# ATP 685P

# QUEENSLAND

# TARDRUM 1

# WORKOVER PROGRAM

**28 July 2003**

**Revision 6**

# SAMSON-INTERNATIONAL (AUSTRALIA) PTY LTD

**Prepared by Upstream Petroleum Pty Ltd, 2003**

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# 1 INTRODUCTION

## 1.1 Background

Samson-International (Australia) Pty Ltd (Samson) has farmed in to all of Sunshine Gas Limited's (SHG) Australian permits as Operator. For ATP 685P this follows a farmin by SHG into the permit where Santos QNT Pty Ltd is Operator. Samson will be the effective Operator for the workover of Tardrum-1, and has appointed Upstream Petroleum Pty Ltd (UP) as their field operations contractor. UP will project manage the workover of Tardrum-1.

ATP 685P is situated adjacent to and north of the established coal bed methane (CBM) fields Scotia (Santos) and Peat (OCA). This region is a proven hydrocarbon/coal province. For a variety of reasons this licence area has only been lightly explored to date.

## 1.2 History

Tardrum-1 was drilled by Santos QNT Pty Ltd in July 2001. The well encountered four potentially productive coal seams (Lower C2B, C3, C4, C6) within the Upper Baralaba Coal Measures and two interseam sand units (1A and 1B). The two sand units were tested by open hole DST with the upper 1B sand producing gas to surface. Both intervals were interpreted as being tight gas sands. The well was then cased with 5 ½" casing set at 1330.22 mRT and suspended.

During subsequent operations in August 2001 the production casing was found to be leaking at the port collar when pressure tested and a nominal 4" ID casing patch had to be run and set at 924.7 to 928.2 mRT. Each Coal Seam (C2B, C3/C4 and C6) was perforated and stimulated via foamed nitrogen fracturing and flowed briefly back to surface. Each coal seam produced some gas during the flowback. The two interseam sand units were also perforated and stimulated using foamed nitrogen fracturing then flowed back to surface. The well was again suspended with a drillable bridge plug set at 648mRT.

A snubbing unit was mobilized in December 2001, drilled out the bridge plugs and frac baffles and installed a 2-3/8" packerless completion with the end of the tubing above the coal seams at 1080.3mRT. Originally the completion design included a packer but the 4.675" gauge ring would not pass a casing restriction at 777.5m. A 3.9" LIB was run on slickline and hung up briefly at the restriction, then went through. The configuration of the restriction is not known, except that it was identified subsequent to fracturing.

A Xmas tree was installed. The well was flowed back by Santos in January 2002 and produced gas and water continuously and did not clean up. The flowback testing was repeated by Upstream Petroleum in March 2003 which confirmed the Santos results that gas and water was being produced continuously from the well. Upstream concluded from water level measurements in the well that the gas was most likely to have been produced from the 1A and 1B sandstone units. The presence of a small amount of condensate produced with the gas supported this conclusion. Upstream were unable to determine the source of the continuous water production. The stabilized gas production rate from the well was less than 0.1mmscfd.

## 1.3 Workover Objective

The objective of the workover is to install a completion that will permit the complete dewatering of the coals and determine whether they are able to contribute to the total production from the well. In order to achieve this the existing completion will be retrieved and rerun deeper with a Progressive Cavity Pump (PCP) installed below the lowest perforated coal seam. The pump will be used to dewater the coals by pumping the water from the well sump to surface via the tubing whist producing gas against a minimum surface backpressure via the annulus.

The gas rate will be tested sufficiently long to ensure that the water influx rate is known and the stable coal seam gas contribution is measured versus the previous test in April 2003, believed to be from the sands.

## 1.4 Completion Issues

Note that the previously perforated sands will be open, and while tight, have been observed to pressurise the well to over 1000 psi STHP within 12 hours of shutin. Hence the existing wellhead configuration will be largely retained to permit well control when pump drive rods are pulled at any time.

No packer will be run, nor any tools with an OD that may not pass the deformed casing at 777.5m. It is intended to run a torque stopper under the PCP to prevent tubing rotation and possible backoff, but if the results of a slickline gauge run prior to rerunning the tubing indicate it will not pass the casing restriction, it will be run above the restriction.

While closing the SSD for flowback in April 2003, a 1.75" gauge cutter found fill at 1291.9mRT, probably frac sand. This 21.5m fill may have increased during the subsequent flowback in early May. Consequently it will be tagged with a drift run that will pass the collapse point before running the 4.25" drift.

When pumping the water level down to obtain optimum coal seam dewatering, water depth will be measured via Echometer. As it may be difficult to control water level versus pump rate, the pump will be run deeper than originally proposed, ie 30 feet below the bottom perforation, to allow for flexibility.

During the April 2003 flowback, produced water total chlorides measured around 7000 ppm. The maximum total chlorides content of water that may be flowed to the environment per the Environmental Protection Act is 1000ppm. Water with higher salt concentrations than this must be collected in evaporation ponds, or trucked to a suitable disposal site.

## 1.5 HSE and Public Relations

Coordination of pre-arranged and spontaneous visits to the wellsite in a safe and informative manner is the objective in addition to:

Recording non-conformances
Addressing complaints in a timely manner
Monitoring aspects of Environmental Management Procedures compliance
Attending to additional PR issues as they arise

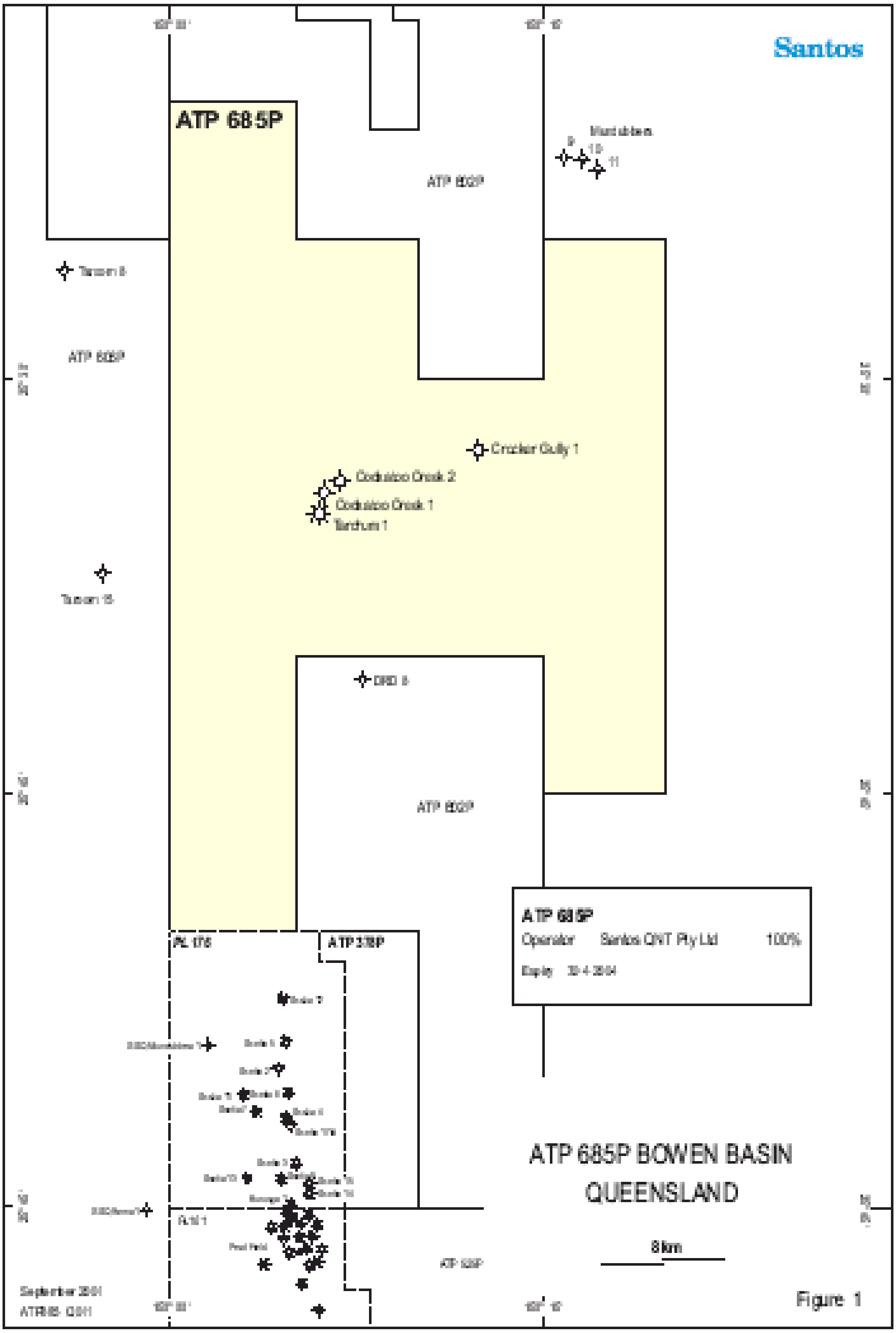
Note that Santos is the Permit Holder and retains the responsibility for dealing with landholder, cultural heritage and native title issues in ATP 685P, while the Deputy Person in Charge has the immediate responsibility for dealing with all other issues. Health and Safety standards as defined in the Samson Bridging Document to UP's Integrated management System are to be applied.

