

"Sharing to be better # 14"

Well control incident – P&A – Gas post TCP detonation

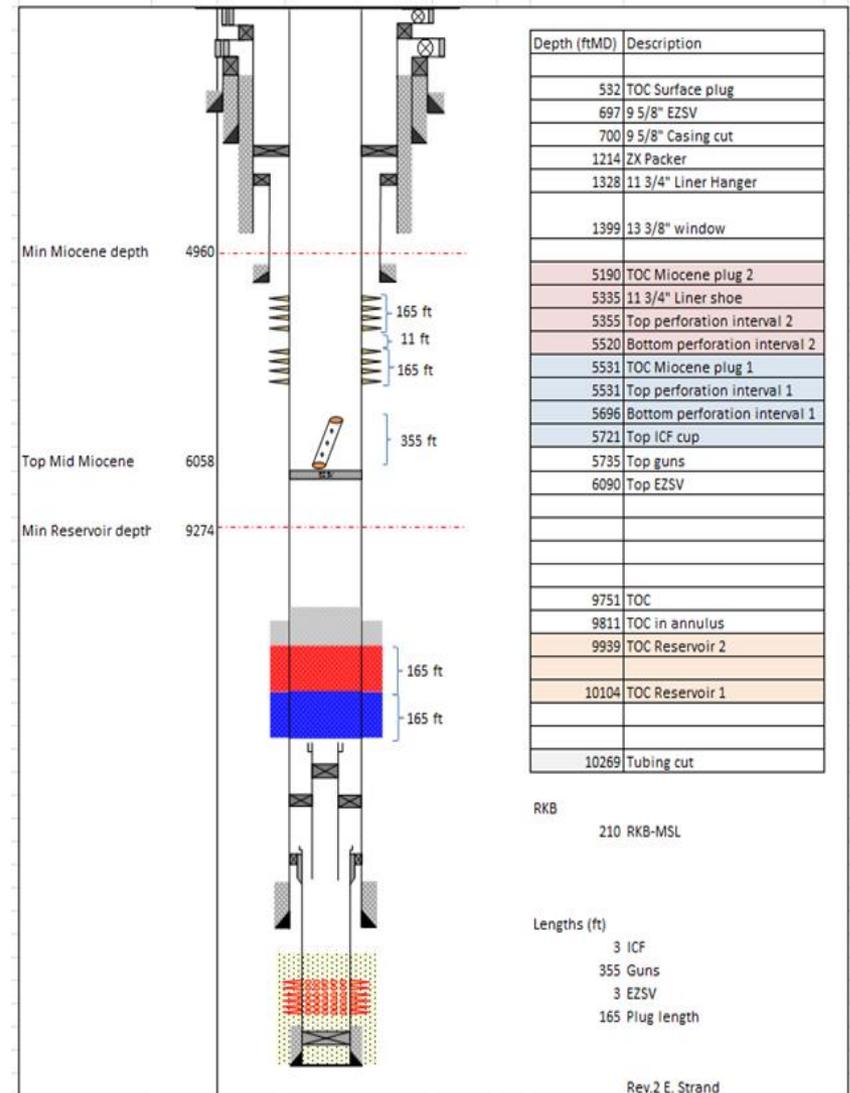
Summary



- A platform production well was P&A'd from a jack up rig with a 18 5/8" 15K psi, 4 ram BOP
- Well was internally risk categorized as Red due to well lacked secondary cement barriers and the primary cement barriers where questionable
- Potential of gas in returns when perforating for PWC at Miocene depth
- During perforation for PWC P&A cement plugs for Miocene barrier a gain was observed
- Well was shut-in and losses occurred while circulating over choke
- Once gas was circulated out well was stable
- After 7,5 hrs operation could continue as planned

Status prior detonating the TCP for P/W/C for Miocene barrier

- Reservoir plugs set and tested
- EZSV plug set and tested
- Hole angle – 38 deg
- MW – 1.74 SG / 14.5 ppg
- Fluid behind casing – 1.70 SG / 14.2 ppg OBM / Gas
- 9 5/8" casing string
- 7" TCP string w/18 shot/ft 1,106" entrance holes
- 2 x 50m (2 x 165 ft) TCP string
- 220,6 kg RDX explosives
- Jet wash tool for washing perforations (No cups)
- Perforate for 2 barrier plugs simultaneously
- Depth at top of perforation 1626 m MD / 1402m TVD (5335 ft MD / 4600 ft TVD)



