

EXAM PART A - Well Integrity (45p)

A gas injection well was drilled in 1980's on a fixed platform. The well was an injector for 30 years and was in shut-in status for the last 10 years. There are currently no pressure readings for the well and a theoretical worst-case scenario estimates a maximum SIWHP of 170 bar. The wellbore schematic has been shown in Appendix A. Review the provided appendix and answer the questions in Part A of this exam. In 2010, due to leak in control line, SCSSV was removed.

A.1. List four well integrity issues that the well is suffering from. **(5p)**

A.2. Define the primary and secondary well barrier envelopes, for having the well in temporarily abandoned status, by listing the well barrier elements. Suggest solution(s), if new well barrier element(s) to be placed for establishing the well barrier envelopes. Mark the envelopes on well schematic provided in Appendix A: primary with "Blue" and secondary with "Red". **(20p)**

A.3. Based on the selected well barrier elements, in previous question, create a well barrier diagram (WBD) and explain the reasoning for making WBD or its outcome. **(15p)**

A.3. List two major well integrity challenges that the production tubing may have been suffering from or experiencing during its life in the well. **(2p)**

A.4. Calculate the initial reservoir pressure. **(3p)**

EXAM PART B – Permanent P&A (55p)

Consider the well presented in Appendix A and cement log in Appendix B to answer the questions in Part B. The reservoir has been depleted and its pressure has been dropped to 160 bar. The simulations suggest that the future SIWHP will be maximum of 170 bar. The production is not economical with the current oil price (occurred due to COVID19 Pandemic situation) and your production department decided to permanently plug and abandon the reservoir, including this gas injector. The geological data shows that there are two sandstone formations in the overburden: Lista and Utsira. Lista contains hydrocarbon with no flow potential. However, it is not recommended to intake hydrocarbon. Utsira is also sandstone formation with permeability but no hydrocarbon or flow potential. Assume gas gradient: 0.02 bar/m.

B.1. Consider the data provided in Appendix A. Explain and list the type of activities that can be done rigless prior to engage a rig. **(5p)**

B.2. Consider the provided data in question and pore-frac. pressure curve (Appendix A). Find and report the minimum setting depth (MSD) to permanently plug and abandon the main reservoir and show it on Appendix A. Explain how did you estimate the MSD? Propose a depth for establishing the permanent envelopes (show it also on Appendix A). Write your reasoning for proposing the depth. **(15p)**

B.3. Consider the SBT (Segmented Bond Log) log provided in Appendix B. Assume that it shows the cement behind 9 5/8-in. casing. There are five tracks presented on the log. Explain the reasoning behind every track and what kind of info do they provide? **(5p)**

B.4. Assume that you are going to permanently plug the main reservoir by establishing primary and secondary barriers. The plugs shall be rock-to-rock and you are going to place them in the depth you selected in Question B.2. List the operational sequences until the rock-to-rock barriers are in place. How are you going to verify the plugs after placement? How much barrier material do you need to establish the barriers? Consider NORSOK D-010 (Rev. 4, 2013) as recommended practice for plug length(s). Report the volume in m³. Which barrier placement technique would you employ? Explain your reasoning for selecting this technique. **(10p)**

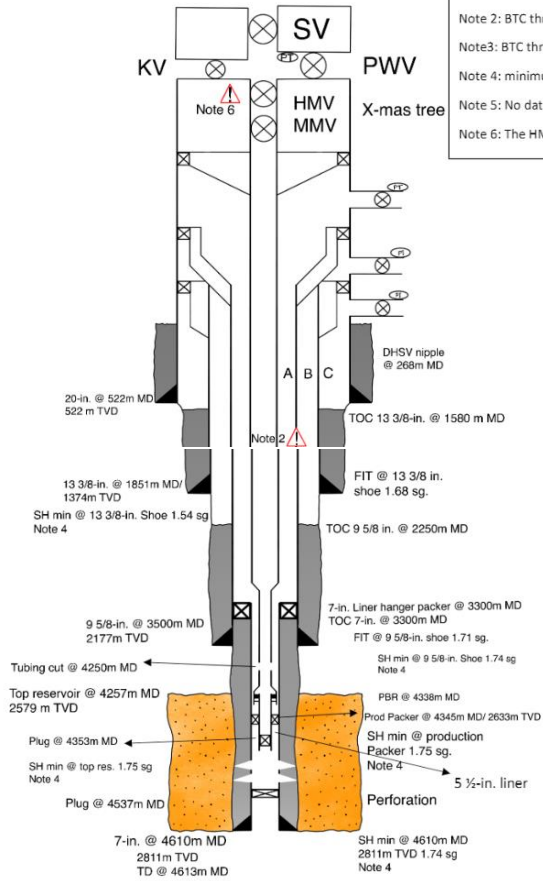
B.5. After permanently abandoning the main reservoir, you need to abandon the source of flows in overburden. How many plugs are required to be installed to seal

the formation(s) in the overburden? Write your reasoning regarding the number of required plugs. Propose depth(s) for the plugs to be installed and also show them on Appendix A. Write your reasoning for the proposed depth(s). List the operational sequences until the barrier(s) are in place. How are you going to verify the plugs after placement? **(10p)**

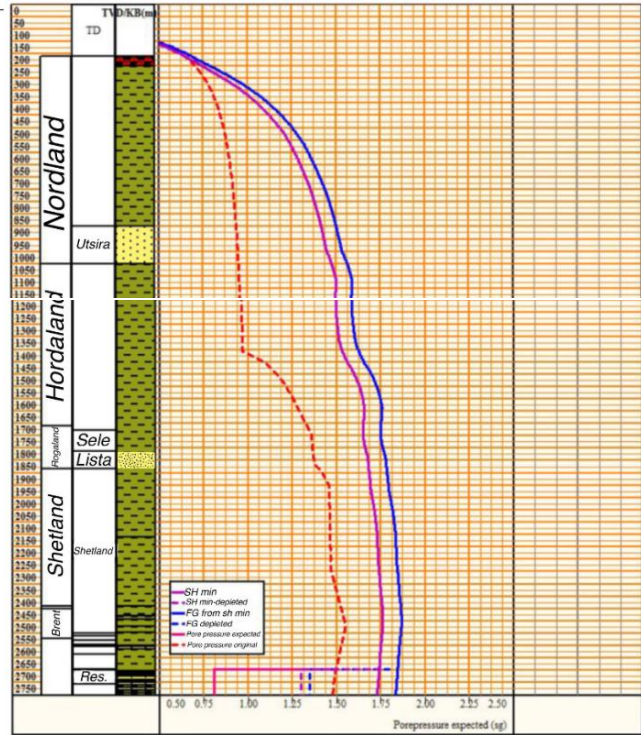
B.6. After sealing the flow potentials in the overburden, environmental plug shall be installed. What is the role of environmental plug? At what depth are you going to establish the plug? How is the plug verified? What is the relationship of environmental plug and Utsira in this specific well? **(10p)**

Good Luck!

Appendix A



- Notes:
- Note 1: TOC is not verified.
 - Note 2: BTC threads in 9 5/8-in. casing are not gas tight.
 - Note 3: BTC threads in 13 3/8-in. casing are not gas tight.
 - Note 4: minimum horizontal stress is estimation from frac gradient curve.
 - Note 5: No data available.
 - Note 6: The HMV does not function as per definition from requirements.



Appendix B