Environmental standards applied will be those defined by Santos in their QNTBU Environmental Procedures.

Refer to the separate Samson Emergency Response Plan and the generic Samson Well Control Plan (included as Appendix D) as necessary.

# 2 CURRENT WELL STATUS

## 2.1 Location Map



## 2.2 Pre-workover Well Data

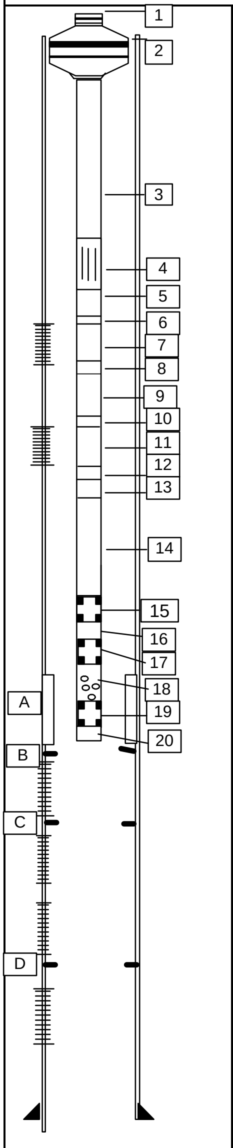
| | | |
|---|---|---|
| Well Name | : | Tardrum-1 |
| Well Classification | : | Gas Appraisal – Coal Seam Methane |
| Country/State | : | Australia, Qld |
| Permit | : | Cockatoo Creek Block, ATP 685P |
| Basin | : | Denison Trough |
| Operator | : | Samson-International (Australia) Pty Ltd |
| Permit Interests | : | Per Farm-in Agreement between:<br>Santos QNT Pty Ltd and Sunshine 685 Pty Ltd,<br>and between Samson-International (Australia)<br>Pty Ltd and Sunshine Gas Limited |
| Location | : | Shot point 291 on line SG00-09<br>Lat $25^0$ 34' 13.21" South<br>Long $150^0$ 06' 18.10" East<br>Datum WGS 84/GDA 94 approx. |
| Drilling Rig K.B Elevation. | : | 4.65 m above ground level |
| Workover Rig Floor Elevation | : | 2m above ground level |
| Ground Level | : | 194.4 m above sea level |
| Spud Date | : | July 2001 |
| Workover Date | : | August 2003 |
| Drilling Contractor/Rig | : | Oil Drilling and Exploration Pty Ltd Rig 4 |
| Workover Contractor/Rig | : | Eastern Well Services Rig 2 |
| Completion- Existing | : | Packerless 2 3/8" tubing completion with end at<br>1080.2m, and closed SSD at 658m |
| Completion- Planned | : | Packerless 2 3/8" tubing completion with end at<br>1243.6m, and Progressive Cavity Pump |
| PBTD | : | 1313.4 mRT |

## 2.3 Current Well Completion Schematic

**PETROLEUM ENGINEERING DEPARTMENT**

**PROPOSED DOWNHOLE SINGLE GAS COMPLETION**

**WELL:** **Tardrum 1** **DATE:** **11/02/2002**




PBTD - 4309' KBRT

| ITEM NO. | DESCRIPTION | LENGTH (ft) | DEPTH RT (ft) | MIN. ID. (in) |
|---|---|---|---|---|
| 1 | K.B. to top of tubinghead spool (to be confirmed) | 13.51 | | |
| 2 | CIW FBB tubing hanger 7-1/16" x 2-3/8" EUE top & bottom, 2" BPV prep. | 0.75 | 13.51 | |
| 3 | 79Jts Tubing, 2-3/8" 4.7# J55 EUE | 2491.50 | 14.26 | 1.995 |
| 4 | 2-3/8" Otis Sliding Sleeve 121XO w/ 2-3/8" EUE pin x pin & 1.875" X profile Closed. | 2.85 | 2505.76 | 1.875 |
| 5 | 1 Jt Tubing, 2-3/8" 4.7# J55 EUE | 31.70 | 2508.61 | 1.995 |
| 6 | Xover 2-3/8" EUE box x 2-3/8" BH3 pin | 1.04 | 2540.31 | 1.995 |
| 7 | 3 Jts 2-3/8" BH3 J55 Blast Joints (20 ft length joints) | 58.70 | 2541.35 | 1.995 |
| 8 | Xover 2-3/8" BH3 box x 2-3/8" EUE pin | 0.70 | 2600.05 | 1.995 |
| 9 | 7 Jts Tubing, 2-3/8" 4.7# J55 EUE | 220.71 | 2600.75 | 1.995 |
| 10 | Pup Joint 2-3/8" 4.7# EUE J55 (6ft) | 6.07 | 2821.46 | 1.995 |
| 11 | Xover 2-3/8" EUE box x 2-3/8" BH3 pin | 1.03 | 2827.53 | 1.995 |
| 12 | 2 Jts 2-3/8" BH3 J55 Blast Joints (20 ft length joints) | 39.68 | 2828.56 | 1.995 |
| 13 | Xover 2-3/8" BH3 box x 2-3/8" EUE pin | 0.81 | 2868.24 | 1.995 |
| 14 | 21 Jt 2-3/8" 4.7# EUE J55 | 659.29 | 2869.05 | 1.995 |
| 15 | Landing Nipple, 2-3/8" Vitex 11X1, EUE | 0.96 | 3528.34 | 1.875 |
| 16 | Pup Joint 2-3/8" 4.7# EUE J55 (6ft) | 6.00 | 3529.30 | 1.995 |
| 17 | Landing Nipple, 2-3/8" Otis 11X18760-A , EUE | 1.30 | 3535.30 | 1.875 |
| 18 | Perforated Pup Joint 2-3/8" 4.7# EUE J55 (6ft) | 6.12 | 3536.60 | 1.995 |
| 19 | Landing Nipple, 2-3/8" Otis XN , EUE | 1.39 | 3542.72 | 1.791 |
| 20 | Collar, 2-3/8" EUE | 0.41 | 3544.11 | |
| | END OF TUBING | | 3544.52 | |
| | | | | |
| | **NOTE:** Casing has partly collapsed at 2551'kb passed a 3.9" blind box through | | | |
| | and unable to pass a 4.767 gauge ring through 7/12/01. Unable to get PLS packer | | 1080.32 | mRT |
| | with 4.675" OD through 6/12/01. Collars may hang up on 4" frac baffle | | | |
| | when POOH with tubing. | | | |
| A | 4" ID Casing Patch 3033' to 3045' (924.66 - 928.21 mRT) | | | |
| B | 4" frac baffle at 3443.41' | | | |
| C | 3-7/8" frac baffle at 3710.47' | | | |
| D | 3.5" frac baffle at 3953.25' | | | |
| | | | | |
| | Note: Surface casing has 152psi shut in pressure and flows water. | | | |
| | | | | |
| | Sliding sleeve Down to open. | | | |

| FORMATION | INTERVAL (m RT) | SIZE | TYPE | SPF | TYPE | WT(g) |
|---|---|---|---|---|---|---|
| Permian 1B Sandstone | 779-790 | 3-1/2" | HSD | 6 | 34B HJ II | 21 |
| Permian 1A Sandstone | 865-870 | 3-1/2" | HSD | 6 | 34B HJ II | 21 |
| C2 Lower B Coal Seam | 1108.35-1111.90 | 2-1/2" | HSD | 6 | 35B UP | 10.5 |
| C3 Coal Seam | 1148.80-1151.80 | 2-1/2" | HSD | 6 | 35B UP | 10.5 |
| C4 Coal Seam | 1186.95-1189.33 | 2-1/2" | HSD | 6 | 35B UP | 10.5 |
| C6 Coal Seam | 1220.38-1225.08 | 2-1/2" | HSD | 6 | 35B UP | 10.5 |

REMARKS:

ANNULUS FLUID: N/A

INDICATED STRING WEIGHT: 17000lbs

CALCULATED STRING WEIGHT: 17000lbs

SLACK-OFF WEIGHT: 17000lbs

OTHER:

| | | |
|---|---|---|
| NOT TO SCALE | WELLSITE SUPERVISOR | I Fendley |
| PROPOSED: YES | DATE OF INSTALLATION | 8/12/2001 |
| RE-COMPLETION: No | DRAFTED: B Harradine | DATE: 11-February-02 |
| COMPLETION: YES | REVISED: | DATE: |
| OTHER: | | |

