# Level 1 - Well Containment Screening Tool

## LEVEL 1 - Well Containment Screening Tool (Complete a separate form for each hole section that has potential hydrocarbon flow zones)

Rev 1.18

**1) General Well Information**

| | |
|---|---|
| **Well Name:** | OCSG 22968 Kakuna #1 ST00 BP01 |
| **Lease/Block:** | GC504 |
| **Water Depth (ft):** | 3,637 |
| **RKB to Mudline Depth (ft):** | 3,723 |
| **Location (lat/long):** | X 2,312,025, Y 9,977,480 |
| **Planned TD (ft):** | 29,084 ft-TVD/ 30,144 ft-MD |
| **Planned Spud Date:** | June 24, 2011 |

**2) Offset Well Information**

| | Well | Distance/Direction |
|---|---|---|
| 1) | **Tahiti** | 12.0 miles SE |
| 2) | **Knotty Head** | 22.0 miles E |
| 3) | **Caesar** | 16.0 miles SSE |
| 4) | **Tonga** | 18.0 miles SSE |
| 5) | **Chilkoot** | 26.3 miles NW |
| 6) | **Ouachita** | 13.7 miles NE |

**3) Well Design**

| | |
|---|---|
| **Wellhead Description** | Dril-Quip SS-15 BigBore II 15K |
| **Capping Stack Description** | Helix / Trendsetter Eng. 15K Capping Stack |

**User entry**

**Calculation cell. Do not input data**

**Casing Plan**

| Size/Weight/Grade/Connection | Top (ft-TVD) | Bottom (ft-TVD) |
|---|---|---|
| 36", 552#, X56, D60MT | 3,712 | 4,039 |
| 22", 224#, X80, XLW GP95 | 3,709 | 5,982 |
| 18", 117#, P110, Hyd511 | 3,791 | 9,278 |
| 16", 97#, HC-Q125, Hyd511 | 7,955 | 13,981 |
| 14", 112.6#, HC-Q125, VAM Top | 3,709 | 3,909 |
| 14", 112.6#, HC-Q125, Hydril 523 | 3,909 | 18,604 |
| 14", 112.6#, HC-Q125, Hydril 513 | 18,604 | 18,850 |
| 11-3/4", 65#, HC-Q125, Hydril 523 | 18,516 | 19,600 |
| 11-3/4", 65#, HC-Q125, VAM SLIJ II | 19,600 | 21,187 |
| 11-3/4", 65#, HC-Q125, Hydril 523 | 21,187 | 21,899 |
| 9-7/8", 62.8#, HC-Q125, VAM SLIJ II | 18,016 | 23,384 |

**Screening tool results**

| | |
|---|---|
| 5) Formation integrity below deepest exposed shoe | PASS |
| 6A) Burst Integrity | PASS |
| 6B) Trapped annuli check | PASS |
| 6C) Collapse Integrity | LEVEL 2 REQUIRED |

**4) Productive Formation Information**

**HOLE SECTION:** 8.5" x 9.875" **SHOE DEPTH(FT-TVD):** 23,384

| Name | Depth (ft-TVD) | Reservoir Fluid | Reservoir Pressure (ppg) | Reservoir Pressure (psi) | Assumed fluid gradient for calc (psi/ft) | Mud Line Shut in Pressure (psi) | Shut in ppg @ shoe | Comments |
|---|---|---|---|---|---|---|---|---|
| Lower Miocene | 25,350 | Oil | 14.9 | 19,641 | 0.23 | 14,667 | 15.78 | |
| | | | | - | | - | - | |
| | | | | - | | - | - | |
| | | | | - | | - | - | |
| | | | | - | | - | - | |
| | | | | - | | - | - | |
| | | | | - | | - | - | |

**Use standard gradients for Level 1:**

**Gas = 0.10 psi/ft to 9,000' TVD and 0.15 psi/ft below 11,000' TVD.**

**Oil/Water/Gas = 0.23 psi/ft**

**5) Formation Integrity Analysis**

| Zone of interest | Depth | Frac gradient at depth (ppg) | Max pressure (ppge) | Is shut-in ppge < FG at depth? | Comments |
|---|---|---|---|---|---|
| **Deepest exposed shoe** | 23,384 | 16.00 | 15.78 | YES | |
| | | | - | N/A | |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - **do NOT delete this line**

**6) MECHANICAL INTEGRITY ANALYSIS**

**6.1 BURST ANALYSIS**

| Component | Burst Rating (psi) | Depth to Top of Component (ft) | Setting MW, PP or SW (ppg) | Exposed to SW? (above top hanger) | Internal Shut-in Pressure (psi) | External pressure (psi) | Burst Load (psi) | Design Factor | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Capping BOP stack** | 15,000 | 3,709 | 8.55 | Y | 14,664 | 1,611 | 13,053 | 1.14 | |
| **LMRP connector** | 15,000 | 3,709 | 8.55 | Y | 14,664 | 1,611 | 13,053 | 1.14 | Annular, BOP mandrel & HC connector shell tested to 1.5 times (~ 15K). |
| **Drilling BOP stack** | 15,000 | 3,709 | 8.55 | Y | 14,664 | 1,611 | 13,053 | 1.14 | |
| **Subsea Wellhead** | 15,000 | 3,709 | 8.55 | Y | 14,664 | 1,611 | 13,053 | 1.14 | |
| **14" Casing Hanger / Seal Assembly** | 13,200 | 3,709 | 15.60 | N | 14,664 | 3,009 | 11,655 | 1.13 | 13,200 Rating From DQ |
| **14" Casing (VAM Top)** | 12,450 | 3,709 | 15.60 | N | 14,664 | 3,009 | 11,655 | 1.06 | |
| **14" Casing (Hyd 523)** | 12,450 | 3,909 | 15.60 | N | 14,710 | 3,171 | 11,539 | 1.07 | |
| **14" Casing (Hyd 513) (Actual Cement Top)** | 12,450 | 18,814 | 15.60 | N | 18,138 | 15,262 | 2,876 | 4.32 | Note:The 11-3/4" Liner is not exposed to the pressure from a burst load after a well control event. In the event of blowout followed by subsequent capping and shut in, the 9-7/8" liner will isolate the 11-3/4" from the load. IThe 11-3/4" is shown, as it protects the 14" shoe which had a lower than expected fracture gradient due to a loss zone in salt. |
| **11-3/4" Liner Hanger** | 7,000 | 18,517 | 15.60 | N | 18,070 | 15,021 | 3,049 | 2.29 | |
| **11-3/4" Liner (Hyd523)** | 9,940 | 18,527 | 15.60 | N | 18,072 | 15,029 | 3,043 | 3.26 | |
| **11-3/4" Liner (SLIJ II)** | 9,940 | 19,601 | 15.60 | N | 18,319 | 15,900 | 2,419 | 4.10 | |
| **11-3/4" Liner (Hyd523)** | 9,940 | 21,188 | 15.60 | N | 18,684 | 17,188 | 1,496 | 6.64 | |
| **9-7/8" Liner Hanger** | 10,000 | 18,017 | 15.20 | N | 17,955 | 14,241 | 3,714 | 2.69 | |
| **9-7/8" Liner (SLIJ II)** | 13,840 | 18,027 | 15.20 | N | 17,957 | 14,249 | 3,708 | 3.73 | |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - **do NOT delete this line**

**6.2 TRAPPED ANNULUS SCREENING**

| Casing / Liner Strings (show all strings exposed to HC flow) | Enter string type | String or liner lap fully cemented? | Liner lap <= 500 ft? | Setting Depth (ft-MD) | Setting Depth (ft-TVD) | Planned TOC (ft-MD) | Planned TOC (ft-TVD) | Previous Shoe Depth (ft-MD) | Max Angle above previous shoe | Idle < 1 year? | Hydraulic Isolation Depth ft-MD | Hydraulic Isolation Depth ft-TVD | Trapped Annulus? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **14" Casing** | **Casing** | **N** | **N** | 18,851 | 18,850 | 18,814 | 18,813 | 13,982 | 3 | Y | 18,833 | 18,832 | NO |
| **11-3/4" Liner** | **Liner** | **N** | **Y** | 21,900 | 21,899 | 21,211 | 21,210 | 18,851 | 0 | Y | 21,556 | 21,555 | NO |
| **9-7/8" Liner** | **Liner** | **N** | **N** | 23,387 | 23,384 | 22,837 | 22,835 | 21,900 | 0 | Y | 23,112 | 23,110 | NO |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - **do NOT delete this line**

