

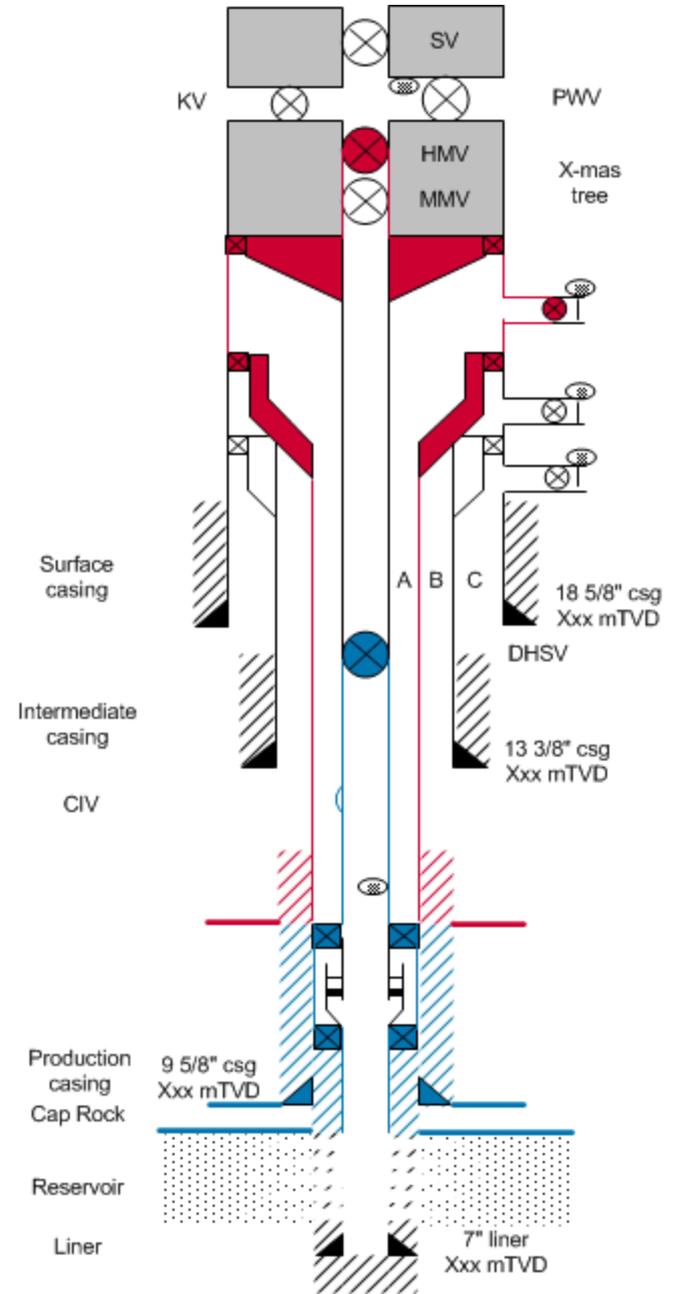


NORSOK D-010 input from WIF

a summary of the main input

General requirement of use of well barrier schematics according to OLF 117

- A drawing illustrating the barrier envelopes. Primary barrier shown with blue colour and secondary with red colour.
 - All casings and cement, including the surface casing, should be presented and labelled with its size and TVD depths
 - The formation strength should be indicated for formation within the barrier envelopes
 - Reservoir(s) should be shown, and separate WBSs prepared if not common well barriers for the different reservoirs.
 - Depths should be shown relatively correct according to each barrier element
- Each barrier element in the barrier envelope(s) should be presented in a table along with its integrity-verification test results and method for monitoring.
- There should be separate fields for the following well information: Installation, well name, well type, well status, MWDP or MSDP, revision number and date, "Prepared by", "Verified/Approved by". Include a Note field for important well integrity information.
- Clear indication if the WBS shows the planned or actual well barrier status for the activity/operation.
- Only qualified WBEs shall be shown as part of the primary and secondary barrier. Any failed or impaired WBEs shall be clearly marked and stated on the well barrier schematic.