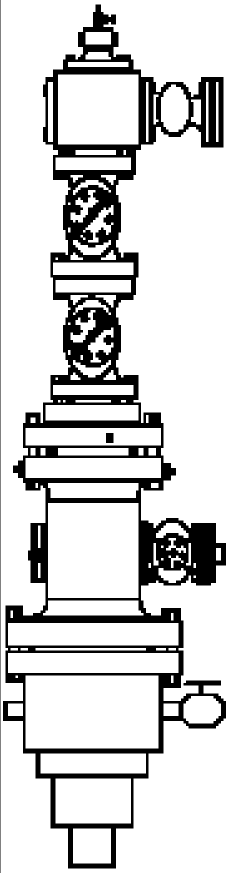
## 2.4 Current Wellhead Details

**PETROLEUM ENGINEERING DEPARTMENT**

Santos

**2-1/16" WELLHEAD**

**WELL:** TARDRUM 01 **DATE:** 8/12/2001



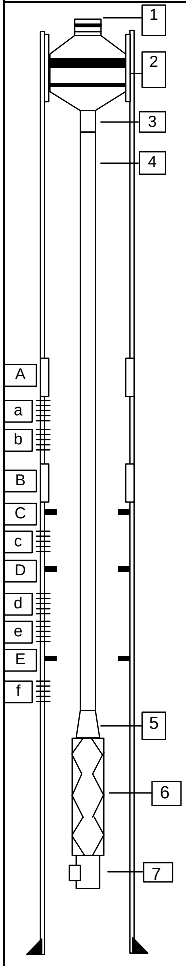
| | | | Description |
|---|---|---|---|
| **TREE CAP** | MAKE/TYPE | | Wood Group |
| | SIZE/RATING | | 2-1/16" 5k w/- Bowen Union |
| | LIFT THREAD | | 2-3/8" EUE |
| | FITTINGS | | 1/2" Needle Valve & Vastrix Nipple |
| **WING VALVE** | MAKE | | Wood Group |
| | SIZE | | 2-1/16" |
| | RATING | | 5 k |
| | TYPE | | BB |
| | STATUS | | |
| **FLOW CROSS** | MAKE | | Wood Group |
| | SIZE | | BB |
| | RATING | | 2-1/16" x 2-1/16" x 2-1/16" x 2-1/16" |
| | TYPE | | 5 k |
| | STATUS | | |
| **UPPER MASTER VALVE** | MAKE | | Wood Group |
| | TYPE | | Gate Valve 2200 series, BB |
| | SIZE | | 2-1/16" |
| | RATING | | 5 k |
| | STATUS | | |
| **LOWER MASTER VALVE** | MAKE | | Wood Group |
| | TYPE | | Gate Valve 2200 series, BB |
| | SIZE | | 2-1/16" |
| | RATING | | 5 k |
| | STATUS | | |
| **ADAPTOR FLANGE** | MAKE/TYPE | | Cameron |
| | SIZE/RATING | | 2-1/16" 5k x 7-1/16" 3k |
| **TUBING SPOOL** | MAKE/TYPE | | CIW type "F" |
| | SIZE/RATING | | 7-1/16" 3k x 11" 3k |
| | OUTLET 1 | VALVE | WG Gate Valve 2200<br>2-1/16" 5k |
| | OUTLET 2 | FITTINGS | 2-1/16" 5k Comp Flg w/- 1-1/2" VR plug |
| **S.C. RISER NIPPLE** | VALVE | | No Surface casing riser fitted at time of completion. |
| | SIZE/RATING | | Surface casing SIP 152psi and flows water. |
| | STATUS | | |
| **CASING BOWL** | MAKE/TYPE | | Wood Group / WG-BP |
| | SIZE/RATING | | 11" 3k x 9-5/8" LTC btm prep |
| | OUTLET 1 | VALVE | 2" NPT Ball Valve |
| | OUTLET 2 | FITTINGS | 2" NPT Bull Plug tapped 1/2" NPT |
| SURF. CSG. | SIZE,WT./GR./THD./DEPTH | | 9-5/8" 36# K55 BTC 1077'RT |
| *INT. CSG. | SIZE,WT./GR./THD./DEPTH | | |
| PROD. CSG. | SIZE,WT./GR./THD./DEPTH | | 5-1/2" 17# L80 LT&C 4357.26' RT |
| TUBING | SIZE,WT./GR./THD./# JTS. | | 2-3/8" 4.7# J55 EUE 101 |
| TUBING HANGER | MAKE/TYPE | | CIW FBB-EN 7-1/16" x 2-3/8" |
| | LIFT THD./BPV PREP. | | 2-3/8" EUE c/w 2" BPV prep |
| **REMARKS** | | | Live annular no packer in this well.<br>Surface casing SIP 152psi and flows water. |

AUTHOR: B. Harradine DRAFTED: DATE DRAWN: 20/09/01

# 3 PROPOSED COMPLETION DESIGN

**Well:** Tardrum 1

**Tubing String Design - Base Case** **DATE:** 28/07/2003




PBTD - 4309' KBRT

| ITEM NO. | DESCRIPTION | LENGTH (ft) | DEPTH RT (ft) | MIN. ID. (in) |
|---|---|---|---|---|
| 1 | Top of tubinghead spool - 13.51 ft RT | 13.51 | | |
| 2 | CIW FBB tubing hanger 7-1/16" x 2-3/8" EUE top & bottom, 2" BPV prep. | 5.00 | 13.51 | 1.995 |
| 3 | 2 x Pup Joints 2', 2-3/8" 4.7# J55 EUE | 4.00 | 18.51 | 1.995 |
| 4 | 128Jts Tubing, 2-3/8" 4.7# J55 EUE | 4032.00 | 22.51 | 1.995 |
| 5 | Xover 2-3/8" EUE box x 3-1/2" EUE pin | 1.00 | 4054.51 | 1.995 |
| 6 | 24-1800 Corlac Progressive Cavity Pump Stator (Ideally @ 4080' RT) | 25.00 | 4055.51 | NA |
| 7 | TX 5-2 Torque Stopper | 1.00 | 4080.51 | 2.441 |
| | END OF TUBING | | 4081.51 | |

**Casing Details**

| | |
|---|---|
| A | **NOTE:** Casing has partly collapsed at 2551'kb passed a 3.9" blind box through and unable to pass a 4.767 gauge ring through 7/12/01. Unable to get PLS packer with 4.675" OD through 6/12/01. Collars may hang up on 4" frac baffle when POOH with tubing. |
| B | 4" ID Casing Patch 3033' to 3045' (924.66 - 928.21 mRT) |
| C | 4" frac baffle at 3443.41' |
| D | 3-7/8" frac baffle at 3710.47' |
| E | 3.5" frac baffle at 3953.25' |
| | Note: Frac baffles all milled with 3.75" bit |

| | Perforations | INTERVAL (m RT) | SIZE | TYPE | SPF | TYPE | WT(g) |
|---|---|---|---|---|---|---|---|
| a | Permian 1B Sandstone | 2556'-2592' | 3-1/2" | HSD | 6 | 34B HJ II | 21 |
| b | Permian 1A Sandstone | 2838'-2854' | 3-1/2" | HSD | 6 | 34B HJ II | 21 |
| c | C2 Lower B Coal Seam | 3636'-3648' | 2-1/2" | HSD | 6 | 35B UP | 10.5 |
| d | C3 Coal Seam | 3769'-3779' | 2-1/2" | HSD | 6 | 35B UP | 10.5 |
| e | C4 Coal Seam | 3894'3902' | 2-1/2" | HSD | 6 | 35B UP | 10.5 |
| f | C6 Coal Seam | 4004'-4019' | 2-1/2" | HSD | 6 | 35B UP | 10.5 |

REMARKS:

ANNULUS FLUID: Initial 9.0ppg KCl Brine

INDICATED STRING WEIGHT:

CALCULATED STRING WEIGHT: 20,000 lb in air

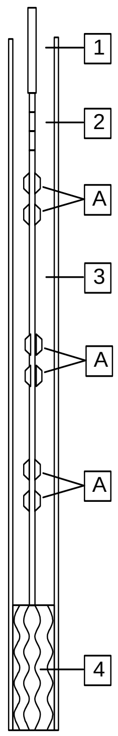
SLACK-OFF WEIGHT:

OTHER:

| | | |
|---|---|---|
| NOT TO SCALE | WELLSITE SUPERVISOR | |
| PROPOSED: YES | DATE OF INSTALLATION | |
| RE-COMPLETION: YES | DRAFTED: G Hogan | DATE: 27-June-03 |
| COMPLETION: NO | REVISED: C Mircea - Rev 4 | DATE: 28-July-03 |
| OTHER: | | |

Well: **Tardrum 1**

**Rod String Design** DATE: **28/07/2003**




STATOR @ 4080'

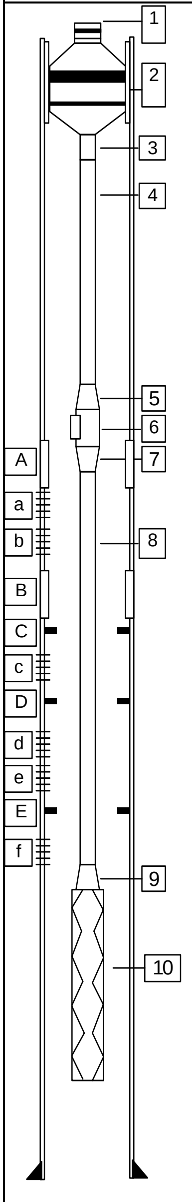
| ITEM NO. | DESCRIPTION | LENGTH (ft) | DEPTH RT (ft) | O.D. (in) |
|---|---|---|---|---|
| | Top of stuffing box - 5 ft RT | 5.00 | | |
| 1 | 26' Polished Rod 1-1/2" x 7/8" pin | 26.00 | 5.00 | 1.25 |
| 2 | 7/8" Pony Rods as Required | 24.00 | 31.00 | 0.875 |
| 3 | 7/8" Sucker Rods x 25' | 4000.00 | 55.00 | 1.875 |
| 4 | 24-1800 Corlac Progressive Cavity Pump Rotor (Ideally @ 4080' RT) | 25.00 | 4055.00 | NA |
| | END OF ROD STRING | | 4080.00 | |
| | | | | |
| A | Rod Guides 2" x 1.75" OD 2 per Rod | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| | |
|---|---|
| REMARKS: | |
| TUBING FLUID: | ?? |
| INDICATED STRING WEIGHT: | ?? |
| CALCULATED STRING WEIGHT: | |
| SLACK-OFF WEIGHT: | |
| OTHER: | |

| | | | |
|---|---|---|---|
| NOT TO SCALE | WELLSITE SUPERVISOR | | |
| PROPOSED: YES | DATE OF INSTALLATION | | |
| RE-COMPLETION: YES | DRAFTED: G Hogan | DATE: | 27-June-03 |
| COMPLETION: NO | REVISED: G Hogan - Rev 2 | DATE: | 07-Jul-03 |
| OTHER: | | | |