**6.3 COLLAPSE ANALYSIS**

| Component | Collapse rating (psi) | Depth of interest (ft TVD) | Hydraulic Isolation Depth (ft-TVD) | Below HID: Pore Pressure @ Depth (ppg) | Above Hydraulic Isolation Depth: Previous Shoe Depth (ft-TVD) | Above Hydraulic Isolation Depth: Fracture Gradient @ Previous Shoe (ppg) | Above Hydraulic Isolation Depth: Setting Mud Weight (ppg) | Internal Pressure (psi) | Un-trapped Annulus Calcs: External Pressure (psi) | Un-trapped Annulus Calcs: Collapse Load (psi) | Un-trapped Annulus Calcs: Design Factor | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **14" Casing at WH** | 10,651 | 3,709 | 18,832 | 15.5 | 13,981 | 16.6 | 15.6 | 1,614 | 3,736 | 2,122 | 5.01 | |
| **14" Casing at XO (VAM Top)** | 10,651 | 3,909 | 18,832 | 15.5 | 13,981 | 16.6 | 15.6 | 1,660 | 3,898 | 2,238 | 4.75 | |
| **14" Casing at XO (Hyd 523)** | 10,651 | 3,909 | 18,832 | 15.5 | 13,981 | 16.6 | 15.6 | 1,660 | 3,898 | 2,238 | 4.75 | |
| **14" Casing at Hyd (Hyd523) Iso Depth** | 10,651 | 18,832 | 18,832 | 15.5 | 13,981 | 16.6 | 15.6 | 5,092 | 16,004 | 10,911 | 0.97 | The 9-7/8" Liner Top is above the HID of the 14" Casing |
| **14" Casing at shoe (Hyd513)** | 10,651 | 18,850 | 18,832 | 15.5 | 13,981 | 16.6 | 15.6 | 5,096 | 15,193 | 10,097 | 1.05 | |
| **11-3/4" Liner Hanger** | 5,900 | 18,516 | 21,555 | 15.5 | 18,850 | 16.2 | 15.6 | 5,019 | 15,608 | 10,589 | 0.55 | FG Based upon Actual FIT |
| **11-3/4" Liner at X/O (Hyd523)** | 5,740 | 19,600 | 21,555 | 15.5 | 18,850 | 16.2 | 15.6 | 5,269 | 16,488 | 11,219 | 0.51 | Pp based on openhole pore pressure where influx occurred at 18,909' TVD of 15.5 ppg KWM. |
| **11-3/4" Liner at X/O (SLIJ II)** | 5,740 | 21,187 | 21,555 | 15.5 | 18,850 | 16.2 | 15.6 | 5,634 | 17,775 | 12,141 | 0.47 | |
| **11-3/4" Liner at HID (Hyd523)** | 5,740 | 21,556 | 21,555 | 14.1 | 18,850 | 16.2 | 15.6 | 5,719 | 15,805 | 10,086 | 0.56 | |
| **11-3/4" Casing at shoe (Hyd523) - NO APB** | 5,740 | 21,899 | 21,555 | 14.1 | 18,850 | 16.2 | 15.6 | 5,797 | 16,056 | 10,259 | 0.55 | |
| **9-7/8" Liner Hanger** | 5,630 | 18,016 | 23,110 | 14.5 | 21,899 | 17.6 | 15.2 | 4,904 | 16,973 | 12,068 | 0.46 | Liner hanger limited by 9-5/8" 47 ppf Vam Top connection |
| **9-7/8" Liner at HID (SLIJ II)** | 11,640 | 23,109 | 23,110 | 14.5 | 21,899 | 17.6 | 15.2 | 6,076 | 20,998 | 14,923 | 0.78 | |
| **9-7/8" Casing at shoe (SLIJ II)** | 11,640 | 23,384 | 23,110 | 14.5 | 21,899 | 17.6 | 15.2 | 6,139 | 17,632 | 11,492 | 1.01 | |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - **do NOT delete this line**

## LEVEL 2 - Well Containment Analysis Tool

Rev 1.18

**1) General Well Information**

| | |
|---|---|
| Well Name: | OCSG 22968 Kakuna #1 ST00 BP01 |
| Lease/Block: | GC504 |
| Water Depth (ft): | 3637 |
| RKB to Mudline Depth (ft): | 3723 |
| Location (lat/long): | X 2,312,025, Y 9,977,480 |
| Planned TD (ft): | 29,084 ft-TVD/ 30,144 ft-MD |
| Planned Spud Date: | June 24, 2011 |

**2) Offset Well Information**

| Well | Distance/Direction |
|---|---|
| 1) Tahiti | 12.0 miles SE |
| 2) Knotty Head | 22.0 miles E |
| 3) Caesar | 16.0 miles SSE |
| 4) Tonga | 18.0 miles SSE |
| 5) Chilkoot | 26.3 miles NW |
| 6) Ouachita | 13.7 miles NE |

**3) Well Design**

| | |
|---|---|
| Wellhead Description | Dril-Quip SS-15 BigBore II 15K |
| Capping Stack Description | Helix / Trendsetter Eng. 15K Capping Stack |

User entry

Calculation cell. Do not input data

**Casing Plan**

| Size/Weight/Grade/Connection | Top (ft-TVD) | Bottom (ft-TVD) |
|---|---|---|
| 36", 552#, X56, D60MT | 3,712 | 4,039 |
| 22", 224#, X80, XLW GP95 | 3,709 | 5,982 |
| 18", 117#, P110, Hyd511 | 3,791 | 9,278 |
| 16", 97#, HC-Q125, Hyd511 | 7,955 | 13,981 |
| 14", 112.6#, HC-Q125, VAM Top | 3,709 | 3,909 |
| 14", 112.6#, HC-Q125, Hydril 523 | 3,909 | 18,604 |
| 14", 112.6#, HC-Q125, Hydril 513 | 18,604 | 18,850 |
| 11-3/4", 65#, HC-Q125, Hydril 523 | 18,516 | 19,600 |
| 11-3/4", 65#, HC-Q125, VAM SLIJ II | 19,600 | 21,187 |
| 11-3/4", 65#, HC-Q125, Hydril 523 | 21,187 | 21,899 |
| 9-7/8", 62.8#, HC-Q125, VAM SLIJ II | 18,016 | 23,384 |

### Level 2 results

| | |
|---|---|
| 5. Formation integrity below deepest exposed shoe | PASS |
| 6.1 Burst Integrity - Primary strings | PASS |
| 6.3 Collapse Integrity - Primary strings | L2 FORMATION INTEGRITY AND/OR SECONDARY STRING VERIFICATION REQUIRED |
| 7. Secondary string verification | L2 FORMATION INTEGRITY VERIFICATION REQUIRED |
| 8. Formation strength verification for failed strings | PASS |

**4) Productive Formation Information**

HOLE SECTION: 8.5" x 9.875"  SHOE DEPTH(FT-TVD): 23,384

| Name | Depth (ft-TVD) | Reservoir Fluid | Reservoir Pressure or Bottom hole Flowing Pressure (ppg) | Reservoir Pressure or Bottom hole Flowing Pressure (psi) | Assumed fluid gradient for calc (psi/ft) | Mud Line Shut in Pressure (psi) | Shut in ppg @ shoe | Comments |
|---|---|---|---|---|---|---|---|---|
| Reservoir 1 - Shutin (choked) condition | 25,350 | Oil | 14.9 | 19,641 | 0.29 | 13,369 | 15.68 | |
| Reservoir 2 - Shutin (choked) condition | | | | - | | - | - | |
| Reservoir 3 - Shutin (choked) condition | | | | - | | - | - | |
| Reservoir 4 - Shutin (choked) condition | | | | - | | - | - | |
| Reservoir 5 - Shutin (choked) condition | | | | - | | - | - | |
| Reservoir 6 - Shutin (choked) condition | | | | - | | - | - | |
| Reservoir 7 - Shutin (choked) condition | | | | - | | - | - | |
| Lowest UNRESTRICTED FLOWING gradient (any combination of reservoirs) | | | | | 0.29 | | | |

**5) Formation Integrity Analysis**

| Zone of interest | Depth | Frac gradient at depth (ppg) | Max pressure (ppge) | Is shut-in ppg < FG at depth? | Comments |
|---|---|---|---|---|---|
| Deepest exposed shoe | 23,384 | 16.00 | 15.68 | YES | |
| | | | - | N/A | |
| | | | - | N/A | |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - do NOT delete this line

