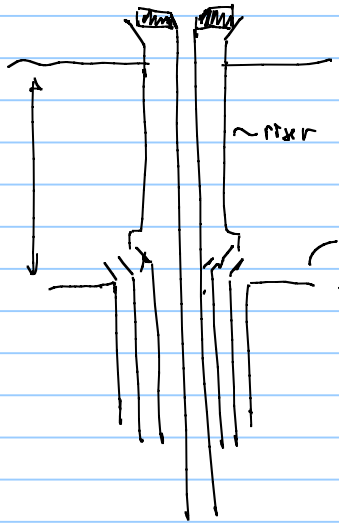
- Considerations when selecting an offshore structure (cont.)
- Layout of production systems → (Subsea)

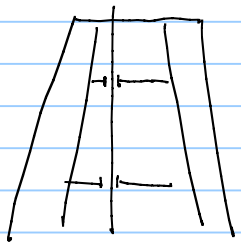
Vortex shedding (cool video) by Harvard science demonstrations

https://www.youtube.com/watch?v=_Hbbkd2d3H8&feature=youtu.be

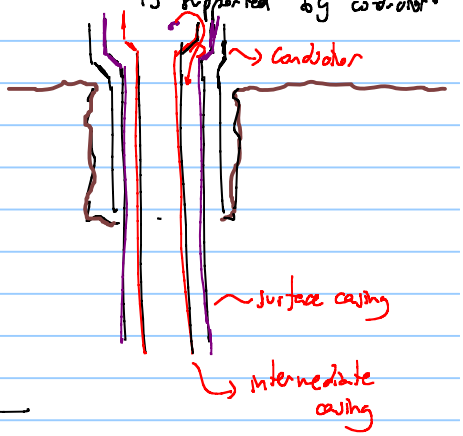
Structures that allow dry x-mas tree → bottom-supported → if water depth is small, well are drilled like onshore
↘ SPAR, TLP, Semi-sub?
↳ movement is restricted by tethers
↳ long hull limits movement

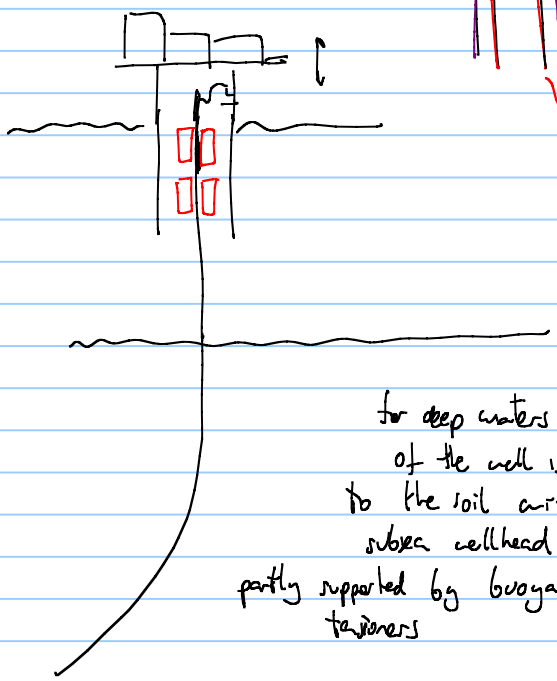
wells





weight of the well is supported by conductor





for deep waters, the weight of the well is partly transferred to the soil with a subsea wellhead and partly supported by buoyancy cans or tensioners

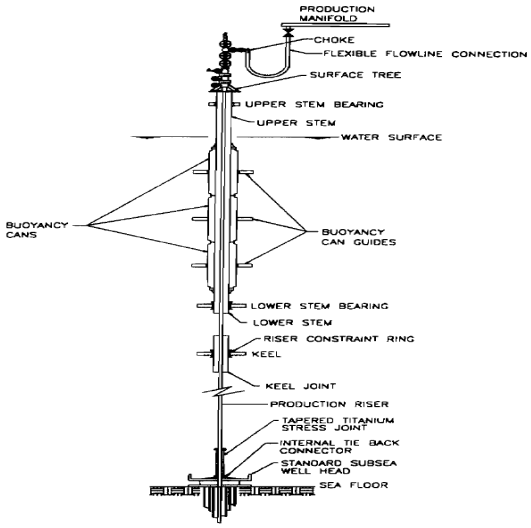


Figure 6 - Well System

OTC 8382

Neptune Project: Spar History and Design Considerations
R.S. Glanville, J.E. Halkyard, R.L. Davies, A. Steen, F. Frimm, Deep Oil Technology, Inc.