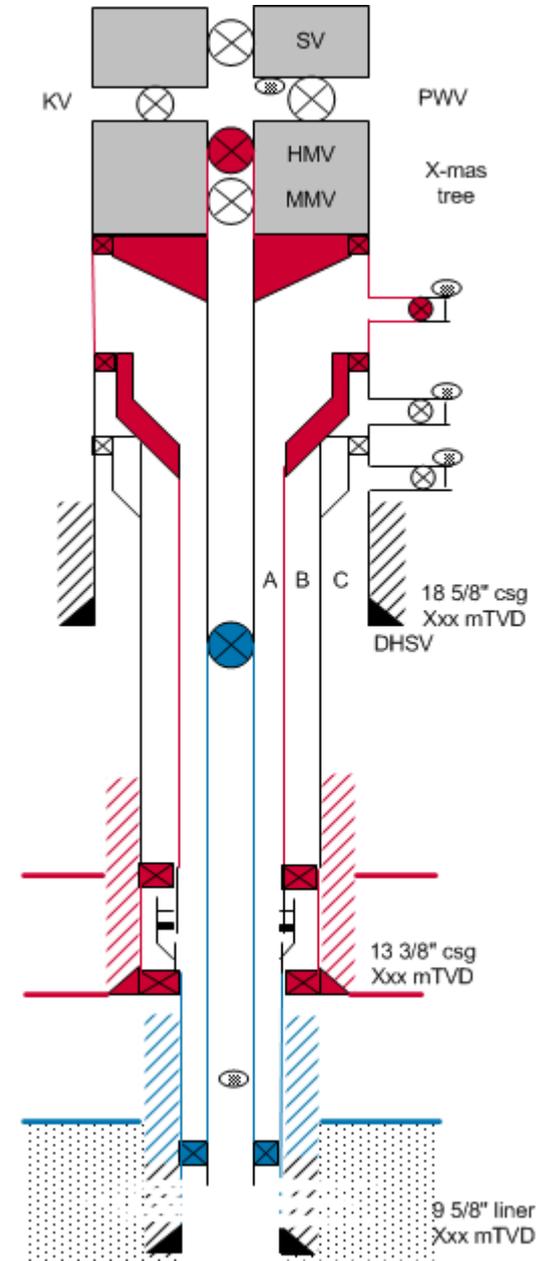


Maintenance program and procedures

- A preventive maintenance program shall be prepared for all WBEs where the integrity status is not continuously monitored or pressure trended. All periodical inspections, leak and function tests shall be a part of the maintenance program.
- Minimum required test frequencies but also based on:
 - reliability data - maximum 2% yearly failure rate of valve type on an installation, for safety critical valves.
 - Special well conditions - risk of corrosion, sand production, high flow rates, deposits and scale
 - Changes in flow composition
- Procedures for periodic testing, monitoring, start up and shut down of well shall be prepared. The procedures shall clearly state the method, limits, steps and any precautions.
- Verify shutdown function before operating the well. Assess required closure time based on risk and operating well conditions.