Well: **Tardrum 1**

**Contingent Tubing String Design - Hang Up at Deformation** **DATE:** 28/07/2003




PBTD - 4309' KBRT

| ITEM NO. | DESCRIPTION | LENGTH (ft) | DEPTH RT (ft) | MIN. ID. (in) |
|---|---|---|---|---|
| 1 | Top of tubinghead spool - 13.51 ft RT | 13.51 | | |
| 2 | CIW FBB tubing hanger 7-1/16" x 2-3/8" EUE top & bottom, 2" BPV prep. | 5.00 | 13.51 | 1.995 |
| 3 | Pup Joints, 2-3/8" 4.7# J55 EUE (2 x 10' + 2 x 6') | 32.00 | 18.51 | 1.995 |
| 4 | 78Jts Tubing, 2-3/8" 4.7# J55 EUE | 2457.00 | 50.51 | 1.995 |
| 5 | Xover 2-3/8" EUE box x 2-7/8" EUE pin | 1.00 | 2507.51 | 1.995 |
| 6 | TX 5-2 Torque Stopper | 1.00 | 2508.51 | 2.441 |
| 7 | Xover 2-7/8" EUE box x 2-3/8" EUE pin | 1.00 | 2509.51 | 1.995 |
| 8 | 49Jts Tubing, 2-3/8" 4.7# J55 EUE | 1543.50 | 2510.51 | 1.995 |
| 9 | Xover 2-3/8" EUE box x 3-1/2" EUE pin | 1.00 | 4054.01 | 1.995 |
| 10 | 24-1800 Corlac Progressive Cavity Pump Stator (Ideally @ 4080' RT) | 25.00 | 4055.01 | NA |
| | END OF TUBING | | 4080.01 | |

**Casing Details**

| | |
|---|---|
| A | **NOTE:** Casing has partly collapsed at 2551'kb passed a 3.9" blind box through and unable to pass a 4.767 gauge ring through 7/12/01. Unable to get PLS packer with 4.675" OD through 6/12/01. Collars may hang up on 4" frac baffle when POOH with tubing. |
| B | 4" ID Casing Patch 3033' to 3045' (924.66 - 928.21 mRT) |
| C | 4" frac baffle at 3443.41' |
| D | 3-7/8" frac baffle at 3710.47' |
| E | 3.5" frac baffle at 3953.25' |
| | Note: Frac baffles all milled with 3.75" bit |

| | Perforations | INTERVAL (m RT) | SIZE | TYPE | SPF | TYPE | WT(g) |
|---|---|---|---|---|---|---|---|
| a | Permian 1B Sandstone | 2556'-2592' | 3-1/2" | HSD | 6 | 34B HJ II | 21 |
| b | Permian 1A Sandstone | 2838'-2854' | 3-1/2" | HSD | 6 | 34B HJ II | 21 |
| c | C2 Lower B Coal Seam | 3636'-3648' | 2-1/2" | HSD | 6 | 35B UP | 10.5 |
| d | C3 Coal Seam | 3769'-3779' | 2-1/2" | HSD | 6 | 35B UP | 10.5 |
| e | C4 Coal Seam | 3894'3902' | 2-1/2" | HSD | 6 | 35B UP | 10.5 |
| f | C6 Coal Seam | 4004'-4019' | 2-1/2" | HSD | 6 | 35B UP | 10.5 |

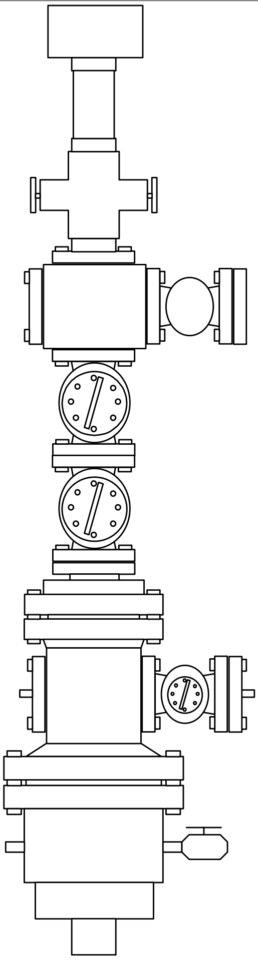
REMARKS:

| | |
|---|---|
| ANNULUS FLUID: | Initial 9.0ppg KCl Brine |
| INDICATED STRING WEIGHT: | |
| CALCULATED STRING WEIGHT: | 20,000 lb in air |
| SLACK-OFF WEIGHT: | |
| OTHER: | |

| | | | |
|---|---|---|---|
| NOT TO SCALE | WELLSITE SUPERVISOR | | |
| PROPOSED: YES | DATE OF INSTALLATION | | |
| RE-COMPLETION: YES | DRAFTED: G Hogan | DATE: | 27-June-03 |
| COMPLETION: NO | REVISED: C. Mircea - Rev 4 | DATE: | 28-July-03 |
| OTHER: | | | |

**Well: Tardrum 1** **DATE: 7/07/2003**

**Wellhead Design**



| | | |
|---|---|---|
| **Drive Head / Stuffing Box** | Make/Type<br>Size | Erwin G-900 RH Drive Head for 1-1/4" Polished Rod<br>2-7/8" EUE pin |
| **Rod BOP** | Make/Type<br>Size<br>Rating | JP Ratigan Manual BOP with 1-1/4" Rams<br>2-7/8" EUE box x 2-7/8" EUE pin<br>1500psi |
| **Adapter** | Size<br>Rating | 2-7/8" EUE box x 2-1/16" API 5k Flange<br>1500psi x 5000psi |
| **Wing Valve** | Make/Type<br>Size<br>Rating | Wood Group BB<br>2-1/16"<br>5000psi |
| **Flow Cross** | Make/Type<br>Size<br>Rating | Wood Group BB<br>2-1/16" x 2-1/16" x 2-1/16" x 2-1/16"<br>5000psi |
| **Master Valve** | Make/Type<br>Size<br>Rating | Wood Group BB Gate Valve 2200 Series<br>2-1/16" x 2-1/16"<br>5000psi |
| **Master Valve** | Make/Type<br>Size<br>Rating | Wood Group BB Gate Valve 2200 Series<br>2-1/16" x 2-1/16"<br>5000psi |
| **Adapter Flange** | Make/Type<br>Size<br>Rating | Wood Group BB<br>2-1/16" x 7-1/16"<br>5000psi x 3000psi |
| **Tubing Spool** | Make/Type<br>Size<br>Rating<br>Outlet 1<br>Outlet 2 | CIW Type F<br>7-1/16" x 11"<br>5000psi x 3000psi<br>WG Gate Valve 2200 Series 2-1/16" 5000psi<br>Compl Flange 2-1/16" 5000psi with 1-1/2" VR Plug |
| **Casing Bowl** | Make/Type<br>Size<br>Rating<br>Outlet 1<br>Outlet 2 | Wood Group / WG-BP<br>11" x 9-5/8" LTC bim prep<br>3000psi<br>2" NPT Ball Valve<br>2" NPT Bull Plug tapped 1/2" NPT |
| **Surface Csg**<br>**Prodn Csg**<br>**Tubing** | Sz/Wt/Gr/Thd/Dep<br>Sz/Wt/Gr/Thd/Dep<br>Sz/Wt/Gr/Thd/Jts | 9-5/8" 36# k-55 BTC 1077' RT<br>5-1/2" 17# L-80 LT&C 4357' RT<br>2-3/8" 4.7# J-55 EUE 101 |
| **Tubing Hanger** | Make/Type<br>Lift Thd/BPV Prep | CIW FBB-EN 7-1/16" x 2-3/8"<br>2-3/8" EUE c/w 2" BPV prep |
| **Remarks** | No surface casing riser was installed during the initial completion<br>Live annulus, no packer in this well | |

| | | |
|---|---|---|
| Drafted: G Hogan | Date: | 23-June-03 |
| Revised: G Hogan Rev 2 | Date: | 7-July-03 |

# 3 WORKOVER PROGRAMME

1. Mobilise workover rig to location and rig up. Pump out fresh water lying in location pits, where not required as makeup water.

2. Clean mud pit with pressure cleaning equipment to remove any solids, scale or rust. Fill mud pit with fresh clean water and circulate clean the pipework and pumping equipment to be used for well kill. Use a mild pickling acid such as SAPP or a surfactant to assist with cleaning as necessary. Dump the solids contaminated water to the flare pit. Mix 150bbls of 9.0 ppg KCl brine and add 200ppm biocide (gluaraldehyde) and 200ppm Oxygen Scavenger (Ammonium Bisulphite).