OTC 16199

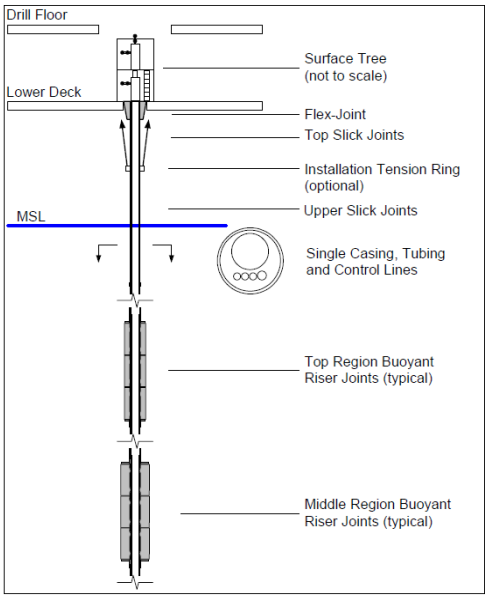
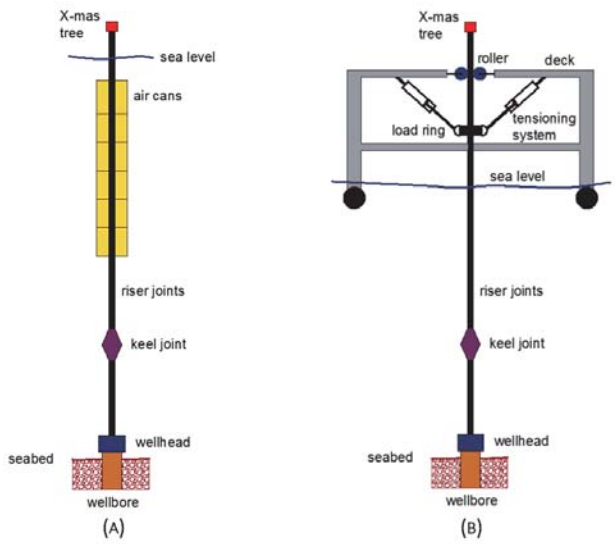
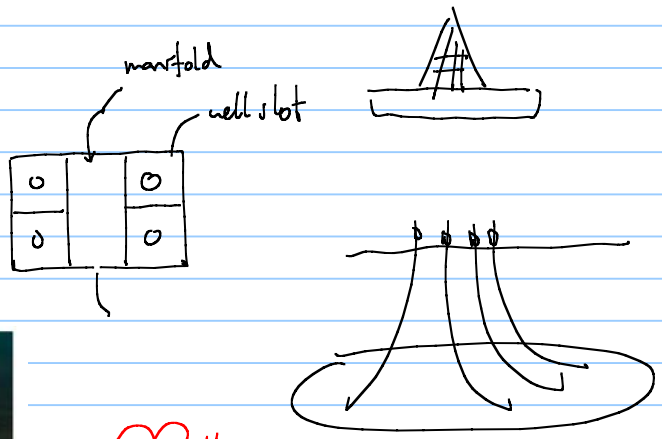


Figure 7a Production CVAR Stack-up (top half)



Layout of Subsea production systems

- template well (cluster)