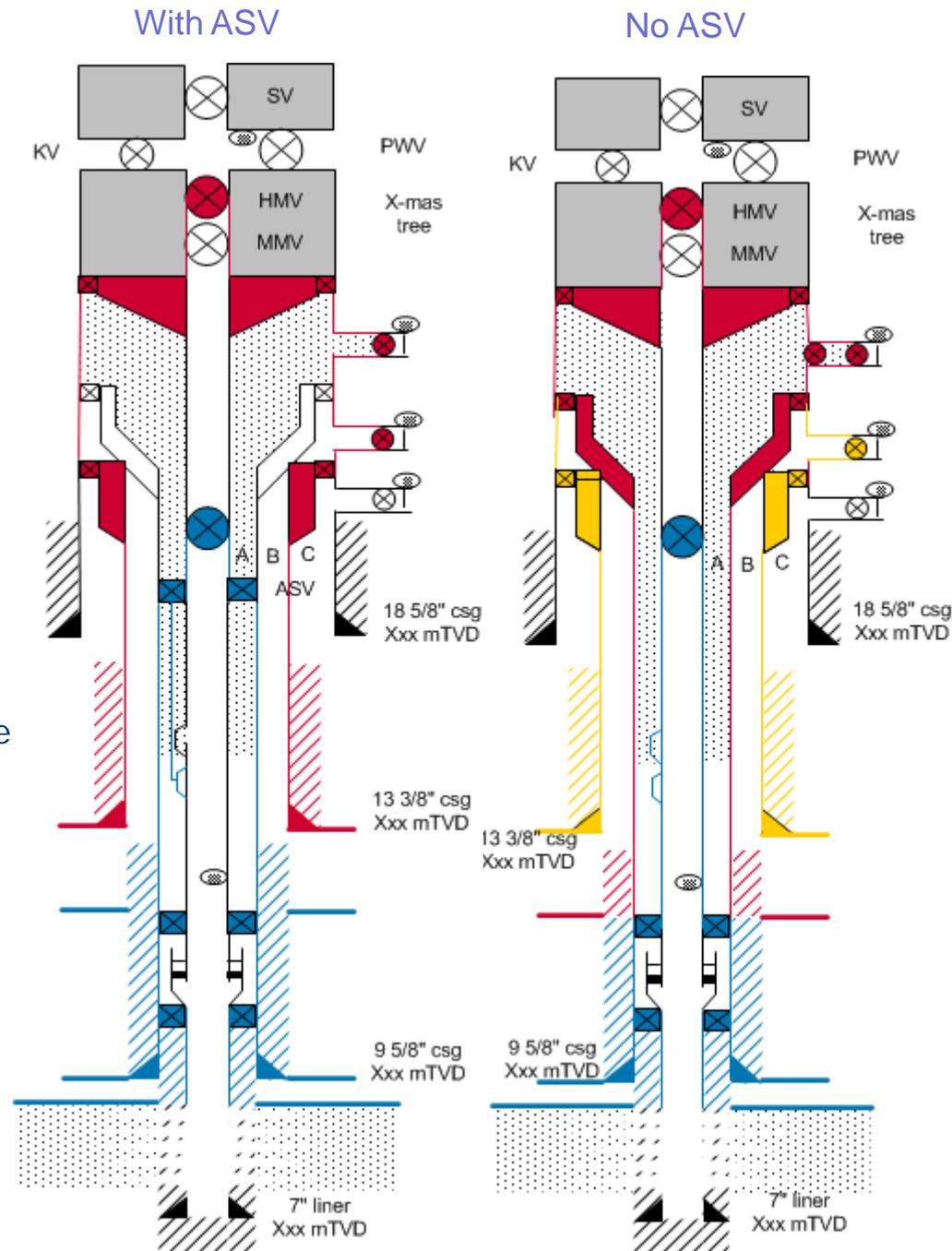
Disposal and injection wells

- All injection wells shall have a mechanical annular seal between the completion string and the casing/liner, e.g. production packer. The annular seal shall be installed at a depth ensuring that the injection or any casing leak below the seal will not lead to fracturing of the cap rock or leak to shallower formations when applying METP. The requirement for downhole pressure monitoring shall be evaluated.
- For wells that are injecting at a higher pressure than the formation barrier strength at depth, the following shall apply:
 - the production packer shall be set below the cap rock
 - the cement shall be logged and confirmed bonding from the top perforation up to 200m above top of reservoir.
 - it shall be documented that the injection will not result in a reservoir pressure exceeding the formation barrier strength.



Gas lift wells

- have ASCSSV or Any other downhole device that is qualified as a well barrier element in addition to what is found in the wellhead area.
 - Analysis and/or risk assessment shall show that any hydrocarbon volume in the annulus above the primary barrier shall not have unacceptable consequences if the wellhead/surface well barrier is lost. The total risk for the installation shall be included in the analysis.
- Intermediate casing and formation/cement act as barrier against gas lift pressure unless analysis and/or risk assessment shows that any hydrocarbon volume in the annulus do not have unacceptable consequences if the wellhead/production casing barrier is lost.



Logging of casing integrity after drilling activities

- All casing strings that are part of well barrier or load bearing casings shall be logged for wear after drilling if simulation shows risk of significant wear

Main changes for chapter 8 - Production

- Updated well barrier schematics according to OLF 117 - and more examples of typical well types
- Updated requirements for handover documentation - according to OLF 117
- Requirements for operating envelopes for pressures, temperature, flow rates, composition of well fluid and passive annuli
- Requirements for alarm limits
 - For assuring maintenance of operational limits
 - For trending and early detection of annulus leakages
- Annulus pressure envelope considerations:
 - Temperature effects
 - Response time
 - Changes in fluid densities
 - Risk of communication between tubulars or escalation risk if such communication should occur
- For valves bordering to external environment / surroundings (e.g. swab valve), no leakage is acceptable. (Otherwise API RP 14B)

Main changes for chapter 8 - Production (continue)

Category	Principle
Red	One barrier failure and the other is degraded/not verified, or leak to surface
Orange	One barrier failure and the other is intact, or a single failure may lead to leak to surface
Yellow	One barrier degraded, the other is intact
Green	Healthy well - no or minor issue

- All wells shall be well integrity categorised according to the fulfilment of the well barrier philosophy (ref OLF 117)
- Registered anomalies shall be investigated to determine the source of anomaly and if relevant, quantify any leak rate across the well barrier. When assessing a well barrier anomaly the following should be taken into consideration:
 1. method of normalisation of the situation and restoring of two independent well barriers;
 2. gas and/or liquid leak rate across the well barrier;
 3. ensure that the acceptance criteria for qualifying the well barrier is maintained;
 4. possibility of deterioration of the leak;
 5. blow-out potential should the secondary well barrier fail;
 6. verification of well design to ensure that the present design can manage new load scenarios;
 7. ensure that the operating limits are still valid.
- Upon confirmation of loss of the defined well barrier, in general the well shall be shut in and the remaining barrier verified. No other activities than reestablishing barrier shall be carried out, and reestablishing shall be prioritized.
- If for any reason the risk of loss of containment is significantly increased by shutting in the well, the well may be kept on production pending well barrier reestablishment.