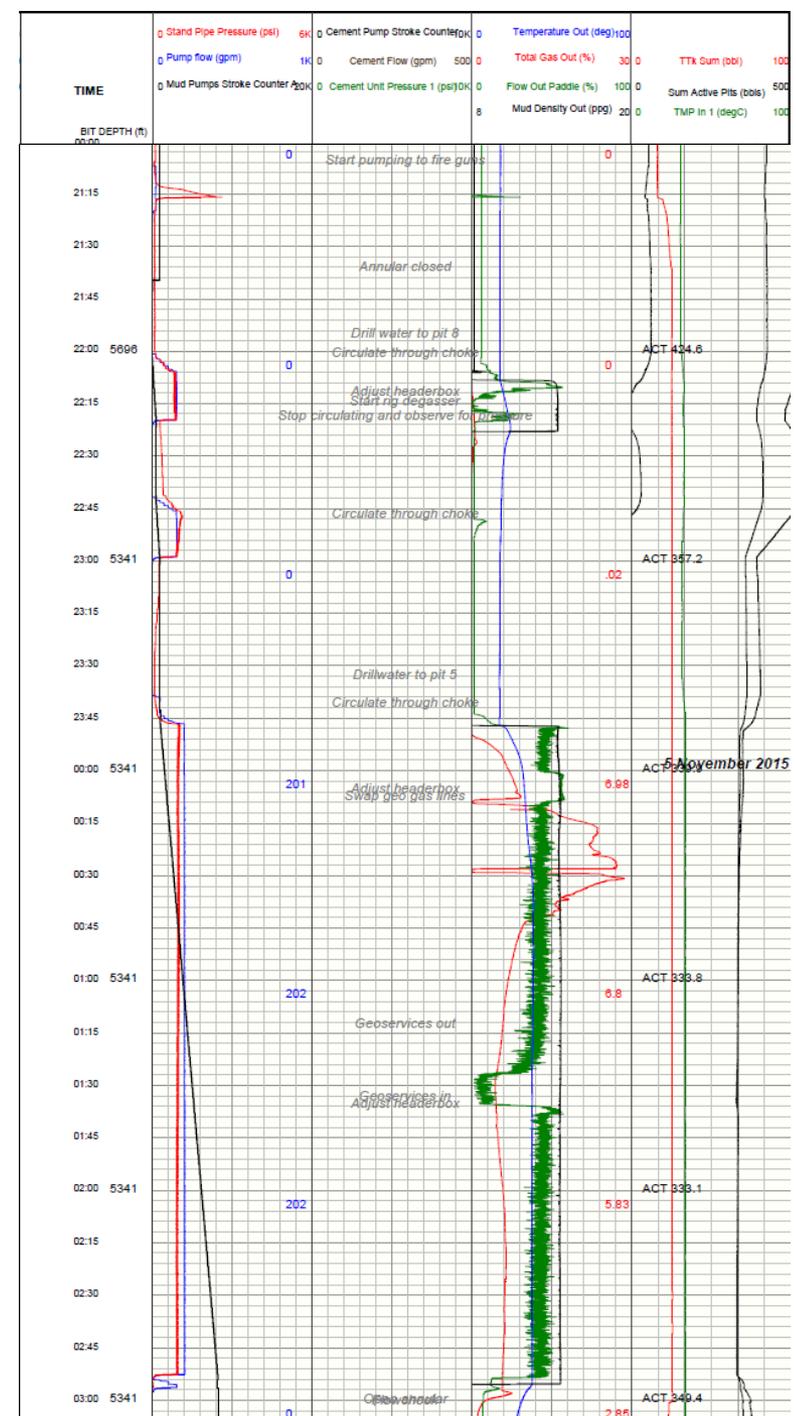
Sequence of well control incident

- Perforate 9 5/8" casing to place Miocene cement barrier plugs.
- Flow Check - Observed well on trip tank – 0.48m³ (3 bbl) gain and increased to 0.8m³ (5 bbl) gain. Closed in and observe pressure build up to 24.1 bar (350 psi) and stabilize.
- Circulate out gas over choke using drillers method with 1325 lpm (153 gpm) for 15 min.
- Close in well and observe pressure build up to 33 bar (480 psi) and stabilize.

Question 1: What will 33 bar (480 psi) surface pressure do to formation with FG – 1.91 sg (16.0 ppg) at 1402 m TVD (4,600 ft)?

Question 2: Which Kill method would you use?