**6) MECHANICAL INTEGRITY ANALYSIS**

**6.1 BURST ANALYSIS**

| Component | Burst Rating (psi) | Depth to Top of Component (ft) | Setting MW, PP or SW (ppg) | Exposed to SW? (above top hanger) | Internal Shut-in Pressure (psi) | External pressure (psi) | Burst Load (psi) | Design Factor | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Capping BOP stack | 15,000 | 3,709 | 8.55 | Y | 13,365 | 1,611 | 11,755 | 1.27 | |
| LMRP connector | 15,000 | 3,709 | 8.55 | Y | 13,365 | 1,611 | 11,755 | 1.27 | Annular, BOP mandrel & HC connector shell tested to 1.5 times (~ 15K). FAT attached; |
| Drilling BOP stack | 15,000 | 3,709 | 8.55 | Y | 13,365 | 1,611 | 11,755 | 1.27 | |
| Subsea Wellhead | 15,000 | 3,709 | 8.55 | Y | 13,365 | 1,611 | 11,755 | 1.27 | |
| 14" Casing Hanger / Seal Assembly | 13,200 | 3,709 | 15.60 | N | 13,365 | 3,009 | 10,357 | 1.27 | |
| 14" Casing (VAM Top) | 12,450 | 3,709 | 15.60 | N | 13,365 | 3,009 | 10,357 | 1.20 | Burst calculation for this hole section for 14" uses standard spec sheet |
| 14" Casing (Hyd 523) | 12,450 | 3,909 | 15.60 | N | 13,423 | 3,171 | 10,252 | 1.21 | capacity not required to be used as burst load in this hole section does not exceed specification sheet. |
| 14" Casing (Hyd 513) (Actual Cement Top) | 12,450 | 18,814 | 15.60 | N | 17,746 | 15,262 | 2,484 | 5.01 | |
| 11-3/4" Liner Hanger | 7,000 | 18,517 | 15.60 | N | 17,660 | 15,021 | 2,639 | 2.65 | |
| 11-3/4" Liner (Hyd523) | 9,940 | 18,527 | 15.60 | N | 17,663 | 15,029 | 2,633 | 3.77 | |
| 11-3/4" Liner (SLIJ II) | 9,940 | 19,601 | 15.60 | N | 17,974 | 15,900 | 2,074 | 4.79 | |
| 11-3/4" Liner (Hyd523) | 9,940 | 21,188 | 15.60 | N | 18,434 | 17,188 | 1,246 | 7.97 | |
| 9-7/8" Liner Hanger | 10,000 | 18,017 | 15.20 | N | 17,515 | 14,241 | 3,274 | 3.05 | Weatherford 9-7/8" x 14" liner hanger used with new design. |
| 9-7/8" Liner (SLIJ II) | 13,840 | 18,027 | 15.20 | N | 17,518 | 14,249 | 3,269 | 4.23 | |

Annular FAT

<<Insert additional rows as necessary for other zones of interest and copy down formulas - do NOT delete this line

**6.2 TRAPPED ANNULUS SCREENING**

| Casing / Liner Strings (Show all strings exposed to HC flow) | Enter string type | String or liner lap fully cemented? | Liner lap <= 500 ft? | Setting Depth (ft-MD) | Planned TOC (ft-MD) | Previous Shoe Depth (ft-MD) | Max Angle above previous shoe | Idle < 1 year? | Trapped Annulus? | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 14" Casing | Casing | N | N | 18,851 | 18,814 | 13,982 | 3 | Y | NO | |
| 11-3/4" Liner | Liner | N | Y | 21,900 | 21,211 | 18,851 | 0 | Y | NO | |
| 9-7/8" Liner | Liner | Y | N | 23,387 | 22,837 | 21,900 | 0 | Y | NO - Cement model reqd | Plan 550' primary cement plus squeeze into liner top to isola the 11-3/4" liner from the shut-in pressure. |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - do NOT delete this line

**6.3 COLLAPSE ANALYSIS**

APB calculator for Untrapped Annulus

| String | OH Weak pt (ft TVD) | Setting MW (ppg) | FG at weak pt (ppg) | Calculated APB (psi) | Level 2 Alternative APB (psi) | Comments / justification of alternative APB used |
|---|---|---|---|---|---|---|
| 14" Casing | 13,981 | 15.6 | 16.6 | 727 | N/A | APB Limited by FG @ 16" |
| 11-3/4" Liner | 18,850 | 15.6 | 16.2 | 588 | N/A | APB Limited by FG @ 14" |
| 9-7/8" Liner | 21,899 | 15.2 | 15.9 | 797 | N/A | APB Limited by FG @ Base of Salt |

Standard APB calc for Untrapped Annulus assumes APB is limited by FG at the previous shoe or a weak point

<<Insert additional rows as necessary for other zones of interest and copy down formulas - do NOT delete this line

| Collapse Ananlysis Component description | Collapse rating (psi) | Depth of interest (ft TVD) | Hydraulic Isolation Depth (ft-TVD) | Annulus Pressure Buildup (psi) | Setting MW, or PP (ppg) | Internal Pressure (psi) | External Pressure (psi) | Collapse Load (psi) | Design Factor | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| 14" Casing at WH | 9,430 | 3,709 | 18,832 | 727 | 15.6 | 1,613 | 3,736 | 2,123 | 4.44 | |
| 14" Casing at XO (VAM Top) | 9,430 | 3,909 | 18,832 | 727 | 15.6 | 1,671 | 3,898 | 2,227 | 4.23 | |
| 14" Casing at XO (Hyd 523) | 10,651 | 3,909 | 18,832 | 727 | 15.6 | 1,671 | 3,898 | 2,227 | 4.78 | |
| 14" Casing at Hyd (Hyd523) @ 9-7/8" Liner Top | 10,651 | 18,016 | 18,832 | 727 | 15.6 | 5,762 | 15,342 | 9,580 | 1.11 | Collapse rating for Hydril casing updated to reflect the MTRs for Nexen's inventory pipe. The minimum collapse pressure from any batch of pipe was 10,651 psi. The tool was not failing, but this gave a more robust design factor. |
| 14" Casing at shoe (Hyd513) - NO APB | 10,651 | 18,850 | 18,832 | 0 | 15.5 | 6,004 | 15,193 | 9,189 | 1.15 | Pore pressure used to calculate external pressure. Pore pressure based of drilled inlux (15.5 ppg calculated) at 18,910' MD. Believed to be isolated zone, as drilling progressed with 14.9 ppg MWt up to that point. |
| 11-3/4" Liner Hanger | 5,900 | 18,516 | 21,555 | 588 | 15.6 | 5,907 | 15,608 | 9,701 | 0.60 | 11-3/4" liner is shown because it acts to protect the 14" casing shoe from a |
| 11-3/4" Liner at X/O (Hyd523) | 5,740 | 19,600 | 21,555 | 588 | 15.6 | 6,221 | 16,488 | 10,266 | 0.55 | burst load exceeding 16.2 ppg EMW. Cement squeeze on 9-7/8' liner top |
| 11-3/4" Liner at X/O (SLIJ II) | 5,740 | 21,188 | 21,555 | 588 | 15.6 | 6,682 | 17,776 | 11,094 | 0.51 | means 11-3/4" liner does not see collapse load. |
| 11-3/4" Liner at HID (Hyd523) | 5,740 | 21,555 | 21,555 | 588 | 15.6 | 6,788 | 18,073 | 11,285 | 0.50 | HID at 21,555 TVD most likely depth of collapse. Justification for no hydrocarbons to seafloor attached: (Previously Approved) |
| 11-3/4" Casing at shoe (Hyd523) - NO APB | 5,740 | 21,899 | 21,555 | 0 | 14.1 | 6,888 | 16,056 | 9,168 | 0.62 | Pore pressure used to calculate external pressure. |
| 9-7/8" Liner Hanger (No APB - See Comment) | 5,630 | 18,016 | 23,110 | 0 | 15.2 | 5,762 | 14,240 | 8,478 | 0.66 | No 9-7/8" liner hanger APB or collapse due to planned liner top cement |
| 9-7/8" Liner at HID (SLIJ II) | 13,040 | 23,110 | 23,110 | 797 | 15.2 | 7,239 | 19,063 | 11,824 | 1.10 | HID at 23,110 TVD most likely collapse depth. APB tied to BOS frac grad. See Fault Connectivity justification for no Hyd to seafloor. Collapse rating based on MTRs. |
| 9-7/8" Casing at shoe (SLIJ II) - NO APB | 13,040 | 23,384 | 23,110 | 0 | 14.5 | 7,319 | 17,632 | 10,313 | 1.26 | Pore pressure used to calculate external pressure. |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - do NOT delete this line

Fault Connectivity

**7) SECONDARY STRING VERIFICATION** =======> Check box if no secondary strings exposed: ☐

**7.1 COLLAPSE VERIFICATION**

| Secondary String | Collapse rating Secondary String (psi) | Depth of interest (ft TVD) | Primary string failure depth (ft TVD) | Internal Flowing Pressure at failure pt (psi) | MW failed string was set in (ppge) | Secondary string Internal pressure (psi) | Secondary string APB (psi) | Secondary string setting MW, or PP (ppg) | Secondary string External pressure (psi) | Collapse load (psi) | Collapse DF | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14" | 10,651 | 18,016 | 23,110 | 7,239 | 15.2 | 3,213 | 727 | 15.6 | 15,342 | 12,129 | 0.87 | Cannot utilize this calculation where the liner top is squeezed. This protects the 14" and 11-3/4" from collapse load up to 9-7/8" liner hanger depth. |
| | | | | - | | - | | | - | - | | Pressure seen on shut-in will be controlled by BOS Leak off. The 11-3/4" casing shoe integrity will contain shut-in pressure, with 1707 psi safety margin. |
| | | | | - | | - | | | - | - | | 11-3/4" liner not analysed as it will be isolated by cementation between 9-7/8" liner and 11-3/4" down to shoe. |