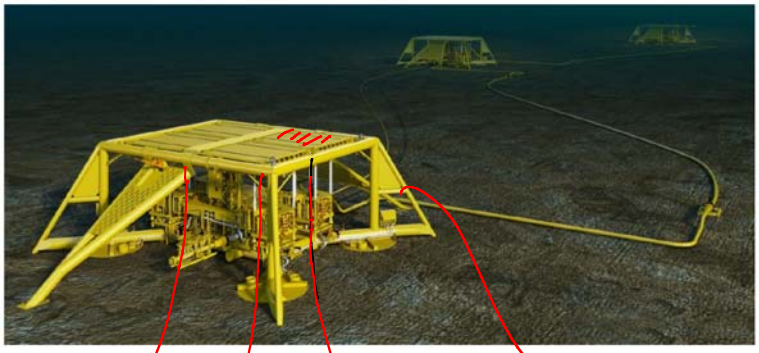
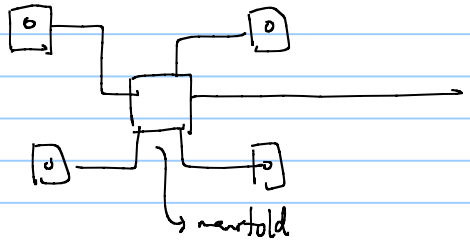


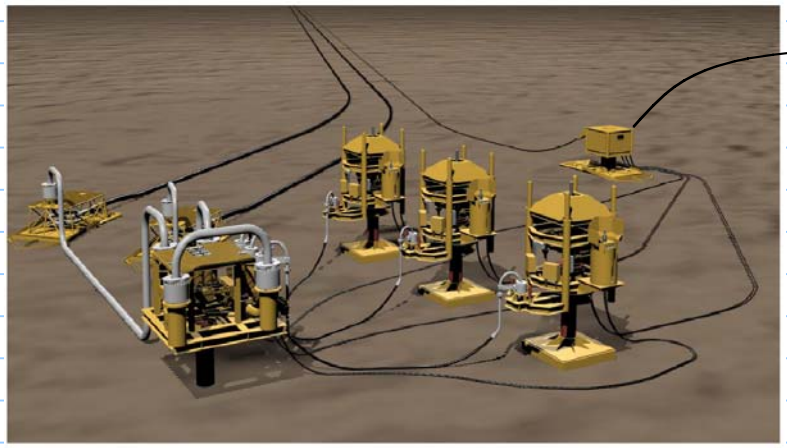
Figure 3.3 Typical NCS tie-back solution (Image: Statoil ASA)

Norway

Template (provides protection against fishing nets, etc.)

- clustered satellite wells → well are close to each other but are not on same template

