Risk aspects related to BOP testing

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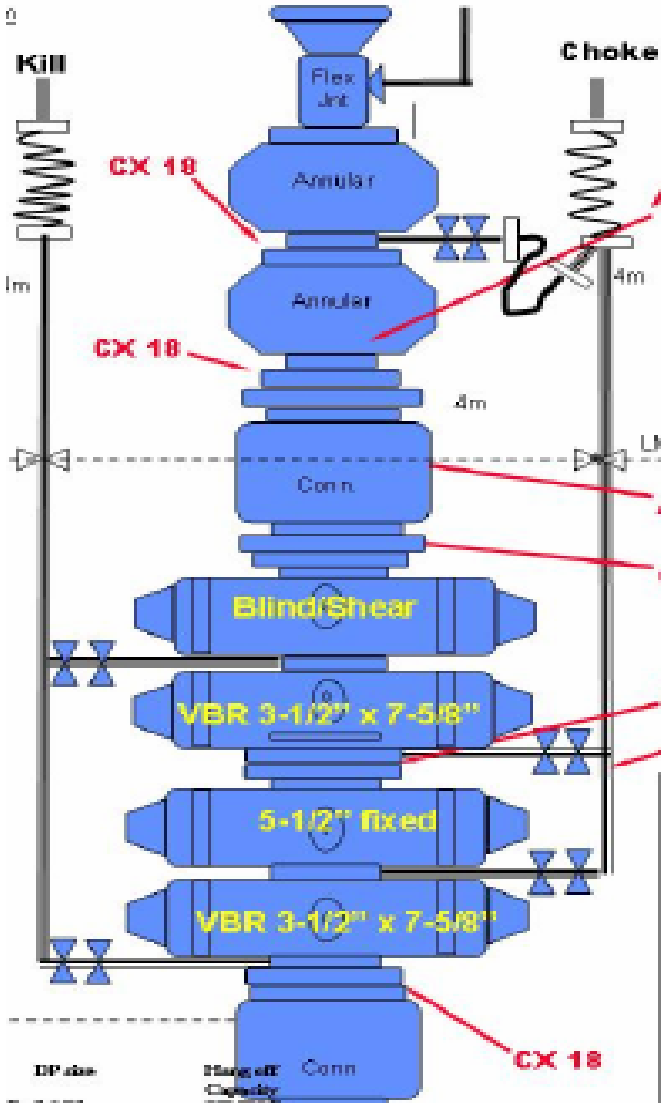
Thor Paulsen

StatoilHydro

BOP – BlowOut Preventer

- Safety critical barrier element in drilling operations
  - Strict requirements to reliability
- Must be capable of terminating potential flow from the well during all activities in a drilling operation
  - BOP's are therefore built up with several packing devices (pipe rams, annular preventers, shear/seal ram) to terminate flow from the well with different drillpipe sizes and without drillpipe through the BOP
- Must be possible to circulate fluid in/out of the well with BOP closed
  - BOP's are therefore equipped with kill and choke lines