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| Secondary String (to be verified) | Failed string(s) | Primary string failure depth (ft TVD) | Hanger depth of failed string(ft TVD) | MW failed string was set in (ppge) | Internal Flowing Pressure at failure pt (psi) | Fluid drop (ft TVD) | Hydrocarbon gradient (psi/ft) | Average fluid density in annulus (ppg) | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 14" | 9-7/8" | 23,110 | 18,016 | 15.2 | - 7,239 - | 0 | 0.29 | 15.2 | 9-7/8" liner top squeeze cemented. Isolation assumed. Note: 11-3/4" string isolated by 9-7/8" liner top squeeze. |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - do NOT delete this line

**7.2 BURST VERIFICATION WITHOUT UNDERGROUND FLOW**

| Secondary String | Burst rating (psi) | Depth of interest (ft TVD) | Primary string failure depth (ft TVD) | Average fluid density in annulus (ppge) | Internal Shut-in Pressure at Primary string failure pt (psi) | Secondary String Internal pressure (psi) | Exposed to SW? (above top hanger) | MW / PP (ppg) | Secondary string External pressure (psi) | Burst load (psi) | Burst DF | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14" | 12,450 | 18,016 | 23,110 | 15.2 | - 18,992 - | - 14,965 - | N | 15.6 | - 14,615 - | - 351 - | 35.50 | Calculation done. This conservatively assumes 14" sees Pb. But 9-7/8" liner top is squeezed. Isolates 14" casing. Actual burst load calculated is 2594 psi = 4.80 DFb |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - do NOT delete this line

**8) LEVEL 2 FORMATION INTEGRITY ANALYSIS** Check box if no formation exposed behind failed strings: ☐

| Description of depth where formation integrity is checked & Description of Strings that failed | Primary string Failure depth (ft TVD) | Depth of Previous shoe or weak point (ft TVD) | FG at previous shoe or weak point (ppg) | Average fluid density in annulus (ppge) | Internal Shut-in Pressure at Primary string failure pt (psi) | Annulus pressure at previous shoe or weak pt (psi) | Frac margin (psi) | Comments |
|---|---|---|---|---|---|---|---|---|
| 14" Shoe (Protected by 11-3/4" / 9-7/8" liner design) | 23,110 | 21,899 | 15.9 | 15.2 | - 18,992 - | - 18,034 - | 72 | The weak point is shown as the base of salt. Note that the anticipated fracture gradient of the salt at the 11-3/4" liner shoe is 17.6 ppg. When applied to this calculation the fracture margin goes up to 2001 psi and would be contained by 11-3/4" shoe. |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - do NOT delete this line

# Level 1 - Well Containment Screening Tool

## LEVEL 1 - Well Containment Screening Tool (Complete a separate form for each hole section that has potential hydrocarbon flow zones)

Rev 1.18

**1) General Well Information**

| | |
|---|---|
| **Well Name:** | OCSG 22968 Kakuna #1 ST00 BP01 |
| **Lease/Block:** | GC504 |
| **Water Depth (ft):** | 3,637 |
| **RKB to Mudline Depth (ft):** | 3,723 |
| **Location (lat/long):** | X 2,312,025, Y 9,977,480 |
| **Planned TD (ft):** | 29,084 ft-TVD/ 30,144 ft-MD |
| **Planned Spud Date:** | June 24, 2011 |

**2) Offset Well Information**

| | Well | Distance/Direction |
|---|---|---|
| 1) | **Tahiti** | 12.0 miles SE |
| 2) | **Knotty Head** | 22.0 miles E |
| 3) | **Caesar** | 16.0 miles SSE |
| 4) | **Tonga** | 18.0 miles SSE |
| 5) | **Chilkoot** | 26.3 miles NW |
| 6) | **Ouachita** | 13.7 miles NE |

**3) Well Design**

| | |
|---|---|
| **Wellhead Description** | Dril-Quip SS-15 BigBore II 15K |
| **Capping Stack Description** | Helix / Trendsetter Eng. 15K Capping Stack |

**Casing Plan**

| Size/Weight/Grade/Connection | Top (ft-TVD) | Bottom (ft-TVD) |
|---|---|---|
| 36", 552#, X56, D60MT | 3,712 | 4,039 |
| 22", 224#, X80, XLW GP95 | 3,709 | 5,982 |
| 18", 117#, P110, Hyd511 | 3,791 | 9,278 |
| 16", 97#, HC-Q125, Hyd511 | 7,955 | 13,981 |
| 14", 112.6#, HC-Q125, VAM Top | 3,709 | 3,909 |
| 14", 112.6#, HC-Q125, Hydril 523 | 3,909 | 18,604 |
| 14", 112.6#, HC-Q125, Hydril 513 | 18,604 | 18,850 |
| 11-3/4", 65#, HC-Q125, Hydril 523 | 18,516 | 19,600 |
| 11-3/4", 65#, HC-Q125, VAM SLIJ II | 19,600 | 21,187 |
| 11-3/4", 65#, HC-Q125, Hydril 523 | 21,187 | 21,899 |
| 9-7/8", 62.8#, HC-Q125, VAM SLIJ II | 18,016 | 23,384 |
| 7-5/8", 39#, HC-Q125, VAM SLIJ II | 22,885 | 26,538 |
| 7-5/8", 39#, HC-Q125, Hyd 513 | 26,538 | 27,000 |

**Screening tool results**

| | |
|---|---|
| 5) Formation integrity below deepest exposed shoe | PASS |
| 6A) Burst Integrity | LEVEL 2 REQUIRED |
| 6B) Trapped annuli check | PASS |
| 6C) Collapse Integrity | LEVEL 2 REQUIRED |

User entry

Calculation cell. Do not input data

**4) Productive Formation Information**

**HOLE SECTION:** 6.5 **SHOE DEPTH(FT-TVD):** 27,000

| Name | Depth (ft-TVD) | Reservoir Fluid | Reservoir Pressure (ppg) | Reservoir Pressure (psi) | Assumed fluid gradient for calc (psi/ft) | Mud Line Shut in Pressure (psi) | Shut in ppg @ shoe | Comments |
|---|---|---|---|---|---|---|---|---|
| Lower Miocene | 28,150 | Oil | 15.5 | 22,689 | 0.23 | 17,071 | 15.97 | |
| Reservoir 2 | | | | - | | - | - | |
| Reservoir 3 | | | | - | | - | - | |
| Reservoir 4 | | | | - | | - | - | |
| Reservoir 5 | | | | - | | - | - | |
| Reservoir 6 | | | | - | | - | - | |
| Reservoir 7 | | | | - | | - | - | |

**Use standard gradients for Level 1:**

**Gas = 0.10 psi/ft to 9,000' TVD and 0.15 psi/ft below 11,000' TVD.**

**Oil/Water/Gas = 0.23 psi/ft**

**5) Formation Integrity Analysis**

| Zone of interest | Depth | Frac gradient at depth (ppg) | Max pressure (ppge) | Is shut-in ppge < FG at depth? | Comments |
|---|---|---|---|---|---|
| **Deepest exposed shoe** | 27,000 | 16.80 | 15.97 | YES | |
| | | | - | N/A | |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - **do NOT delete this line**