- Continue circulate out gas using drillers method.
- Close in well due to 11.1 m³ (70 bbl) mud loss
- Bleed off pressure from 23.4 bar (340 psi) to zero.
 - 3.4 bar steps
- Circulate out gas over fully open choke
 - Max gas - 27.3% in flow line
- Flow check – 0.2m³ (1,2 bbl) gain
- Circulate bottoms up – well stable
- Continue with P&A operation



Lesson Learned



- Gains observed in Active post Perforation
 - Gas produced from TCP string
 - 100 m³ pr 50 m TCP – 200 m³ in this case
 - Compression at 1402 m (4600 ft) TVD – 0.8m³ (5bbl) gas
 - Some of the gas might migrate to formation

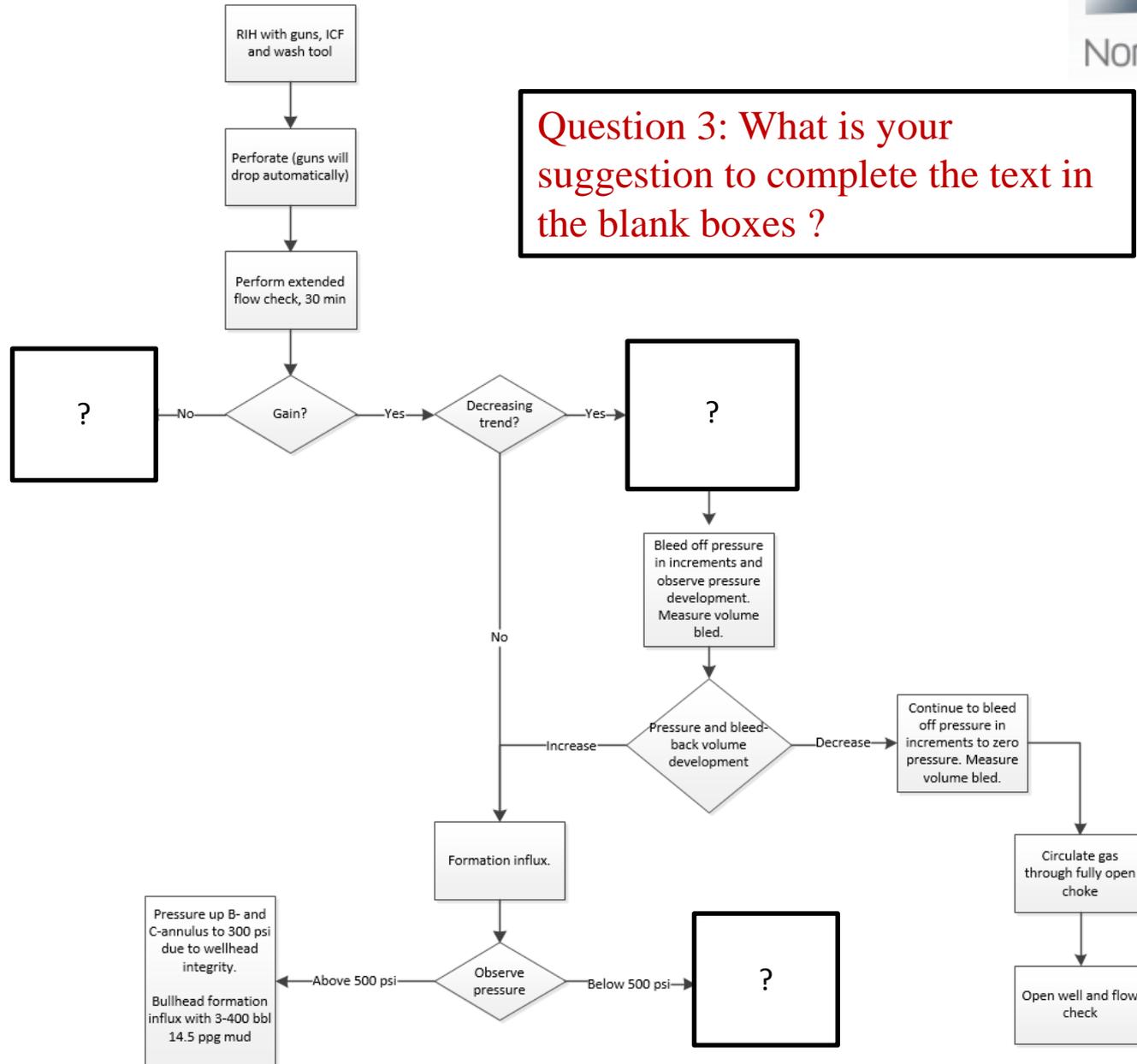
- Post detonation – TCP guns will fill with mud from well bore
 - Inside volume of 50 m 7" TCP string – approx. 1.1 m³
 - With 100 m TCP string – 2.2m³ to fill pipe
 - After gas has been circulated out, losses can be observed as TCP string will fill up with mud post perforation.