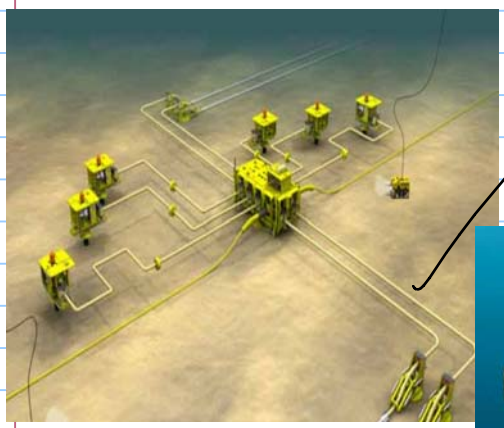




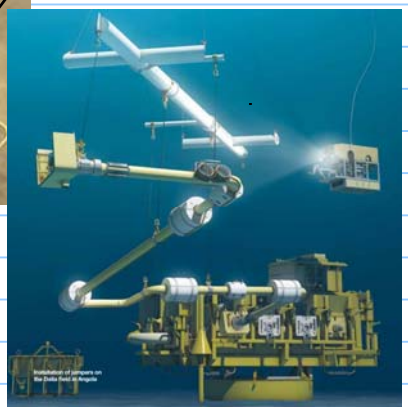
SDU subsea distribution unit

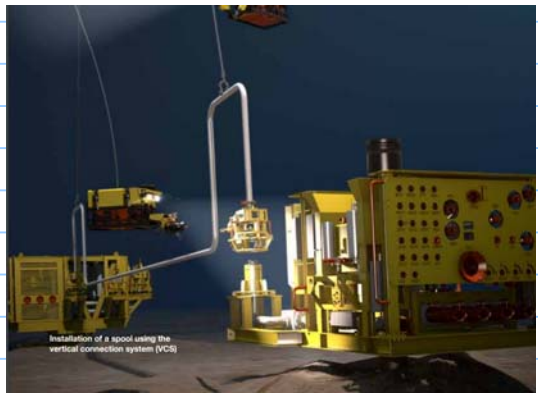
GoM

Figure 3.4 Typical GOM subsea tie-back

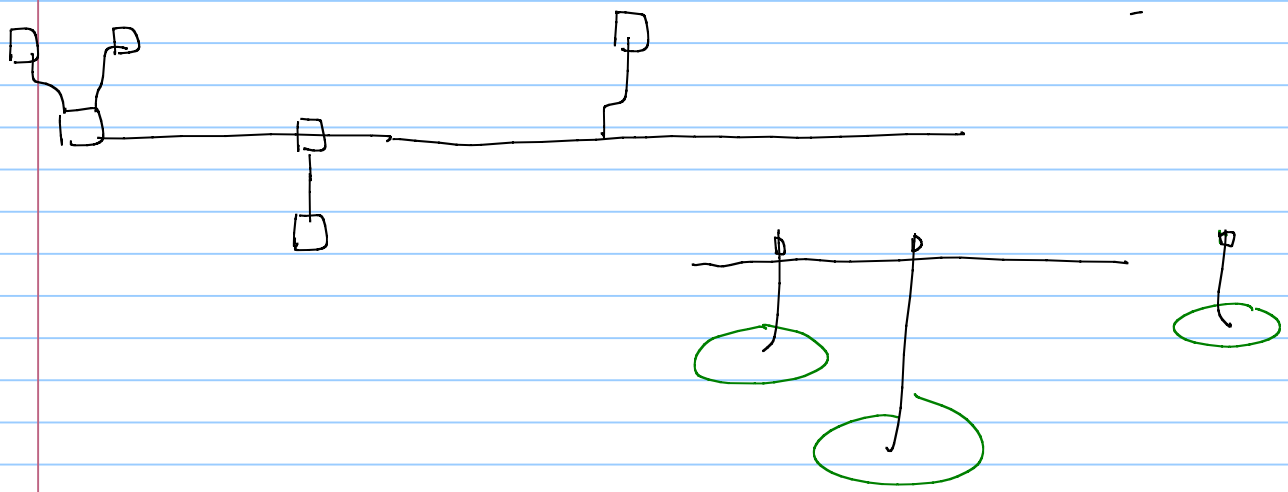


jumper (rigid pipe)



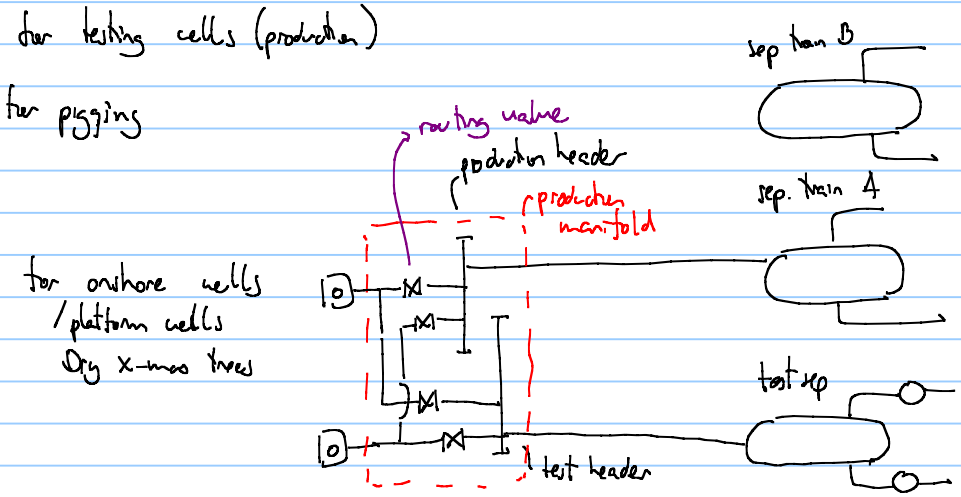


- satellite wells (not clustered). Expensive! (if many wells) drilling rig must be mobilized many times