**6) MECHANICAL INTEGRITY ANALYSIS**

**6.1 BURST ANALYSIS**

| Component | Burst Rating (psi) | Depth to Top of Component (ft) | Setting MW, PP or SW (ppg) | Exposed to SW? (above top hanger) | Internal Shut-in Pressure (psi) | External pressure (psi) | Burst Load (psi) | Design Factor | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Capping BOP stack** | 15,000 | 3,709 | 8.55 | Y | 17,067 | 1,611 | 15,457 | 0.97 | |
| **LMRP connector** | 15,000 | 3,709 | 8.55 | Y | 17,067 | 1,611 | 15,457 | 0.97 | Annular, BOP mandrel & HC connector shell tested to 1.5 times (~ 15K). |
| **Drilling BOP stack** | 15,000 | 3,709 | 8.55 | Y | 17,067 | 1,611 | 15,457 | 0.97 | |
| **Subsea Wellhead** | 15,000 | 3,709 | 8.55 | Y | 17,067 | 1,611 | 15,457 | 0.97 | |
| **14" Casing Hanger / Seal Assembly** | 13,200 | 3,709 | 15.60 | N | 17,067 | 3,009 | 14,059 | 0.93 | 13,200 Rating From DQ |
| **14" Casing (VAM Top)** | 12,450 | 3,709 | 15.60 | N | 17,067 | 3,009 | 14,059 | 0.88 | Please note that the changes are as follows regarding the liner plan: |
| **14" Casing (Hyd 523)** | 12,450 | 3,909 | 15.60 | N | 17,113 | 3,171 | 13,942 | 0.89 | 1 - Due to lower than expected FIT of 16.2 ppg EMW at 14" casing shoe |
| **14" Casing (Hyd 513) (Actual Cement Top)** | 12,450 | 18,814 | 15.60 | N | 20,542 | 15,262 | 5,280 | 2.35 | due to a weak zone at +/- 18,909' TVD RKB, the 9-7/8" liner top brought |
| **11-3/4" Liner Hanger** | 7,000 | 18,517 | 15.60 | N | 20,473 | 15,021 | 5,452 | 1.28 | above 11-3/4" to protect same from collapse load. This in turn protects 14" |
| **11-3/4" Liner (Hyd523)** | 9,940 | 18,527 | 15.60 | N | 20,476 | 15,029 | 5,447 | 1.82 | shoe from burst load upon shut-in of well. |
| **11-3/4" Liner (SLIJ II)** | 9,940 | 19,601 | 15.60 | N | 20,723 | 15,900 | 4,822 | 2.06 | 2 - 7-5/8" liner added to enable drilling to planned well TD. The 7-5/8" is |
| **11-3/4" Liner (Hyd523)** | 9,940 | 21,187 | 15.60 | N | 21,087 | 17,187 | 3,901 | 2.54 | being placed where the 9-7/8" liner had been previously. This will ensure |
| **9-7/8" Liner Hanger** | 10,000 | 18,017 | 15.20 | N | 20,358 | 14,241 | 6,118 | 1.63 | robust casing design if uncontrolled well control incident. |
| **9-7/8" Liner (SLIJ II)** | 13,840 | 18,027 | 15.20 | N | 20,361 | 14,249 | 6,112 | 2.26 | Thus, 11-3/4" liner will not see either the collapse load or burst load from |
| **7-5/8" Liner Hanger** | 7,500 | 22,887 | 15.40 | N | 21,478 | 18,328 | 3,151 | 2.38 | an incident due to cement squeeze of 9-7/8" liner top annulus. |
| **7-5/8" Liner (SLIJ II)** | 14,340 | 22,897 | 15.40 | N | 21,481 | 18,336 | 3,145 | 4.55 | Changed burst rating of liner hanger - using different vendor due to |
| **7-5/8" Liner (Hyd 513)** | 12,620 | 26,990 | 15.30 | N | 22,422 | 21,473 | 949 | 13.30 | requirement for dual wiper plug system. |
| | | | | | | | | | Changed connection from Hydril 523 to combination of Vam SLIJ II and Hydril 513 (shoe track) due to equipment availability. |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - **do NOT delete this line**

**6.2 TRAPPED ANNULUS SCREENING**

| Casing / Liner Strings (show all strings exposed to HC flow) | Enter string type | String or liner lap fully cemented? | Liner lap <= 500 ft? | Setting Depth (ft-MD) | Setting Depth (ft-TVD) | Planned TOC (ft-MD) | Planned TOC (ft-TVD) | Previous Shoe Depth (ft-MD) | Max Angle above previous shoe | Idle < 1 year? | Hydraulic Isolation Depth ft-MD | Hydraulic Isolation Depth ft-TVD | Trapped Annulus? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **14" Casing** | **Casing** | **N** | **N** | 18,851 | 18,850 | 18,814 | 18,813 | 13,982 | 3 | Y | 18,833 | 18,832 | NO |
| **11-3/4" Liner** | **Liner** | **N** | **Y** | 21,900 | 21,899 | 21,211 | 21,210 | 18,851 | 0 | Y | 21,556 | 21,555 | NO |
| **9-7/8" Liner** | **Liner** | **Y** | **N** | 23,387 | 23,384 | 22,837 | 22,835 | 21,900 | 0 | Y | 23,112 | 23,110 | NO - Cement model reqd |
| **7-5/8" Liner** | **Liner** | **N** | **Y** | 27,543 | 27,000 | 26,043 | 25,746 | 23,387 | 0 | Y | 26,793 | 26,373 | NO |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - **do NOT delete this line**

**6.3 COLLAPSE ANALYSIS**

| Component | Collapse rating (psi) | Depth of interest (ft TVD) | Hydraulic Isolation Depth (ft-TVD) | Below HID: Pore Pressure @ Depth (ppg) | Above Hydraulic Isolation Depth: Previous Shoe Depth (ft-TVD) | Above Hydraulic Isolation Depth: Fracture Gradient @ Previous Shoe (ppg) | Above Hydraulic Isolation Depth: Setting Mud Weight (ppg) | Internal Pressure (psi) | Un-trapped Annulus Calcs: External Pressure (psi) | Un-trapped Annulus Calcs: Collapse Load (psi) | Un-trapped Annulus Calcs: Design Factor | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **14" Casing at WH** | 10,651 | 3,709 | 18,832 | 15.5 | 13,981 | 16.6 | 15.6 | 1,614 | 3,736 | 2,122 | 5.01 | |
| **14" Casing at XO (VAM Top)** | 10,651 | 3,909 | 18,832 | 15.5 | 13,981 | 16.6 | 15.6 | 1,660 | 3,898 | 2,238 | 4.75 | |
| **14" Casing at XO (Hyd 523)** | 10,651 | 3,909 | 18,832 | 15.5 | 13,981 | 16.6 | 15.6 | 1,660 | 3,898 | 2,238 | 4.75 | |
| **14" Casing at Hyd (Hyd523) Iso Depth** | 10,651 | 18,832 | 18,832 | 15.5 | 13,981 | 16.6 | 15.6 | 5,092 | 16,004 | 10,911 | 0.97 | |
| **14" Casing at shoe (Hyd513) - NO APB** | 10,651 | 18,850 | 18,832 | 15.5 | 13,981 | 16.6 | 15.6 | 5,096 | 15,193 | 10,097 | 1.05 | |
| **11-3/4" Liner Hanger** | 5,900 | 18,516 | 21,555 | 15.5 | 18,850 | 16.2 | 15.6 | 5,019 | 15,608 | 10,589 | 0.55 | Note: 11-3/4" not exposed to collapse load due to cementation of the 9-7/8" x 11-3/4" liner annulus via planned top squeeze operation. |
| **11-3/4" Liner at X/O (Hyd523)** | 5,740 | 19,600 | 21,555 | 15.5 | 18,850 | 16.2 | 15.6 | 5,269 | 16,488 | 11,219 | 0.51 | |
| **11-3/4" Liner at X/O (SLIJ II)** | 5,740 | 21,187 | 21,555 | 15.5 | 18,850 | 16.2 | 15.6 | 5,634 | 17,775 | 12,141 | 0.47 | |
| **11-3/4" Liner at HID (Hyd523)** | 5,740 | 21,555 | 21,555 | 14.1 | 18,850 | 16.2 | 15.6 | 5,718 | 18,074 | 12,355 | 0.46 | |
| **11-3/4" Casing at shoe (Hyd523) - NO APB** | 5,740 | 21,899 | 21,555 | 14.1 | 18,850 | 16.2 | 15.6 | 5,797 | 16,056 | 10,259 | 0.55 | |
| **9-7/8" Liner Hanger (No APB - See Comment)** | 5,630 | 18,016 | 23,110 | 14.5 | 21,899 | 17.6 | 15.2 | 4,904 | 16,973 | 12,068 | 0.46 | Changed collapse rating of 7-5/8" |
| **9-7/8" Liner at HID (SLIJ II)** | 11,640 | 23,110 | 23,110 | 14.5 | 21,899 | 17.6 | 15.2 | 6,076 | 20,999 | 14,923 | 0.77 | liner hanger - using different vendor |
| **9-7/8" Casing at shoe (SLIJ II) - NO APB** | 11,640 | 23,384 | 23,110 | 14.5 | 21,899 | 17.6 | 15.2 | 6,139 | 17,632 | 11,492 | 1.01 | due to requirement for dual wiper |
| **7-5/8" Liner Hanger** | 7,500 | 22,885 | 26,373 | 14.5 | 23,384 | 16.0 | 15.4 | 6,024 | 19,056 | 13,032 | 0.57 | plug system. Changed 7-5/8" |
| **7-5/8" Liner at HID (SLIJ II)** | 12,810 | 26,373 | 26,373 | 15.2 | 23,384 | 16.0 | 15.4 | 6,827 | 21,849 | 15,023 | 0.85 | connection from Hydril 523 to |
| **7-5/8" Liner at shoe (Hyd 513)** | 11,080 | 27,000 | 26,373 | 15.3 | 23,384 | 16.0 | 15.4 | 6,971 | 21,481 | 14,510 | 0.76 | combination of Vam SLIJ II and Hydril 513 (shoe track) due to equipment availability. |