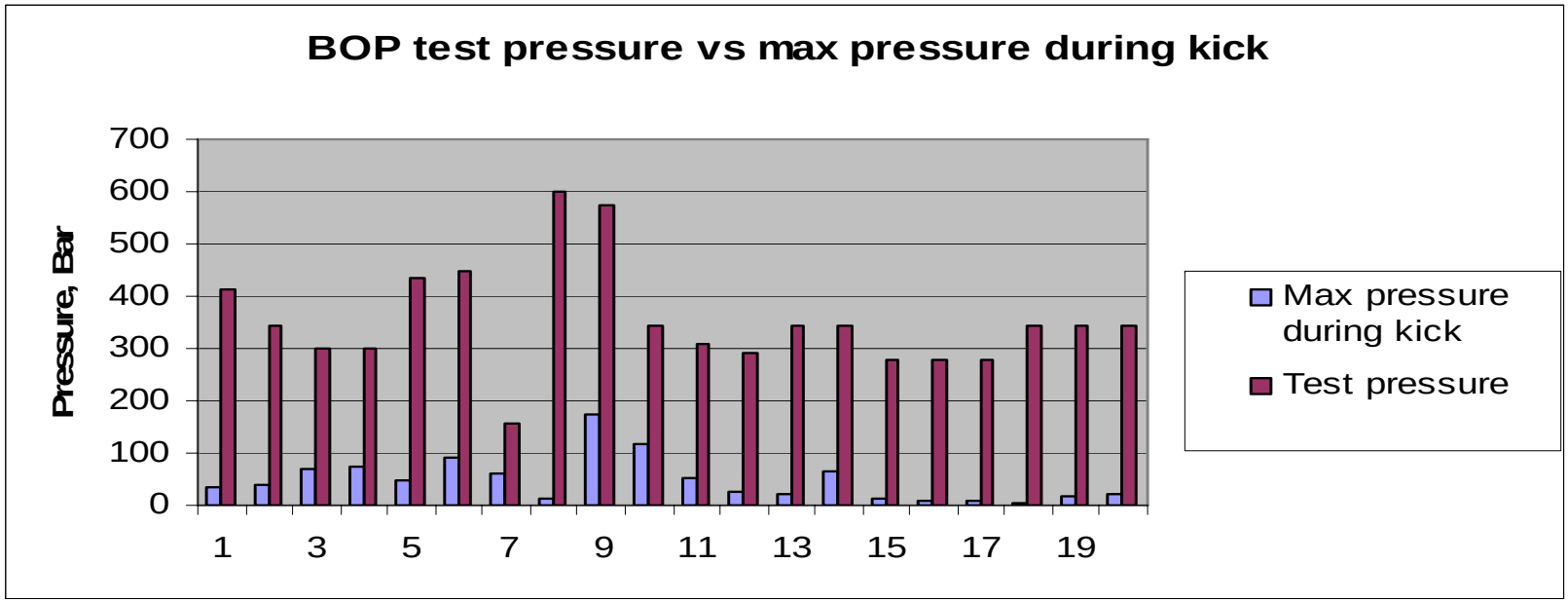


BOP testing requirements

- Requirement to test BOP is:
  - To section design pressure prior to drilling out of a casing
    - Thereafter function test each 7 days
    - Leak test to section design pressure each 14 days
  - All elements are tested, including valves on kill and choke lines, on regular 14 day test, except the shear seal ram which is tested before drilling out of a new casing.

Test pressure

- BOP's are as a minimum tested to maximum estimated pressure for the section to be drilled, i.e. max pore pressure less gas gradient to surface/seabed.
- Test pressure vs max pressure BOP exposed to during incidents
  - Review of 20 kick incidents shows that max pressure below BOP is far less than the pressure that the BOP has been tested to



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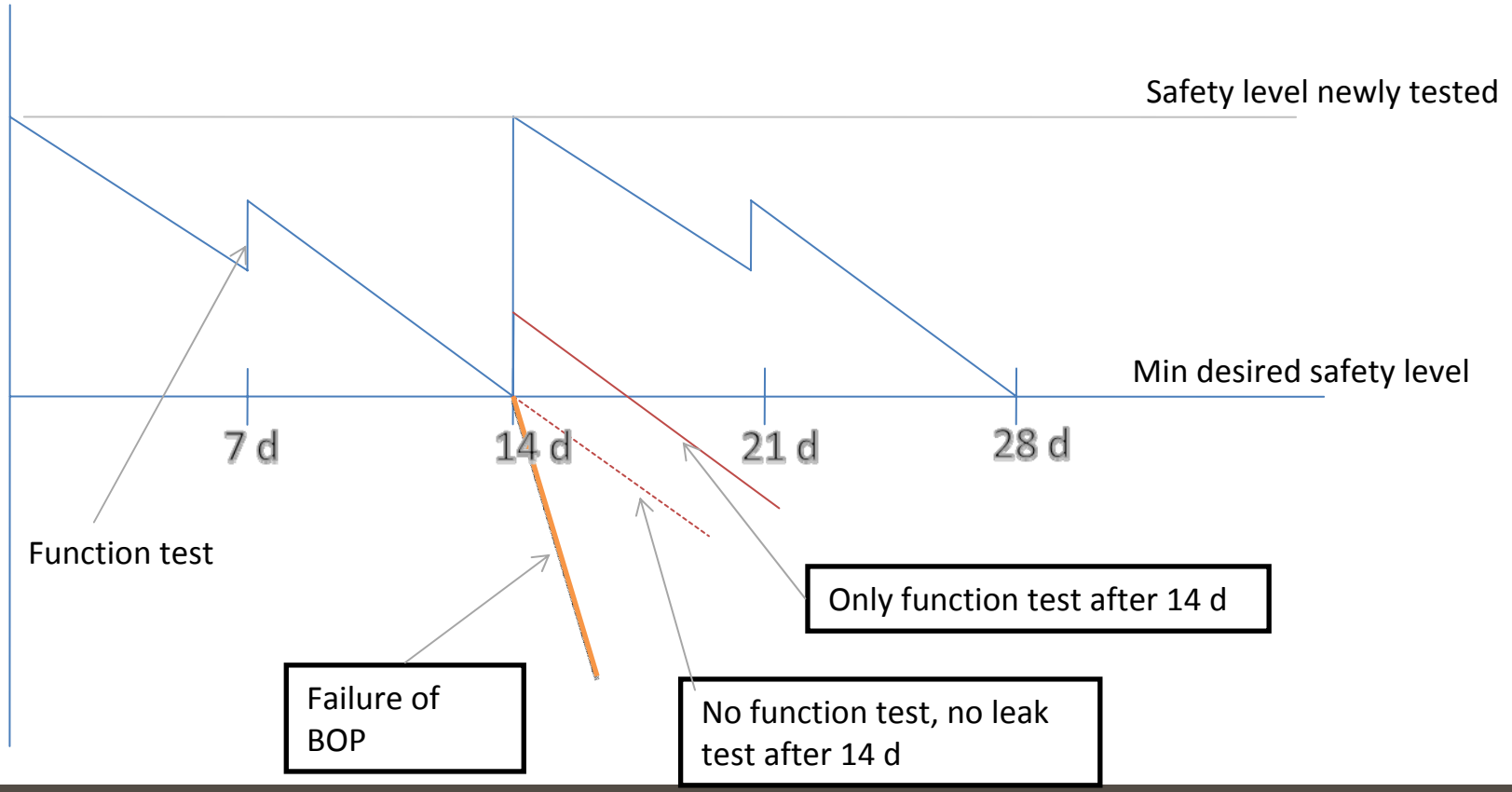
How does the safety level vary?