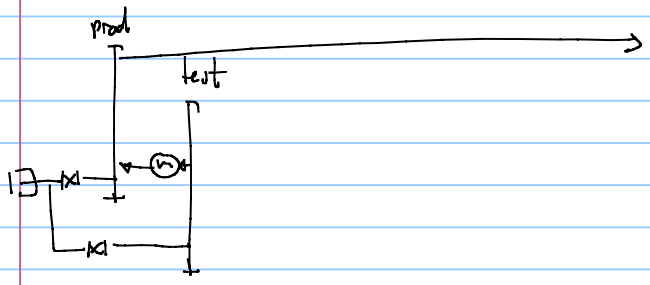


Important considerations for defining the layout of production system:

- need for testing wells (production)
- need for pigging



when multiple trains are used usually a routing study is perform to balance q_o, q_w, q_g for each train, to avoid bottlenecks



on land portable test seperators are used

What about subsea ?

RESOLUÇÃO CONJUNTA ANP/INMETRO Nº 1, DE 10.6.2013 - DOU 12.6.2013 – RETIFICADA DOU 17.6.2013

7.2.7. Testes de poços

7.2.7.1. Nos casos em que os resultados dos testes de poços sejam utilizados somente para apropriação da produção aos poços, cada poço em produção deve ser testado com um intervalo entre testes sucessivos não superior a noventa dias, ou sempre que houver mudanças nas condições usuais de operação ou quando forem detectadas variações na produção.

90 day testing interval

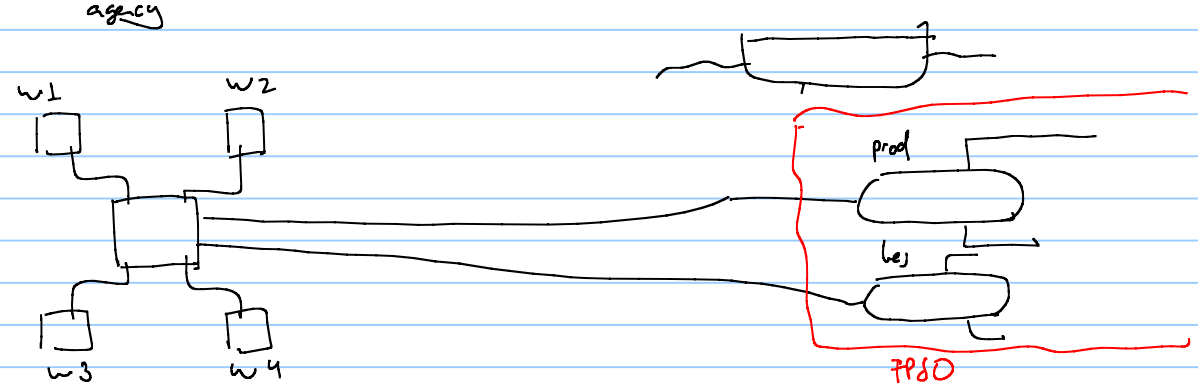
7.2.7.2. Quando os resultados dos testes de poços forem utilizados para apropriação da produção a um campo, em casos de medição fiscal compartilhada, cada poço em produção deve ser testado em intervalos não superiores a quarenta e dois dias, ou sempre que houver mudanças nas condições usuais de operação ou quando forem detectadas variações na produção.