<<Insert additional rows as necessary for other zones of interest and copy down formulas - **do NOT delete this line**

## LEVEL 2 - Well Containment Analysis Tool

Rev 1.18

**1) General Well Information**

| | |
|---|---|
| Well Name: | OCSG 22968 Kakuna #1 ST00 BP01 |
| Lease/Block: | GC504 |
| Water Depth (ft): | 3637 |
| RKB to Mudline Depth (ft): | 3723 |
| Location (lat/long): | X 2,312,025, Y 9,977,480 |
| Planned TD (ft): | 29,084 ft-TVD/ 30,144 ft-MD |
| Planned Spud Date: | June 24, 2011 |

**2) Offset Well Information**

| Well | Distance/Direction | |
|---|---|---|
| 1) Tahiti | 12.0 miles | SE |
| 2) Knotty Head | 22.0 miles | E |
| 3) Caesar | 16.0 miles | SSE |
| 4) Tonga | 18.0 miles | SSE |
| 5) Chilkoot | 26.3 miles | NW |
| 6) Ouachita | 13.7 miles | NE |

**3) Well Design**

| | |
|---|---|
| Wellhead Description | Dril-Quip SS-15 BigBore II 15K |
| Capping Stack Description | Helix / Trendsetter Eng. 15K Capping Stack |

User entry

Calculation cell. Do not input data

**Casing Plan**

| Size/Weight/Grade/Connection | Top (ft-TVD) | Bottom (ft-TVD) |
|---|---|---|
| 36", 552#, X56, D60MT | 3,712 | 4,039 |
| 22", 224#, X80, XLW GP95 | 3,709 | 5,982 |
| 18", 117#, P110, Hyd511 | 3,791 | 9,278 |
| 16", 97#, HC-Q125, Hyd511 | 7,955 | 13,981 |
| 14", 112.6#, HC-Q125, VAM Top | 3,709 | 3,909 |
| 14", 112.6#, HC-Q125, Hydril 523 | 3,909 | 18,604 |
| 14", 112.6#, HC-Q125, Hydril 513 | 18,604 | 18,850 |
| 11-3/4", 65#, HC-Q125, Hydril 523 | 18,516 | 19,600 |
| 11-3/4", 65#, HC-Q125, VAM SLIJ II | 19,600 | 21,187 |
| 11-3/4", 65#, HC-Q125, Hydril 523 | 21,187 | 21,899 |
| 9-7/8", 62.8#, HC-Q125, VAM SLIJ II | 18,016 | 23,384 |
| 7-5/8", 39#, HC-Q125, VAM SLIJ II | 22,885 | 26,538 |
| 7-5/8", 39#, HC-Q125, Hyd 513 | 26,538 | 27,000 |

**Level 2 results**

| | |
|---|---|
| 5. Formation integrity below deepest exposed shoe | PASS |
| 6.1 Burst Integrity - Primary strings | PASS |
| 6.3 Collapse Integrity - Primary strings | L2 FORMATION INTEGRITY AND/OR SECONDARY STRING VERIFICATION REQUIRED |
| 7. Secondary string verification | L2 FORMATION INTEGRITY VERIFICATION REQUIRED |
| 8. Formation strength verification for failed strings | CONSEQUENCE ANALYSIS REQUIRED |

**4) Productive Formation Information**

HOLE SECTION: 6.5 SHOE DEPTH(FT-TVD): 27,000

| Name | Depth (ft-TVD) | Reservoir Fluid | Reservoir Pressure or Bottom hole Flowing Pressure (ppg) | Reservoir Pressure or Bottom hole Flowing Pressure (psi) | Assumed fluid gradient for calc (psi/ft) | Mud Line Shut in Pressure (psi) | Shut in ppg @ shoe | Comments |
|---|---|---|---|---|---|---|---|---|
| Reservoir 1 - Shutin (choked) condition | 28,150 | Oil | 15.5 | 22,689 | 0.29 | 15,605 | 15.92 | Justification for Nexen's recommended gradient as attached; |
| Reservoir 2 - Shutin (choked) condition | | | | - | | - | - | |
| Reservoir 3 - Shutin (choked) condition | | | | - | | - | - | WCD& Fluid Gradient Rev052511 |
| Reservoir 4 - Shutin (choked) condition | | | | - | | - | - | |
| Reservoir 5 - Shutin (choked) condition | | | | - | | - | - | |
| Reservoir 6 - Shutin (choked) condition | | | | - | | - | - | A 0.29 psi/ft gradient is identified as the min gradient required for the Kakuna design to pass Level 2. |
| Reservoir 7 - Shutin (choked) condition | | | | - | | - | - | The PDF document attached is Nexen's anticipated gradient for Middle & Lower Miocene at Kakuna. |
| Lowest UNRESTRICTED FLOWING gradient (any combination of reservoirs) | | | | | 0.29 | | | |

**5) Formation Integrity Analysis**

| Zone of interest | Depth | Frac gradient at depth (ppg) | Max pressure (ppge) | Is shut-in ppg < FG at depth? | Comments |
|---|---|---|---|---|---|
| Deepest exposed shoe | 27,000 | 16.80 | 15.92 | YES | |
| | | | - | N/A | |
| | | | - | N/A | |

<<Insert additional rows as necessary for other zones of interest and copy down formulas **do NOT delete this line**

**6) MECHANICAL INTEGRITY ANALYSIS**

**6.1 BURST ANALYSIS**

| Component | Burst Rating (psi) | Depth to Top of Component (ft) | Setting MW, PP or SW (ppg) | Exposed to SW? (above top hanger) | Internal Shut-in Pressure (psi) | External pressure (psi) | Burst Load (psi) | Design Factor | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Capping BOP stack | 15,000 | 3,709 | 8.55 | Y | 15,601 | 1,611 | 13,990 | 1.07 | |
| LMRP connector | 15,000 | 3,709 | 8.55 | Y | 15,601 | 1,611 | 13,990 | 1.07 | Annular, BOP mandrel & HC connector shell tested to 1.5 times (~ 15K). FAT attached; |
| Drilling BOP stack | 15,000 | 3,709 | 8.55 | Y | 15,601 | 1,611 | 13,990 | 1.07 | Annnular FAT |
| Subsea Wellhead | 15,000 | 3,709 | 8.55 | Y | 15,601 | 1,611 | 13,990 | 1.07 | |
| 14" Casing Hanger / Seal Assembly | 13,200 | 3,709 | 15.60 | N | 15,601 | 3,009 | 12,592 | 1.04 | |
| 14" Casing (VAM Top) | 13,700 | 3,709 | 15.60 | N | 15,601 | 3,009 | 12,592 | 1.08 | Pb rating uses actual material yield(137ksi) & wall thickness(0.800"). |
| 14" Casing (Hyd 523) | 13,249 | 3,909 | 15.60 | N | 15,659 | 3,171 | 12,488 | 1.06 | Pb rating uses 132,985 psi Min yield, per MTRs, with 87.5% Remaining WT. See below: |
| 14" Casing (Hyd 513) (Actual Cement Top) | 13,249 | 18,814 | 15.60 | N | 19,981 | 15,262 | 4,720 | 2.80 | Nexen MTRs for 14" Hyd 523 pipe have a minimum burst rating of 13,249 psi, based on 87.5% RWT, calculated using API burst calculation, per Formula #31 in page 14 of API Bulletin 5C3. Note: This is conservative, as Nexen inspects to 90% Remaining Wall. |
| 11-3/4" Liner Hanger | 7,000 | 18,517 | 15.60 | N | 19,895 | 15,021 | 4,874 | 1.43 | |
| 11-3/4" Liner (Hyd523) | 9,940 | 18,527 | 15.60 | N | 19,898 | 15,029 | 4,869 | 2.04 | |
| 11-3/4" Liner (SLIJ II) | 9,940 | 19,601 | 15.60 | N | 20,210 | 15,900 | 4,309 | 2.30 | |
| 11-3/4" Liner (Hyd523) | 9,940 | 21,188 | 15.60 | N | 20,670 | 17,188 | 3,482 | 2.85 | Please note that the comments regarding regarding the liner re-design: |
| 9-7/8" Liner Hanger | 10,000 | 18,017 | 15.20 | N | 19,750 | 14,241 | 5,510 | 1.81 | 1 - 11-3/4" Liner top adjusted for actual 14" casing setting depth. |
| 9-7/8" Liner (SLIJ II) | 13,840 | 18,027 | 15.20 | N | 19,753 | 14,249 | 5,505 | 2.51 | 2 - 7-5/8" contingency liner added to enable drilling to well TD. |
| 7-5/8" Liner Hanger | 7,500 | 22,887 | 15.40 | N | 21,163 | 18,328 | 2,835 | 2.64 | 3 - 9-7/8" liner burst ratings based on actual MTR minimum test yield rating. |
| 7-5/8" Liner (SLIJ II) | 14,340 | 22,897 | 15.40 | N | 21,166 | 18,336 | 2,830 | 5.06 | 4 - Changed burst rating of 7-5/8" liner hanger - using different vendor due to requirement for dual wiper plug system. |
| 7-5/8" Liner (Hyd 513) | 12,620 | 26,990 | 15.30 | N | 22,353 | 21,473 | 879 | 14.35 | 5 - Changed connection from Hydril 523 to combination of Vam SLIJ II and Hydril 513 (shoe track) due to equipment availability. |
| | | | | | - | - | - | | |