- Miocene gas behind casing
 - Experience shows that gas is often trapped behind casing at Miocene depth

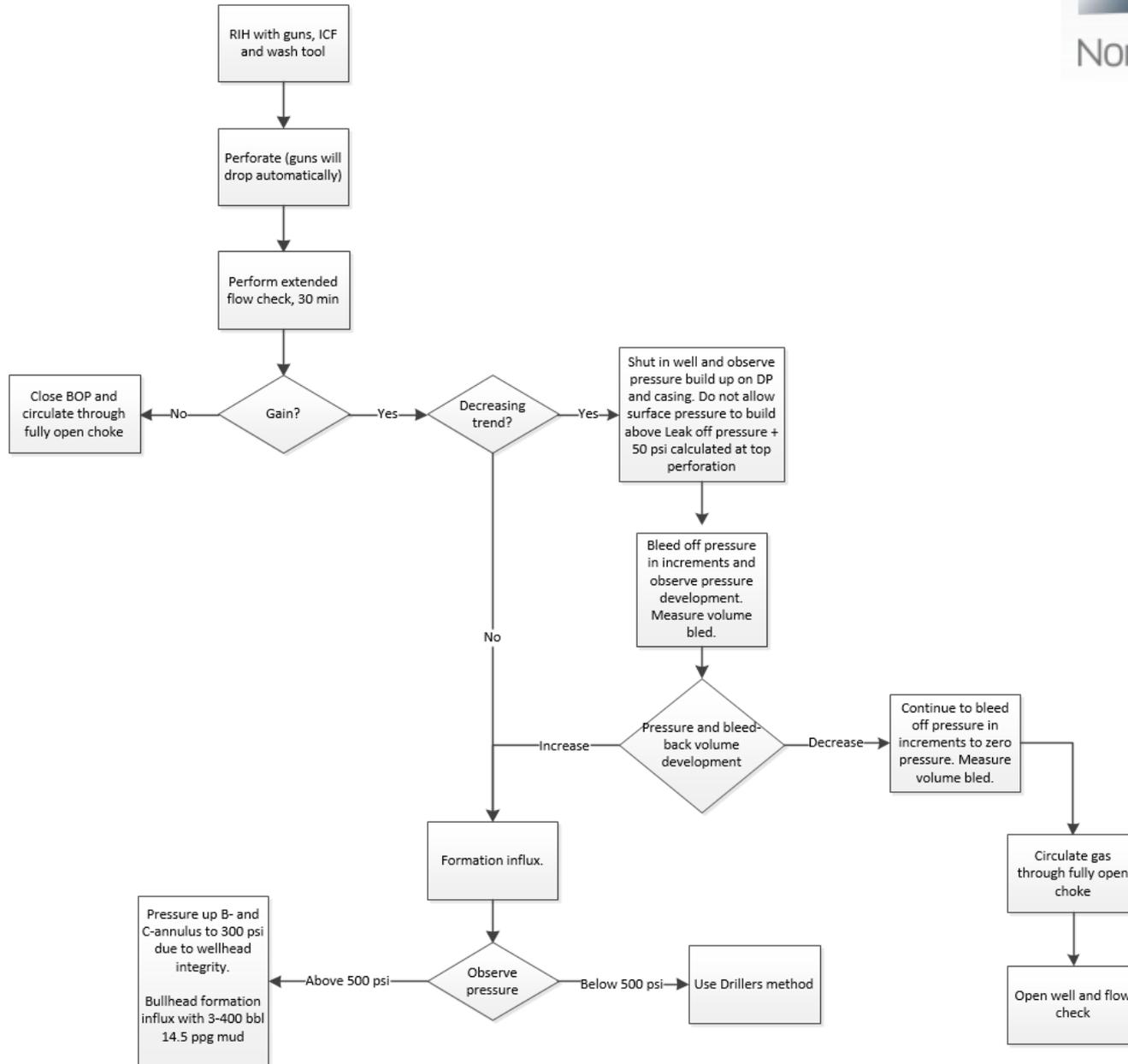
Lesson Learned – Flow Chart Example



Question 3: What is your suggestion to complete the text in the blank boxes ?



Lesson Learned – Flow Chart Example



Discussion



- Perforating casing for Miocene P&A barriers will have risk of gains and gas in returns
 - Trapped gas behind casing
 - Gas from TCP guns
 - Gas from fluid being circulated out

- Losses and Gains
 - Losses and gains will be observed post perforation
 - Gains from gas expansion
 - Losses to formation and to fill TCP string
 - If stable flow check post perforation – Proof of over balance and gains will be a result of gas expansion
 - Do not let surface pressure go above leak off pressure

- Weigh up mud to cure gains and gas influx can result in serious losses due to formation fracture.
 - Circulate out gas through open or closed system depending on gas/gain amount and evaluate situation once gas levels are down to an acceptable level.
 - Field experience to be accounted for

Question 4: Is the detailed operation plan updated with the potential outcome prior to execution?

Question 5: How would you handle the situation according to the operators well control manual and the contractors well control manual?