3. Rig up flare line with 2 7/8" tubing to the flare pit and install star pickets to hold down every joint. Flareline end should have air induction shroud on it to assist burning at low rates.

Note- no cold gas venting is permissible, flare to be lit or pilot flame burning whenever flowing gas to the pit.

4. Hook up chiksan piping to the well annulus and bleed off well pressure to the flare pit via the choke manifold. Measure the choke nipple gas rate and take two gas samples in the 20 liter evacuated sample bombs per ASTM procedures and send for chromatographic analysis.

5. Hook up mud pump to the Xmas tree wing valve and circulate KCl brine down the tubing and take gas returns up the annulus via the choke manifold to the flarepit. Flare the gas at the flare pit and upon brine to surface return KCl to the brine tank. Continue to circulate until there is no gas in the well.

6. Bleed off any remaining pressure and ensure the fluid level in the well is static.

7. Rig up polished rod lubricator and install the dual check back pressure valve (BPV) in the tubing hanger

8. Remove the Xmas tree and 2-1/16" x 7-1/16" adaptor flange. Off the critical path, reassemble the surface tree for PCP operations.

9. Nipple up 7-1/16" 3000psi BOP stack dressed with blind rams and 2-3/8" pipe rams.

10. RIH with landing joint and rotate onto tubing hanger. Perform BOP Tests (to 2000 psi high/250 psi low).

11. Unlock and pick up the tubing hanger and flow check the well.

12. POOH and lay down tubing hanger with BPV installed, and rack completion string. Keep hole full while POH and top it up as necessary once the string is pulled. Remove the BPV from the tubing hanger off the critical path.

13. RIH 3.5" OD drift (stator OD) on the rig's sand line and tag fill in casing (last tagged at 1291.9m).

14. RIH 4.25” OD casing drift on the rig’s sand line and check that the drift will pass the casing collapse point at 2551’RT (777.5mRT).

15. Pick up Progressive Cavity Pump (PCP) Stator and make up to 2-7/8” anti rotation device (Torque Stopper TX-5) and RIH.

Note: If the 4.25” drift would not pass the casing collapse point then the torque stopper should be run in the completion string such that it is above the collapse point. Consideration will be given to running a bow spring centraliser under the pump in this instance.

Note: All tubing connections should be made up to the maximum torque for the connection to minimize the possibility of the completion string backing off when the PCP is shut down. Bakerlock the bottom 3 tubing connections above the PCP.

16. Make up 2-7/8”x 2-3/8” (or 3-1/2” x 2-3/8”, as necessary for the pump) crossover assembly and RIH with pump assembly on 2-3/8” tubing to place the pump suction at approximately 4080’RT (1243.6mRT).

17. Make up tubing hanger and RIH and land tubing hanger with landing string.

18. Run an API tubing drift on the rig’s sandline to check free passage for the PCP rotor.

19. Install BPV, lock down tubing hanger and pressure test tubing hanger seals to 2000psi.

.

20. Rig down BOP stack and install 2-1/16 x 7-1/16” adaptor flange, 2-1/16” Xmas tree lower and upper master valves, flow tee and wing valve, 2-1/16” adaptor flange 5000 psi WP x 2-7/8”EUE box, and 2-7/8” 1500psi WP polished drive rod BOP dressed with 1-1/4” BOP rams. Note- both master valves are retained due to the open sandstone perforations above the coal seams, to allow dual valve closure if rods are removed and the well shut in.

21. Rig up polished rod lubricator on top of drive rod BOP and retrieve the BPV. Rig down polished rod lubricator.

22. RIH PCP rotor on 7/8” drive rods with 1.75” OD fluted rod guides (two per rod) and land PCP rotor in stator. Pull back and connect pony rods as required to space out the pump rotor. Install 1.25” polished drive rod, polished rod stuffing box and hydraulic drive head onto polished drive rod BOP.

23. Hook up the well annulus valve to a test choke manifold and gas meter and prepare to flow the well to the flare pit.

24. Hook up the hydraulic power unit to drive head and test run the PCP taking pumped fluid via the wing valve to the 150 bbl gauge tank. Measure the fluid rate and tubing head pressure and check the pump performance against the manufacturer’s pump curves.

25. Pump water out of the well via the tubing using the PCP. Monitor the annulus well fluid levels using the Echometer and draw down the fluid level until it is at/or below the lowest C6 perforation at 4019.3’ (1225.1mRT), or as near as feasible. The water should be piped to a 150 bbl gauge tank so that the rate of dewatering can be measured throughout the dewatering process.

26. Flow the produced water from the tank to the flare pit to maximise evaporation. Flarepit overflow should be routed by gravity flow to the evaporation pit. Any excess water that

exceeds 1000 ppm total chlorides must be trucked off location for disposal at an approved site, or water production stopped by shutting down the pump. Water should be sampled every hour and the salinity of the water measured to determine the proportions of well kill, stimulation and formation fluids being produced, as well as its acceptability for disposal to the environment.

27. While the fluid level in the well is being pumped down to the lowest perforation or as near as feasible, open the annulus valve of the well to flow via the choke manifold to the flare pit. Adjust the pump speed to maintain a constant fluid level at or below the lowermost C6 perforation once the fluid level is drawn down.

28. Measure the flows of water and gas from the well for 12 hours and if the pump is performing correctly shut in the well and rig down/release the workover rig.

29. Take two gas samples from the choke manifold in the 20 litre evacuated sample bombs provided, once the water being pumped out of the well is determined to be formation water. Also take 2 each 1 litre water samples in glass containers, and send for analysis, as required after consultation with Samson.

30. Once the rig is demobilized from the wellsite, if applicable, hook up the gas engine drive to run on wellhead gas by installing the gas regulator, liquid knock out pot and piping required. Start the PCP and continue to test the well whilst maintaining the liquid level at or below the lowermost C6 perforation using the Echometer. Regular and frequent site monitoring will be required throughout the flow test period.

31. Take two further samples of produced gas after stable gas flows have been achieved into evacuated containers, and every two weeks thereafter as required after consultation with Samson, until the completion of the flow test. Send all samples for chromatographic analysis.

32. At test end, consult with Samson as to well suspension for later production or otherwise.

Note: Flow tests extending beyond 1 month require Ministerial approval, to be applied for via the QDNRM if after 2 weeks on test, in consultation with Samson, it appears there is potential for such approval to be required, due to continuing change in gas and/or water production.

# 5 WORKOVER TIME ESTIMATE

| Step Number | Description | Time Estimate (Days based on 12hr/day working) |
|---|---|---|
| 1,2,3 | Mobilise Rig and rig up, mix brine, rig up test equipment | 1.5 |
| 4 | Bleed down well and take samples | 0.2 |
| 5,6 | Kill the well, flow check well | 0.3 |
| 7 | Install BPV | 0.1 |
| 8 | Remove Xmas Tree | 0.1 |
| 9 | Nipple up BOP | 0.2 |
| 10 | Test BOP | 0.3 |
| 11,12 | Recover Completion | 0.8 |
| 13,14 | Drift casing and tag fill | 0.2 |
| 15,16,17 | Run PCP and completion | 1.0 |
| 18,19 | Drift tubing, lock and test tubing hanger | 0.3 |
| 20 | Rig down BOP and install PCP surface arrangement | 0.2 |
| 21 | Retrieve BPV | 0.1 |
| 22 | Run PCP rotor on rod string and install drive head | 0.5 |
| 23 | Hook up well to test equipment | 0.1 |
| 24 | Hook up PCP powerunit and test run the pump | 0.1 |
| 25,26 | Pump out water from well and sample water | 0.2 |
| 27,28,29 | Flow test the well and take samples | 0.5 |
| 30 | Rig down and demobilise rig | 1.5 |
| | **Total** | **8.2** |

## APPENDIX A - EXTRACTS FROM THE PETROLEUM REGULATIONS (LAND), 1966 CLAUSES PERTAINING TO SAFETY

### CLAUSE 135 - FLUID SAMPLES

*All formation fluid recovery from drillstem or other non-routine production tests shall when practicable be sampled. If the Person-in-Charge has the samples analysed he shall send one copy of the results of the analysis to the Senior Petroleum Technologist forthwith.*

*If required by the Senior Petroleum Technologist a portion of each sample, sufficient for analysis shall be forwarded to the Senior Petroleum Technologist suitably labelled as to well number, condition of well when sampled, date, productive interval, type of test, nature of sample and sampling point.*

### CLAUSE 141 - DISPOSAL OF PRODUCED OIL AND GAS

*Any oil or gas which is circulated out of or produced from a well during a drilling or repair operation and which is not flowed via the well's flowline to a gathering facility, shall be flowed through a properly staked temporary flowline to a storage tank or flare on location.*

*Any storage tank used for such purpose shall be situated at least 45m (150') and any flare used for such purpose shall be situated at least 45m (150') from such well.*

*Only in the case of such oil or gas being flowed through a separator or in the case of gas alone to a flare and only when such separated or produced gas is being burnt at the flare, shall clean up or testing of a well to temporary wellsite facilities be allowed to continue during the hours of darkness.*

### CLAUSE 142 - DISPOSAL OF WASTE FLUIDS

*All waste circulating fluids whether or not contaminated with oil, which may have been used during work on a well or which have been produced from a well as it cleans up, unless otherwise removed from the wellsite to a satisfactory storage, shall be pumped or drained to a waste sump.*

*Any such permanent sump on any well location shall, when containing any fluids other than clean water, be adequately fenced, and such fencing if removed during repair operations on a well shall be replaced before completion of operations on the well.*

### CLAUSE 150 - BLOWOUT PREVENTION

*The Person-in-Charge of a well which is being drilled, tested, completed or reconditioned shall at all times maintain casing and blowout prevention equipment that is adequate, having regard to the depth to be drilled, the expected pressure and the necessity, in the case of a blowout, of obtaining a shut-off on open hole, around and inside drill pipe, casing, tubing or any equipment being employed on the well.*

*The above is Section 1 of 8 Sections of Reg. 150.*

## APPENDIX B - REPORTING PROCEDURES AND CONTACT NUMBERS

### DAILY REPORTS

A daily workover report (DWR) will cover the previous 24 hour period to 2400 hours. The reports will be faxed or emailed to UP Operations by 0800 hours each day. UP will be responsible for timely distribution of these reports to Samson.