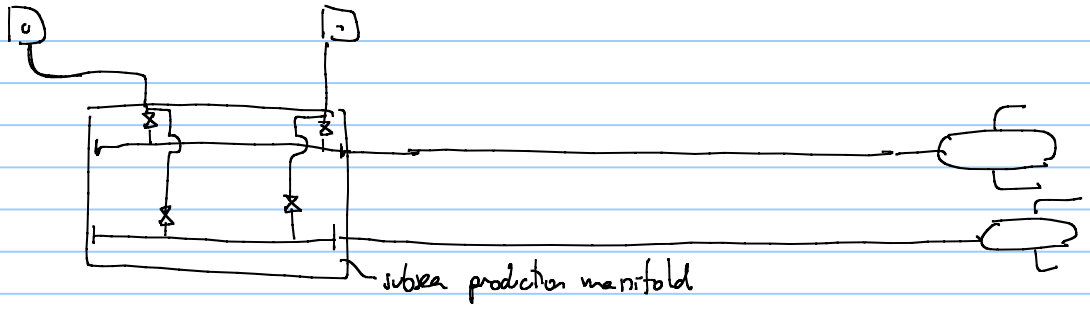
7.2.7.4. Devem ser utilizados separadores de testes ou tanques de testes nos testes de poços. Outros métodos de testes, utilizando novas tecnologias, devem ser previamente aprovados pela ANP.

http://www.anp.gov.br/wwwanp/?dw=66648

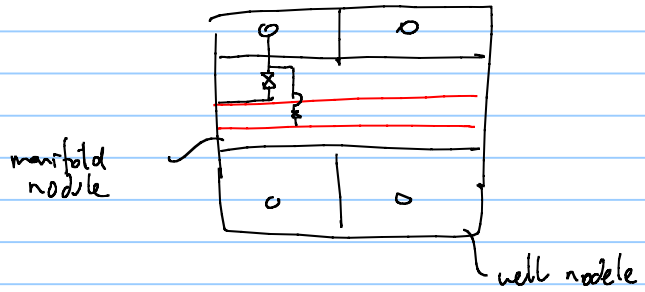
(ANP National petroleum agency

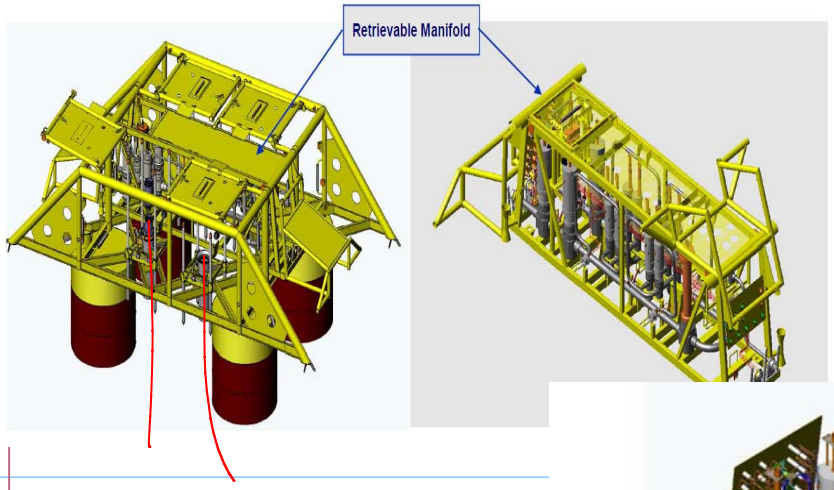
Must use test separator or test "tanks" for well testing