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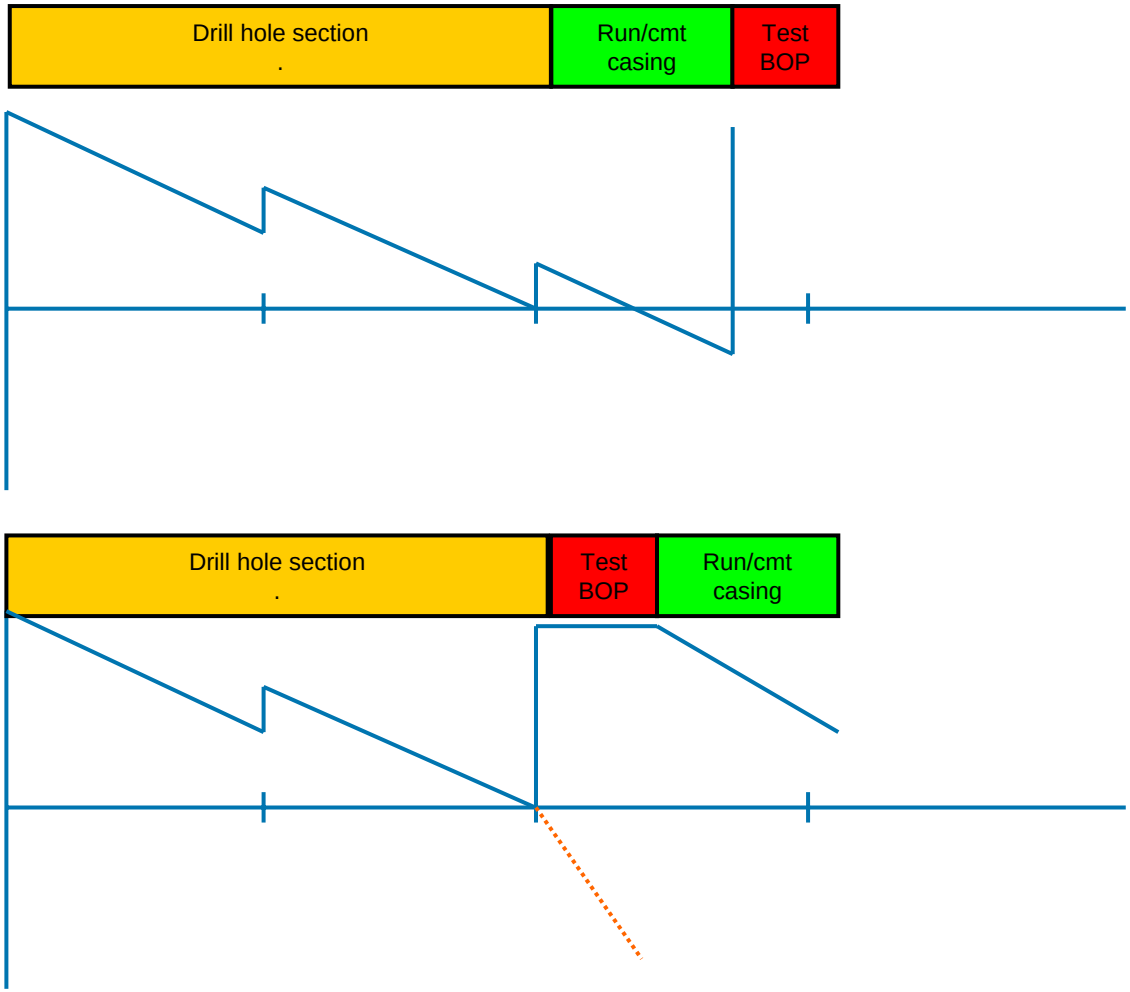
Consequense of failure

- In case of a failure of BOP during test, the BOP need to be pulled for repair.
  - Before pulling for repair, the well must be secured. I.e. two barriers must be established.
    - Barriers that are established must be tested which again exposes the BOP to pressure loads.
  - What is the risk level during this operation?
    - This is very dependent on the status in the well at the time of failure;
      - cased hole?
      - open hole?
      - reservoir exposed?
    - And dependant on type of BOP failure

Illustrative example



Complex picture

- Probability for “provoking” a BOP failure during test?
- Probability for failure of BOP during kick?
- Probability for kick?
- What type of BOP failure?
- Of all registered BOP failures, how many failures can be related to “high pressure” test (that would not have occurred if pressures were low)?

Summary

- Complex subject that need more investigation
- Is it at all possible to calculate risk level and compare with standard testing requirements?
- Is this approach worth looking further into?