## OPERATIONS CONTACT NUMBERS

Most communication from the rig should be directed through UP's Darwin office:

Telephone: 08 89325777
Facsimile: 08 89325744
Email: admin@upstreampetroleum.com.au

After hours communications may be directed to nominated personnel:

## DRILLING OPERATIONS

Operations Superintendent/ATP-685P Deputy Person in Charge: Cam Rathie
Telephone: 08-89325777 (Darwin office)
08-89472028 (home:)
Facsimile: 08-89325744
Mobile: 0419933476
CDMA Mobile:0429933476
Email: camrathie@upstreampetroleum.com.au

Operations Supervisor: Stewart Clark
Telephone: 08-89325777
Facsimile: 08-89325744
CDMA Mobile:0418894394
Email: stewartclark@upstreampetroleum.com.au

Roma Operations Support: Sharpe Engineering
Peter and Anne Sharpe
Telephone: 07-46225656
Facsimile: 07-46225646
Mobile: 0417756089
Email: sharpeng@hwy54.com.au

Workover Supervisor: Paul Reeve
Telephone: 07-54622419
Facsimile: 07-54628566
Mobile: 0428781242
Email: bawddrilling@hypermax.net.au

## SAMSON-INTERNATIONAL

International Operations Manager: Don Dotson
Telephone: 1-713-5772005
Facsimile: 1-713-5772205
Mobile: 1-713-4477127
Email: ddotson@samson.com

## SANTOS CONTACTS

Primary Contact: Bonnie Lowe-Young
Telephone: 07-32286580
Facsimile: 07-32286596
Email: bonnie.lowe-young@santos.com

Land/environmental contact: Jon Warby
Telephone: 07-46222400 (Roma office)
07-46695125 (home)
CDMA Mobile:0427695125
Satphone: 0415199468

Manager Exploration Northern Australia/ATP-685P Person in Charge: Mark Webster
Telephone: 07-32286823
Facsimile: 07-32286596
Mobile: 0409877876

**GOVERNMENT CONTACT NUMBERS**

Queensland Department of Natural Resources and Mines
Level 3, Mineral House
41 George Street,
BRISBANE QLD 4000
Secretary: 07-32379796
Contact: Andy Kozak
Telephone: 07-32371491
Facsimile: 07-32371534
After Hours: 0412167138 (Phil Dash)
Email: andy.kozak@nrm.qld.gov.au

**LOT 5/CP FT847 "COOKS PADDOCK" LANDOWNER**

John Ferling
Telephone: 07-54220043 (Kilcoy)
Facsimile: 07-54220043
Email: TBA

**EMERGENCY CONTACT NUMBERS**

| | |
|---|---|
| Qld Police | 000 Emergency |
| Roma Police | 46229333 |
| Taroom Police | 46273200 |
| Taroom Police mobile | 0427584507 |
| Qld Emergency Service | 000 Emergency |
| Roma Emergency Service | 46224139 |
| Qld Fire Service | 000 Emergency |
| Roma Rural Fire Service | 46222074 |
| Miles Rural Fire Service | 46271658 |
| Qld Ambulance Service | 000 Emergency |
| Roma Ambulance | 46221202 |

| | |
|---|---|
| Taroom Ambulance | 46273352 |
| Roma Health Service | 46221433 |
| Taroom Health Service | 46273177 |

## APPENDIX C - CONTRACTORS' CONTACT NUMBERS

WORKOVER RIG CONTRACTOR- Eastern Well Services

Phone: 07-46385888
Fax: 07-46380444
Attn: David Whiley
Mobile: 0429799961
Email: david@easternwell.com.au

TESTING- Expertest

Phone: 07-46226457
Fax: 07-46226377
Attn: Paul Stone
Mobile: 0428101674
Email: paulstone@expertest.com.au

SAMPLE ANALYSIS- ACS Laboratories

Phone: 07-33571133
Fax: 07-33571100
Attn: Nick Cox
Mobile: 0405100298
Email: n.cox@acslabs.com.au

WELLHEAD SERVICES- Wood Group Pressure Control

Phone: 08-82431700
Fax: 08-82431999
Attn: Richard Crossland
Email: richard.crossland@woodgroup.com

# APPENDIX D - WELL CONTROL PLAN

## GENERAL GUIDELINES

Described below are a summary of Operating Guidelines to be implemented by the Well-Site Drilling Supervisor. Decisions referred to the UP Operations Manager may be deferred to the Samson Drilling Manager, depending on the importance of the issue. These guidelines are intended to reflect prudent well control operating practices and are to be appropriately applied as needed for the drilling environment to be encountered. All guidelines will not apply all of the time. Guidelines which are most appropriate to a specific well will be addressed in the Detailed Drilling Program:

1. A mud tank level monitoring system (e.g. Pit Volume Totalizer), pump stroke counter and mud flow indicator (paddle type sensor) will be installed on the rig, with a monitoring station and alarm system located at or near the driller's station.

2. The Wellhead and BOP system for each hole size will be specified in the Detailed Drilling Program.

3. The choke line will be either suitably pressure-rated Coflexip (or similar) hose or hard line pipe with targeted "T's" for any unavoidable direction changes.

4. The Diverter & BOP system will be chart tested with water as specified in the Detailed Drilling Program at each nipple up and bi-weekly thereafter, if applicable. All tests shall be with low pressure first (250 psi) and then to the expected working pressure of the BOP. Casing valve should be open during the test.

5. BOP nipple-ups or testing shall never be compromised. Bolts are to be made up with full nut on each end. Nuts will be periodically checked and re-tightened if necessary. Bolts will also be checked on every flanged connection from wellhead to BOPE to choke line and manifold.

6. Pump through the separator, flare lines, choke and kill lines with water during BOP testing and after each use.

7. The hydraulic choke line valve next to the BOP and all chokes will remain closed during drilling operations.

8. Always use a wear bushing with an extended skirt to protect the hanger and seal area for the next casing string. Use a wear bushing at all times except when testing the BOP or running casing.

9. The BOP "Diverting" & "Shut-In" procedures, whichever one is applicable, shall be posted near the driller's station.

10. BOP Drills will be performed as specified in the Detailed Drilling Program to ensure adequate training of all rig crew.  Each rig crew member shall also be trained in kick detection.

11. Rig supervisory personnel (Driller and above) shall be Well Control certified with documentation available for inspection at the well site.

12. If cement does not circulate to surface, on surface and intermediate casing strings, immediately notify the UP Operations Manager. The results will be evaluated to determine appropriate actions to be taken.

13. A Formation Integrity Test (FIT) or Leak Off Test will be performed at each casing shoe as specified in the Detailed Drilling Program.  Shoe test will be recorded on a chart and immediately forwarded to the UP Operations Manager.  The results will be evaluated to determine appropriate actions to be taken.

14. The trip tank will be used during all trips made in and out of the hole.

15. The hole will be filled at least every 5 stands while tripping drill pipe and every stand while tripping drill collars.  The Drilling Supervisor will personally supervise this operation, on the rig floor.

16. Fill-up and displacement volumes will be measured and recorded (using a Trip Record form) when tripping out or back in the hole.  Actual volumes measured are to be compared against calculated volumes.  Measured volumes will be called out on intercom system as they are recorded.

17. Always return back to bottom and circulate out if the hole does not take the proper mud fill-up volume.  **If the well starts to flow, shut the well in.  <u>Do not try to beat the well to bottom</u>.**

18. The driller will be required to record and report the volume of mud required to fill the hole whenever pipe is out of the hole for an extended time (e.g. logging).

19. A Pre-Recorded Well Information & Kill Sheet will be kept current as drilling progresses as specified in the Detailed Drilling Program.

20. Slow circulating rate pressures (SCRP) will be obtained at circulating rates of 30-45-60 SPM to determine friction pressure in the circulating system as follows: (1) Once per tour in sensitive hole intervals  (2) When bit is changed  (3) When BHA is changed  (4) When the

mud weight or properties are changed (0.2 ppg or more)  (5) After each trip or (6) When there is any change in pump output.  SCRP's will be recorded on the IADC Report.

21. Maximum kill rate speed will be discussed and decided upon ahead of time with Samson's Drilling Manager and the UP Operations Manager. The slowest pump speed will be used unless a change is approved.