<<Insert additional rows as necessary for other zones of interest and copy down formulas **do NOT delete this line**

**6.2 TRAPPED ANNULUS SCREENING**

| Casing / Liner Strings (Show all strings exposed to HC flow) | Enter string type | String or liner lap fully cemented? | Liner lap <= 500 ft? | Setting Depth (ft-MD) | Planned TOC (ft-MD) | Previous Shoe Depth (ft-MD) | Max Angle above previous shoe | Idle < 1 year? | Trapped Annulus? | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 14" Casing | Casing | N | N | 18,851 | 18,814 | 13,982 | 3 | Y | NO | See Comment in Section 6.1 above for approval of planned TOC |
| 11-3/4" Liner | Liner | N | Y | 21,900 | 21,899 | 18,851 | 0 | Y | NO | |
| 9-7/8" Liner | Liner | Y | N | 23,387 | 22,837 | 21,900 | 0 | Y | NO - Cement model reqd | Plan 550' primary cement plus squeeze into liner top to |
| 7-5/8" Liner | Liner | N | Y | 27,543 | 26,043 | 23,387 | 3 | Y | NO | isolate the 11-3/4" liner from the shut-in pressure. |

<<Insert additional rows as necessary for other zones of interest and copy down formulas **do NOT delete this line**

**6.3 COLLAPSE ANALYSIS**

APB calculator for Untrapped Annulus

| String | OH Weak pt (ft TVD) | Setting MW (ppg) | FG at weak pt (ppg) | Calculated APB (psi) | Level 2 Alternative APB (psi) | Comments / justification of alternative APB used |
|---|---|---|---|---|---|---|
| 14" Casing | 13,981 | 15.6 | 16.6 | 727 | N/A | APB Limited by FG @ 16" |
| 11-3/4" Liner | 18,850 | 15.6 | 16.2 | 588 | N/A | APB Limited by FG @ 14" |
| 9-7/8" Liner | 21,899 | 15.2 | 15.9 | 797 | N/A | APB Limited by FG @ Base of Salt |
| 7-5/8" Liner | 23,384 | 15.4 | 16.0 | 730 | N/A | APB Limited by FG @ 9-7/8" |

Standard APB calc for Untrapped Annulus assumes APB is limited by FG at the previous shoe or a weak point

<<Insert additional rows as necessary for other zones of interest and copy down formulas **do NOT delete this line**

| Collapse Ananlysis Component description | Collapse rating (psi) | Depth of interest (ft TVD) | Hydraulic Isolation Depth (ft-TVD) | Annulus Pressure Buildup (psi) | Setting MW, or PP (ppg) | Internal Pressure (psi) | External Pressure (psi) | Collapse Load (psi) | Design Factor | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| 14" Casing at WH | 9,430 | 3,709 | 18,832 | 727 | 15.6 | 1,613 | 3,736 | 2,123 | 4.44 | |
| 14" Casing at XO (VAM Top) | 9,430 | 3,909 | 18,832 | 727 | 15.6 | 1,671 | 3,898 | 2,227 | 4.23 | |
| 14" Casing at XO (Hyd 523) | 10,651 | 3,909 | 18,832 | 727 | 15.6 | 1,671 | 3,898 | 2,227 | 4.78 | |
| 14" Casing at Hyd (Hyd523) Iso Depth | 10,651 | 18,832 | 18,832 | 727 | 15.6 | 5,999 | 16,004 | 10,005 | 1.06 | Collapse rating for Hydril casing updated to reflect the MTRs for Nexen's inventory pipe. The minimum collapse pressure from any batch of pipe was 10,651 psi. The tool was not failing (DFc=1.02 min), but this gave a more robust design factor. |
| 14" Casing at shoe (Hyd513) - NO APB | 10,651 | 18,850 | 18,832 | 0 | 15.5 | 6,004 | 15,193 | 9,189 | 1.15 | Pore pressure used to calculate external pressure. Pore pressure based of drilled inlux (15.5 ppg calculated) at 18,910' MD. Believed to be isolated zone, as drilling progressed with 14.9 ppg MWt up to that point. |
| 11-3/4" Liner Hanger | 5,900 | 18,516 | 21,555 | 588 | 15.6 | 5,907 | 15,608 | 9,701 | 0.60 | |
| 11-3/4" Liner at X/O (Hyd523) | 5,740 | 19,600 | 21,555 | 588 | 15.6 | 6,221 | 16,488 | 10,266 | 0.55 | |
| 11-3/4" Liner at X/O (SLIJ II) | 5,740 | 21,187 | 21,555 | 588 | 15.6 | 6,682 | 17,775 | 11,093 | 0.51 | |
| 11-3/4" Liner at HID (Hyd523) | 5,740 | 21,555 | 21,555 | 588 | 15.6 | 6,788 | 18,073 | 11,285 | 0.50 | HID at 21,555 TVD most likely depth of collapse. Justification for no hydrocarbons to seafloor attached: (Previously Approved) |
| 11-3/4" Casing at shoe (Hyd523) - NO APB | 5,740 | 21,899 | 21,555 | 0 | 14.1 | 6,888 | 16,056 | 9,168 | 0.62 | Pore pressure used to calculate external pressure. |
| 9-7/8" Liner Hanger (No APB - See Comment) | 5,630 | 18,016 | 23,110 | 0 | 15.2 | 5,762 | 14,240 | 8,478 | 0.66 | No 9-7/8" liner hanger APB or collapse due to planned liner top cement |
| 9-7/8" Liner at HID (SLIJ II) | 13,040 | 23,110 | 23,110 | 797 | 15.2 | 7,239 | 19,063 | 11,824 | 1.10 | HID at 23,109 TVD most likely collapse depth. APB tied to BOS frac grad. See Fault Connectivity justification for no Hyd to seafloor. Collapse rating based on MTRs. |
| 9-7/8" Casing at shoe (SLIJ II) - NO APB | 13,040 | 23,384 | 23,110 | 0 | 14.5 | 7,319 | 17,632 | 10,313 | 1.26 | Pore pressure used to calculate external pressure. |
| 7-5/8" Liner Hanger | 7,500 | 22,885 | 26,373 | 730 | 15.4 | 7,174 | 19,056 | 11,882 | 0.63 | Note that the 9-7/8" and 14" strings are robust in burst & collapse. |
| 7-5/8" Liner at HID (SLIJ II) | 14,237 | 26,373 | 26,373 | 730 | 15.4 | 8,186 | 21,849 | 13,664 | 1.04 | Therefore, there will be no broach to sea floor. 9-7/8" liner hanger burst & |
| 7-5/8" Liner at shoe (Hyd 513) - NO APB | 11,080 | 27,000 | 26,373 | 0 | 15.3 | 8,367 | 21,481 | 13,114 | 0.84 | collapse ratings reflects increased wall thickness due to setting inside 14" casing. 7-5/8" SLIJ II collapse based on MTRs, 7-5/8" Hydril 513 based on P110 float collar. |

Fault Connectivity

<<Insert additional rows as necessary for other zones of interest and copy down formulas **do NOT delete this line**

**7) SECONDARY STRING VERIFICATION** ========> **Check box if no secondary strings exposed:** ☐

**7.1 COLLAPSE VERIFICATION**

| Secondary String | Collapse rating Secondary String (psi) | Depth of interest (ft TVD) | Primary string failure depth (ft TVD) | Internal Flowing Pressure at failure pt (psi) | MW failed string was set in (ppge) | Secondary string Internal pressure (psi) | Secondary string APB (psi) | Secondary string setting MW, or PP (ppg) | Secondary string External pressure (psi) | Collapse load (psi) | Collapse DF | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | - | | - | | | - | - | | |
| 14" | 10,651 | 18,016 | 23,110 | 7,239 | 15.2 | 3,213 | 727 | 15.6 | 15,342 | 12,129 | 0.87 | Cannot utilize this calculation where the liner top is squeezed. This protects the 14" and 11-3/4" from collapse load up to 9-7/8" liner hanger depth. |
| 9-7/8" | 13,040 | 23,110 | 22,885 | 7,174 | 15.4 | 7,354 | 797 | 15.2 | 19,063 | 11,709 | 1.11 | Pressure seen on shut-in will be controlled by BOS Leak off. The 11-3/4" casing shoe integrity will contain shut-in pressure, with 1707 psi safety margin. |
| | | | | - | | - | | | - | - | | 11-3/4" liner not analysed as it was isolated by cementation between 9-7/8" liner and 11-3/4" down to shoe. |

