft/min), through the choke line using

The following data :

Data : Circulation rate = 225 gpm  
 Choke line ID = 2.5 in.

**Adjusting Choke Line Pressure Less for a Higher Mud Weight**

Sample Case : Use the following data to determine the new estimated choke

Line pressure loss:

Data : Old mud weight = 13.5 ppg  
 New múd weight = 15.0 ppg  
 Old choke line pressure loss = 300 ps

**Minimum Conductor Casing Setting Depth**

Sample Case : Using the following data, determine the minimum setting depth

of the conductor casing below the seabed :

Data : Water depth = 450 ft

Gradient of seawater = 0.445 psi/ft  
 Air gap = 60 ft  
 Formation fracture gradient = 0.68 psi/ft  
 Maximum mud weight (to be used while  
 drilling this interval) = 9.0 ppg

**Step 1**

Determine formation fracture pressure :

psi = (450 x 0.445) + (0.68 x “y”)

= 200.25 psi + 0.68”y”

**Step 2**

Determine hydrostatic pressure of mud column :

psi = 9.0 ppg x 0.052 x (60 + 450 + “y’)

= [9.0 x 0.052 x (60 + 450)) + (9.0 x 0.052 x “y”)

= 238.68 + O.468’y”

**Step 3**

Minimum conductor casing setting depth :

20025 + O,68”y” = 238.68 + 0.468”y”

0.68’y” – 0.468’y” = 238.68 – 200.25

O.2l2”y” = 38.43

Therefore, the minimum conductor casing setting depth is 181.3 ft below the seabled.

**Maximum Mud Weight with Returns Back to Rig Floor**

Sample Case : Using the following data, determine the maximum mud weight

That can be used with return back to the rig floor :

Data : Depths  
 Air gap = 75ft  
 Water depth = 600 ft  
 Conductor casing set at = 1225 ft RKB  
 Seawater gradient = 0.445 psi/ft  
 Formation fracture gradient = 0.58 psi/ft

**Step 1**

Determine total pressure at caing seat :

psi = [0.58 (1225 — 600 — 75)] + (0.445 x 600)

= 319 + 267

= 586

**Step 2**

maximum mud weight :

Max mud wt. = 586 psi : 0.052 : 1225 ft

= 9.2 ppg

**Reduction in Bottom hole Pressure if Riser is Disconnected**

Sample Case : Use the following data and determine the reduction in bottom

Hole pressure if the riser is disconnected :

Data : Air gap = 75 ft  
 Water depth = 700 ft  
 Seawater gradient = 0.445 psi/ft  
 Well depth = 2020 ft RKB  
 Mud weight = 9.0 ppg

**Step 1**

Determine bottomhole pressure :

BHP = 9.0 ppg x 0.052 x 2020 ft

= 945.4 psi

**Step 2**

Determine bottomhole pressure with riser disconnected :

BHP = (0.445 x 700) + [9.0 x 0.052 x (2020 — 700— 75)]

= 311.5 + 582.7

= 894.2 psi

**Step 3**

Determine bottomhole pressure reduction :

BHP reduction = 945.4 psi — 894.2 psi

= 51.2 psi

**Bottomhole Pressure When Circulating Out a Kick**

Sample Case : Use the following data and determine the bottomhole pressure

When circulating out a kick :

Data : Total depth - RKB = 13,500 ft  
 Height of gas kick in casing = 1,200 ft  
 Gas gradient = 0.12 psi/ft  
 Original mud weight = 12.0 ppg  
 Kill weight mud = 12.7 ppg  
 Pressure loss in annulus = 75 psi  
 Choke line pressure loss = 220 psi

Air gap = 75 ft  
 Water depth = 1,500 ft  
 Annulus (casing) pressure = 631 psi  
 Original mud in casing below gas = 5,500 ft

**Step 1**

Hydrostatic pressure in choke line :

psi = 12.0 ppg x 0.052 x (1500 + 75)

= 982.8

**Step 2**

Hydrostatic pressure exerted by gas influx :

Psi = 0.12 psi/ft x 1200 ft

= 144

**Step 3**

Hydrostatic pressure of original mud below gas influx :

Psi = 12.0 ppg x 0.052 x 5,500 ft

= 3432

**Step 4**

Hydrostatic pressure of kill weight mud :

psi = 12.7 ppg x O.052 x (13,500 – 5,500 – 1200 — 1500 — 75)

= 12.7 ppg x 0.052 x 5225

= 3450.59

**Step 5**

Bottomhole pressure while circulating out a kick :

Pressure in choke line = 982.8 psi  
Pressure of gas influx = 144 psi  
Original mud below gas in casing = 3432 psi  
Kill weight mud = 3450.59 psi  
Annulus (casing) pressure = 630 psi  
Choke line pressure loss = 200 psi  
Annular pressure loss = 75 psi

Bottomhole pressure while circulating out a kick = 8914.4 psi