22. Do not drill ahead if the current mud weight in the hole is within one lb/gal of the FIT or LOT, at the last casing shoe, without prior UP Operations Manager approval.  (This is to avoid lost circulation or well flow associated with surge and/or swab pressures.)

23. Do not drill ahead if an increase in the size, shape or amount of shale cuttings is observed, without UP Operations Manager approval.  This information is to be immediately reported.

24. Kick tolerance will be monitored as drilling progresses to maintain an awareness of the amount of mud weight increase that can be tolerated during a kick, without breaking down the formation at the shoe.  Kick tolerance can be determined as follows:

$$\text{Kick Tolerance (ppg)} = \frac{\text{Casing Shoe Depth} \times [MW(1) - MW(2)]}{\text{Total Depth}}$$

Where: MW(1) = LOT or FIT EMW (ppg)
MW(2) = Current MW in the Hole (ppg)

25. A ported float will always be run in the drill string.  Float is to be inspected on each trip.

26. A full opening safety valve below the Kelly will be used during drilling operations.  A second full opening safety valve and Gray Inside BOP will be accessible on the rig floor, with crossovers necessary for adapting to the drill collars.  The Safety Valve on the rig floor will be in the open position with a closing wrench attached.

27. The distance from the rig floor to the annular and/or ram preventers will be measured to avoid closing the preventers on a tool joint.  These measurements are to be kept and posted near the drillers station.

28. A person from the rig crew is to be located on the shakers while circulating.   Mud weight and viscosity at the shakers are to be checked and recorded every 15 minutes.  Mud weight will also be checked at the mud pits every 15 minutes when weighted mud is being used.  Mud weight will be called out over intercom system after recording.  Any observed flow changes will be called out immediately.

29. A procedure for flow checking drilling penetration rates increases (e.g. drilling breaks) will be established, communicated and enforced by both the Drilling Supervisor and rig toolpusher.

This procedure will be posted on the rig floor at all times. This procedure should be immediately reviewed, and revised as needed, when a drilling assembly change affecting overall ROP has been made (e.g. PDC bit, motor, etc).

30. A flow check should be made on all connections while drilling ahead, after potential hydrocarbon-bearing zones have been penetrated.

31. Bottoms-up circulating time should be posted and kept current as drilling parameters change (e.g. flow rate, total depth, drilling assembly & wellbore configuration).

32. Bottoms up will be circulated before tripping out of the hole.

33. If a trip is going to be made and a potential hydrocarbon-bearing zone has been penetrated since the last trip, a 10 stand short trip should be considered before tripping out of the hole. When the trip is made, periodic flow checks (e.g. mid-point depth in the wellbore, prior to pulling the first stand of drill collars from the hole, etc) should be performed as needed to ensure that the well is not trying to flow.

34. <u>Control ROP as necessary in the shallow hole to prevent loss circulation as a result of overloading the annulus with cuttings.</u>

35. <u>If a rotating head has been used during the drilling operation, the element may be changed out to facilitate the stripping of casing as it is being run in the well. Do not change out the BOP pipe rams Mwhen casing is to be run, without approval from the UP Operations anager.</u>

36. <u>At least the annular volume will be circulated with mud prior to pumping cement during casing jobs.</u>

37. <u>A pre-mixed LCM pill will be prepared and available ahead of time, in the event that a loss of returns is experienced. In the case of severe losses, the annulus will be filled with water in order to keep the hole full, if necessary. Consult with the UP Operations Manager before drilling ahead is resumed or in instances where specific procedures will be utilized in an attempt to combat the loss.</u>

# CAUSE & PREVENTION OF KICKS

**A kick is the uncontrolled flow of formation fluid into the wellbore. If left uncontrolled, a blowout may occur, potentially causing severe damage to rig equipment, personnel and the environment.**

| CAUSE | BEST PREVENTED BY: |
|---|---|
| 1. Failure to keep the hole full of drilling fluid while tripping. | o Utilizing Trip Tank while tripping<br>o Measuring fill-up volume when pulling drill string and displacement volume while tripping<br>o Utilizing Trip Sheet to compare actual fill volumes with calculated pipe displacement |
| 2. Swapping which occurs when pipe is pulled from the well<br>o Pulling pipe too fast<br>o Excessive overpull, drag or torque<br>o Drilling in gumbo-type formations<br>o High viscosity and high density drilling fluids<br>o Hole not taking proper amount of fluids | o Utilizing Trip Tank while tripping<br>o Measuring fill-up volume when pulling drilling string<br>o Utilizing Trip Sheet to compare actual fill volumes with calculated pipe displacement<br>o Controlling speed at which pipe is pulled |
| 3. Drilling into zones of known pressure with mud weight too low.<br>o Improper water additions<br>o Lack of mud pit supervision<br>o Process equipment not working properly<br>o Barite settling | o Good engineering<br>o Good well procedures<br>o Alert, questioning attitude by Drilling Supervisor, Toolpusher and Mud Engineer |
| 4. Drilling into unexpected, abnormal formation pressure.<br>o See "DETECTION OF KICKS WHILE DRILLING" section | o See "DETECTION OF KICKS WHILE DRILLING" section<br>o Performing well control drills as necessary to achieve satisfactory Drill Crew reaction time<br>o Studying offset wells |
| 5. Lost Circulation (Fluid level of mud in the hole, not rate of loss is critical in well control)<br>o Decrease or rapid increase in pump pressure<br>o Decrease in flow returns<br>o Loss of surface mud volume<br>o Drilling permeable zones<br>o Pressure surging while tripping in the hole | o Careful engineering and proper well design<br>o Maintaining adequate amount of loss circulation materials on location<br>o Controlling speed at which pipe is run in the hole |
| 6. Mud weight high enough to drill but not to trip | o Utilizing Trip Tank on all trips<br>o Measuring fill-up volume with pulling drilling string |

# DETECTION OF KICKS WHILE DRILLING

| | SIGN | HOW TO CHECK IT OUT |
|---|---|---|
| Earliest | 1. Increase in flow-line discharge | Stop pumps and check for flow |
| | 2. Increase in pit volume | Stop pumps and check for flow |
| Won’t use in most cases | 3. Increase in SPM and decrease in circulating pressure | Stop pumps and check for flow |
| Useful only when “feeling our way down” | 4. Drilling Break | Stop pumps and check for flow - (Circulate bottoms up before drilling ahead?) |
| | 5. “D” exponent calculation | Stop pumps and check for flow - (Circulate bottoms up before drilling ahead?) |
| Very Late | 6. Increase in cuttings size and shape | Stop pumps and check for flow |
| Very Late | 7. Water cut mud<br>Salinity Increase (Fresh Water Muds) | Stop pumps and check for flow |

- Don’t assume that a small flow is not a kick
- Observe well long enough to be sure
- Put well on trip tank to check small flows
- When drilling at higher rates of penetration, check for flow on connections

# PERSONNEL RESPONSIBILITIES

**Driller**

- Responsible for reacting to flows or pit gains during drills.
- Responsible for detecting kicks and shutting the well in
- Responsible for monitoring drilling penetration rate and reacting to increased penetration rates (e.g. drilling breaks), according to the procedure communicated by the wellsite supervisor and posted on the rig floor
- Responsible for supervising his crew during well control operations
- Responsible for maintaining pump control during circulation and well killing operations

**Floorhands, Derrickmen, Shakerhands and other Crew Members**

- Should follow the directions of the Driller
- Should remain alert to kick warning signs
- Should report to assigned station bill during well control operations and other well emergencies

**Mud Engineer**

- Responsible for reporting indications of abnormal pressure formations to Driller and Well-Site Supervisor
- Responsible for maintaining mud properties as per program guidelines
- Responsible for providing well information during well control operations.

**Mud Logger**

- Responsible for reporting indications of abnormal pressure formations to the Driller and Well-Site Supervisor
- Responsible for monitoring drilling breaks, pit levels and flow returns at all times
- Responsible for immediately reporting drilling breaks, pit level and flow return gains to the Driller
- Responsible for maintaining a diary of events during well control operations

**Toolpusher**

- Responsible for maintaining up-to-date Well Control Training documentation for critical crew members
- Responsible for ensuring that each crew member has been properly trained in kick detection and BOP shut-in procedures
- Responsible for ensuring that the crew members understand the procedure for performing a flow check on drilling breaks
- Responsible for ensuring that the Driller and Crew are properly deployed during BOP drills and actual well control events
- Should be present at the rig floor when a kick has been taken and during the start of well kill operations

- Responsible for checking that all equipment is working properly
- Responsible for assisting in areas of need as required
- Responsible for briefing the off-duty crews as to the status of operations and prior to crew changeovers

**Service Personnel**

- Responsible for knowing their assigned duties for emergency operations

**Drilling Supervisor**

- Responsible for making sure that BOP drills are continually performed to achieve an acceptable response time and ensure that all crew members understand their respective duties
- Responsible for ensuring that all appropriate personnel on location understand and carry out established policies and procedures with regard to flow checking drilling breaks.
- Responsible for determining kill rate speed in the event a kick is taken (this rate is normally different for each hole size).
- Responsible for determining the maximum allowable SICP for moving pipe through a closed annular preventer
- Responsible for ensuring that the well has been properly shut-in and assigning responsibility for monitoring wellbore pressures.
- Responsible for immediately communicating SIDPP, SICP and Kick Volume, Kill Weight Mud and Kill Procedure to immediate supervisor after a kick has been taken
- Responsible for organizing a pre-kill meeting for all appropriate personnel to be involved with the well control procedure of the well control operation
- Responsible for being present on the rig floor when a kick has been taken and during start up of the well killing operation
- Responsible for updating immediate supervisor as soon as possible concerning any changes in wellbore or surface equipment status or condition.
- Responsible for supervising the overall execution of the procedure required to regain control of the well
- Responsible for assigning responsibility of maintaining a diary of events

# WELL CONTROL (PIT) DRILLS

## Kick While Drilling

- The objective of this drill is to make the drilling crews and mud logger aware of the correct well shut-in procedure, should a kick be detected while drilling

- This drill may be carried out while in open hole or cased hole. However, if the drill string is in open hole, the well should not be shut-in.