<<Insert additional rows as necessary for other zones of interest and copy down formulas **do NOT delete this line**

| Secondary String (to be verified) | Failed string(s) | Primary string failure depth (ft TVD) | Hanger depth of failed string(ft TVD) | MW failed string was set in (ppge) | Internal Flowing Pressure at failure pt (psi) | Fluid drop (ft TVD) | Hydrocarbon gradient (psi/ft) | Average fluid density in annulus (ppg) | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | - | | | | |
| 14" | 9-7/8" | 23,110 | 18,016 | 15.2 | 7,239 | 0 | 0.29 | 15.2 | 9-7/8" liner top squeeze cemented. Isolation assumed. |
| 9-7/8" | 7-5/8" | 22,885 | 22,885 | 15.4 | 7,174 | 0 | 0.29 | 15.4 | |

<<Insert additional rows as necessary for other zones of interest and copy down formulas **do NOT delete this line**

**7.2 BURST VERIFICATION WITHOUT UNDERGROUND FLOW**

| Secondary String | Burst rating (psi) | Depth of interest (ft TVD) | Primary string failure depth (ft TVD) | Average fluid density in annulus (ppge) | Internal Shut-in Pressure at Primary string failure pt (psi) | Secondary String Internal pressure (psi) | Exposed to SW? (above top hanger) | MW / PP (ppg) | Secondary string External pressure (psi) | Burst load (psi) | Burst DF | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | - | - | | | - | - | | Calculation done. This conservatively |
| 14" | 13,249 | 18,016 | 23,110 | 15.2 | 21,227 | 17,201 | N | 15.6 | 14,615 | 2,586 | 5.12 | assumes 14" sees Pb. But 9-7/8" liner top is |
| 9-7/8" | 13,840 | 22,885 | 22,885 | 15.4 | 21,162 | 21,162 | N | 15.2 | 18,088 | 3,074 | 4.50 | squeezed. Isolates 14" casing. Actual burst load calculated is 2594 psi = 4.80 DFb |

<<Insert additional rows as necessary for other zones of interest and copy down formulas **do NOT delete this line**

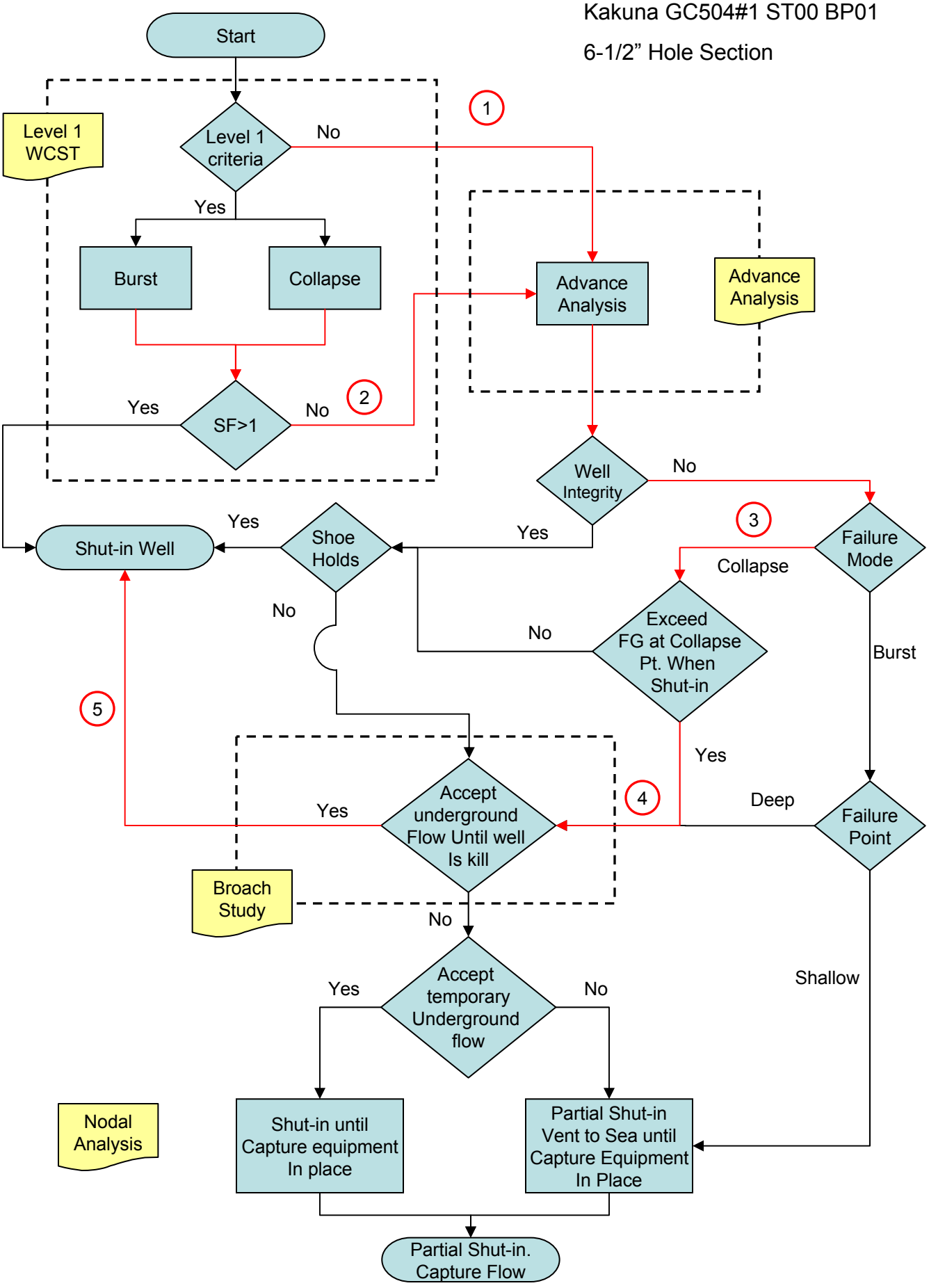
**8) LEVEL 2 FORMATION INTEGRITY ANALYSIS** **Check box if no formation exposed behind failed strings:** ☐

| Description of depth where formation integrity is checked & Description of Strings that failed | Primary string Failure depth (ft TVD) | Depth of Previous shoe or weak point (ft TVD) | FG at previous shoe or weak point (ppg) | Average fluid density in annulus (ppge) | Internal Shut-in Pressure at Primary string failure pt (psi) | Annulus pressure at previous shoe or weak pt (psi) | Frac margin (psi) | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | | | - | - | | |
| 14" Shoe | 23,110 | 20,899 | 15.9 | 15.2 | 21,227 | 19,480 | (2,200) | With shut-in pressure being controlled by the BOS fracture pressure minus 0.29 psi/ft to the 11-3/4" shoe (18,335 psi) and the 11-3/4" shoe fracture pressure (20,042 psi), there is a real terms 1707 psi safety margin. This only applies if 9-7/8" bursts. Design is robust. |
| | | | | | - | - | | This would turn cell H140 green, with a Frac margin = 1707 psi. |
| 9-7/8" Shoe | 22,885 | 23,384 | 16.0 | 15.4 | 21,162 | 21,562 | (2,106) | See comment above. If shoe broaches, the pressure is controlled by the Base of Salt. Salt and robust sho at 11-3/4" liner will prevent broach to seabed. Underground flow until relief well drilled. |

<<Insert additional rows as necessary for other zones of interest and copy down formulas **do NOT delete this line**

Kakuna GC504#1 ST00 BP01

6-1/2" Hole Section



# 6-1/2” Hole

1

Use analog wells oil gradient in Level 2 analysis. Nexen agreed alternative 0.29 psi/ft oil gradient with BOEM for Kakuna prospect.

2

14” casing safety factor less than 1 for burst load applied. (Level 1 Analysis)

14”, 9-7/8” and 7-5/8” liner collapse safety factors lower than 1, for loads applied. (Level 1 Analysis)

3

7-5/8” liner SF<1 under flowing condition. (Level 2 Analysis)

4

Maximum Shut-in Pressure at depth of collapse point exceeds the formation fracture gradient when taken back to 9-7/8” shoe.

Failure of 7-5/8” liner hanger will lead to leak off of shut-in pressure at the Base of Salt.

This reduces the pressure applied at 11-3/4” shoe, resulting in 1707 psi Frac margin, versus the screening tool margin of minus 2200 psi in cell H140.

5

Underground flow is acceptable until the well is killed, with robust 14” shoe per discussion above. Shut-in well with 15K capping system.

*Note: 11-3/4” isolated due to cement squeeze of 11-7/8” x 9-7/8” annulus down to 11-3/4” shoe.*