- The Toolpusher should initiate the drill by raising a float on the pit level system.

- The Driller is expected to detect the pit gain, sound the alarm and take the following steps in securing the well.
  1. Pick up position tool joint above rotary table
  2. Shut down the mud pumps
  3. Check well for flow
  4. Report to the Toolpusher
  5. Record the time required for the crew to react and conduct the drill on the IADC Report. Also record the names of participants involved in the drill.

◊ The mud logger is also expected to detect the gain and notify the driller.

## Kick While Tripping

- The objective is to familiarize the drill crews with the well shut-in procedure in the event of a kick occurring during a trip.

- This drill should only be carried out when the BHA is inside casing and not across the BOP stack.

- The Drilling Supervisor and Toolpusher should coordinate the drill to make it as realistic as possible.

- The driller will be instructed by the Toolpusher to assume positive flow at the appropriate time.

- The Toolpusher should raise the pit level float to initiate the drill.

- The Driller should perform the following operations:
  1. Stop other operations
  2. Sound the alarm

3. Install the fully opened drill string safety valve
4. Open the choke line valve (HCR)
5. Close the annular preventer
6. Record casing and drillpipe pressures.
7. Notify Toolpusher well is shut-in.
8. Record the time and who participated in the drill in the IADC Report

- The Mudlogger is also expected to detect the gain and notify the driller.

- The Toolpusher should ensure that all crews are properly deployed. Preparations for stripping should be made and discussed as part of the drill.

# WELL CONTROL PROCEDURES

## SHUT-IN PROCEDURES:

### While Drilling:

1. Pull up and position tool joint above rotary table
2. Shut down pump
3. Check for flow
4. Close Annular Preventer **AND** open HCR Valve
5. Read/Record SIDPP and SICP
6. Start moving pipe if SICP is less than ______ psi. (This should be decided upon ahead of time)
7. Read/Record gain in pit volume

### While Tripping:

1. Set slips with tool joint positioned above rotary table
2. Install full-opening safety valve in open position
3. Close safety valve
4. Close Annular Preventer and open HCR Valve
5. Put on Kelly and open safety valve
6. Read/Record SIDPP and SICP
7. Start moving pipe if SICP is less than ______ psi. (This should be decided upon ahead of time)
8. Read/Record gain in pit volume

Notes:

◊ When well has been shut-in and readable pressures have been observed, do not open well to verify entry or check its rate.
◊ Decide on maximum casing pressure for pipe movement ahead of time
◊ Install inside BOP if needed in control procedure

If shut-in pressures cannot be obtained because of a drill pipe float in the string, check the drill pipe pressure by slowly pumping mud down the drill pipe while observing both drill pipe and casing pressure. The drill pipe pressure will increase rapidly until the hydrostatic pressure in the drill string plus the drill pipe pressure equals the bottom hole pressure of the well. At this point the float will open and allow pumping into the wellbore. The drill pipe pressure will then level out or stall. This is the “shut-in drill pipe pressure”.

If the drill pipe float has an orifice, the standpipe pressure will be “shut-in drill pipe pressure”

## CIRCULATING OUT KICK PROCEDURES

The ideal well control procedure is one that maintains a bottom-hole pressure throughout the killing process only slightly higher than the formation pressure. The term “Constant Bottom Hole Pressure Method” is applicable to shut-in periods, as well as while circulating. Two acceptable methods available are the Driller’s and “Wait & Weight” Methods.

To maintain the Bottom Hole Pressure constant and equal to the Shut-In Value:

- Take care of the well - Hold SIDPP constant by bleeding mud from the casing annulus
- Start the Pump – Hold SICP constant as the pump is brought up to kill speed
- Circulate the Gas out without letting **<u>Any More In</u>** – Hold Circulating DPP constant until gas is out of the hole (Driller’s Method)

### <u>Driller’s Method</u>

**<u>First step is to remove the influx:</u>**

Hold SIDPP constant until circulation is started by bleeding mud from the casing annulus (allow pressure to rise 100 psi before bleeding. Do not bleed gas).

Hold CP constant while bringing pump up to kill rate speed. This speed is to be held constant (Maximum kill rate speed should have been decided ahead of time).

Hold CP constant a few more minutes until the DPP stabilizes.

Read the DPP and hold this pressure constant until the kick is circulated out of the well.

Hold CP constant while bring pump speed down. When pump speed is down to the point that the pump is barely running, shut the pump off first and then finish closing the choke.

Read pressures.

**<u>Second step is to circulate the well with kill weight mud:</u>**

Calculate kill weight mud and increase mud weight to that value.

Hold CP constant while bringing pump up to kill rate speed – This speed is to be held constant.

Hold CP constant until the drill string volume has been pumped.

Read DPP and hold this pressure constant until mud returns are at kill weight.

Shut down the pump and shut-in the well.

Read pressures (Should be zero).

Check for flow through choke line.

Open the preventers if well is dead.

**<u>“Wait & Weight” Method</u>**

Use the forms provided by UP Operations to help organize and to expedite the simple calculations required for well control by the “Wait & Weight” method. Graphs are also provided for determining the approximate annulus pressures that will develop.

Determine the mud weight sufficient to kill the well. Raise the mud weight sufficient to kill the well on the first circulation.

To establish the initial drill pipe circulating pressure, bring the pumps on the hole in increments of about five strokes per minute to a pre-selected rate while maintaining the annulus pressure constant at the initial stabilized shut-in pressure.

A kick pump out speed should be selected that allows: a) proper manipulation of the choke and b) the mud weight to be raised smoothly and uniformly. Usually two to four barrels per minute is a satisfactory rate.

Following the pressure table on the bottom of the worksheet, reduce the standpipe pressure systematically as the drill pipe is filled with kill weight mud.

Once stabilized circulation is established, the pumping rate should be held constant until the well is shut-in again or the gas is circulated out and the well is dead.

The drill pipe pressure is maintained at the proper value by adjustment of the annulus choke. The annulus pressure gauge responds immediately to choke adjustments whereas there is a time delay of about two seconds per 1000 feet of well depth in the response of the drill pipe pressure gauge. Fortunately, since the annulus and drill pipe form a “U” tube, if the drill pipe pressure is too high or too low, the annulus pressure is too high or too low by the same amount. Proper procedure, then, is to adjust the choke to give the desired pressure change on the annulus and wait for the change to appear on the drill pipe.

**CONTROLLING PRESSURE DURING SHUT-IN**

Minimum wellhead pressure can be maintained with no additional feed-in during shut-in periods by following the steps outlined below:

**Bottom Hole Assembly is on or near bottom and in pressure communication with the annulus**

Pressure communication can be determined by observing surface pressures during shut-in periods. When the drill pipe and annulus are in pressure communication, the pattern of pressure changes of each will be the same (i.e., when the drill pipe increases, the casing pressure should also increase, but not necessarily by the same amount).

Allow the drill pipe pressure to increase approximately 100 psi above the original shut-in value to provide a small safety factor over the formation pressure.

Hold the drill pipe pressure constant by systematically bleeding small volumes of fluid from the annulus.

**Bottom Hole Assembly is not in pressure communication with the annulus or is out of the hole**

In cases where the drill pipe is out of the hole or not in pressure communication with the annulus (e.g., plugged bit, drill pipe float), wellbore pressures can be controlled by systematically bleeding mud from the annulus as gas migrates up the hole.

Each barrel of mud in the annulus exerts a certain pressure depending on its weight in pounds per gallon and its annular height in feet per barrel.

The system is in equilibrium when the column of fluid in the annulus, plus the annulus surface pressure, exactly equal the bottom hole pressure.

Therefore, if the casing pressure increases due to rising gas, a specific amount of mud can be bled off to allow the gas to expand without reducing the bottom hole pressure.

Allow the casing pressure to increase approximately 100 psi above its original shut-ins value to provide a small safety factor over the formation pressure.

Calculate the hydrostatic head contributed by one barrel of mud in the annulus between the drill pipe and casing or open hole immediately above the estimated top of the bubble.

Allow the casing pressure to increase an additional 100 psi. Bleed off a volume of mud equal to a 100 psi head while holding the casing pressure constant.

Repeat this sequence of casing pressure build-up and mud-bleed off steps until the casing pressure stabilized or until gas reaches the surface.

As the mud is bled off, the surface pressure on the annulus has to increase if the bottom hole pressure is maintained constant.

The casing pressure will continue to increase so long as mud, rather than gas is being bled off the annulus.  Do not bleed off gas.