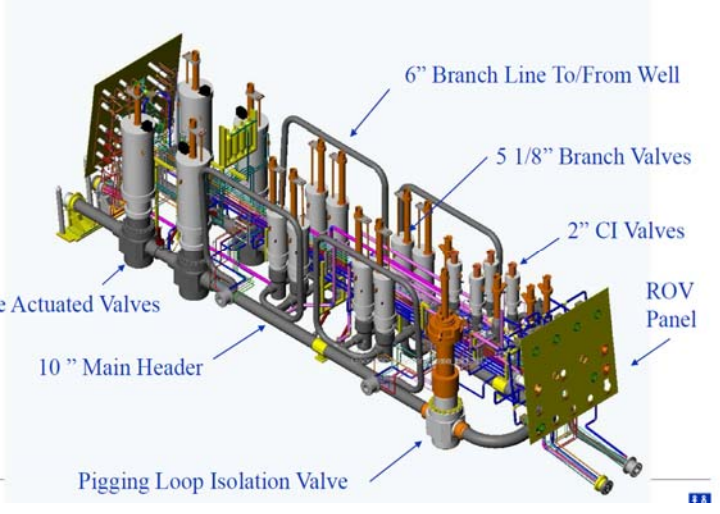


template clustered wells





DNV



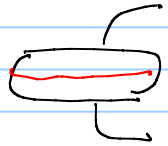
http://www.npd.no/Global/Engelsk/5-Rules-and-regulations/NPD-

REGULATIONS RELATING TO MEASUREMENT OF PETROLEUM FOR FISCAL PURPOSES AND FOR CALCULATION OF CO_2-TAX (THE MEASUREMENT REGULATIONS)

separating!

Multiphase measurement

Multiphase measurement may be used if traditional single phase measurement of hydrocarbons is not possible for financial reasons. The multiphase meter can then be used as a fiscal meter.

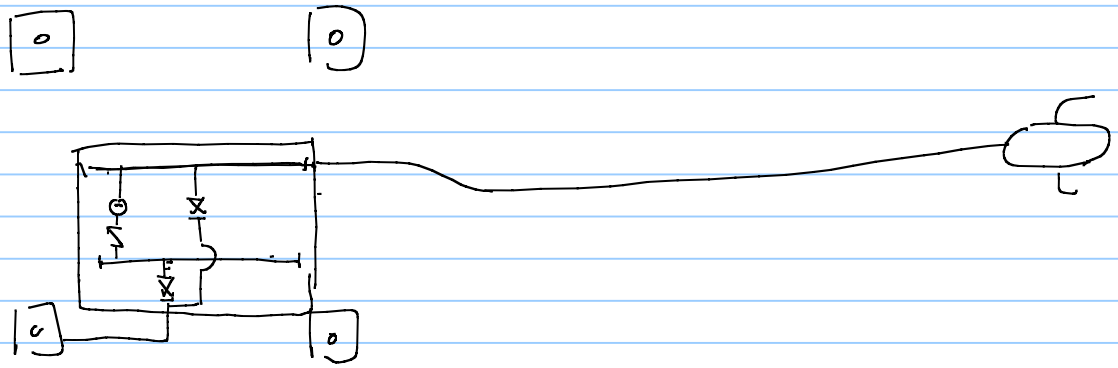


The following elements shall be satisfactorily documented to allow use of a concept based on multiphase measurement, cf. Chapter VII and Section 18:

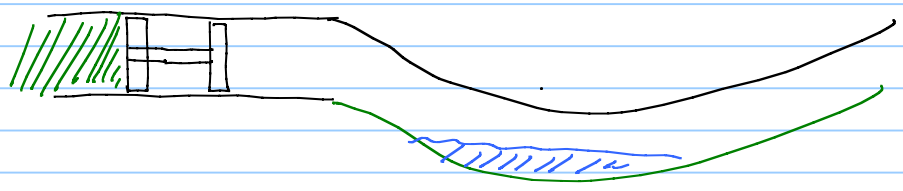
- The operator shall present a concept to the Norwegian Petroleum Directorate for comments and formal processing well before submitting the Plan for Development and Operation (PDO). An estimate of the expected measurement uncertainty shall be presented, combined with financial figures for the risk of loss between production licenses (cf. NORSOK I-105), Annex C).
- The main principles of the operations and maintenance philosophy shall be described.
- Possibility to calibrate meters against test separator or other reference.
- Redundancy in sensors and robustness in the design of the measurement concept.
- Relevant PVT (equation of state) model and representative sampling opportunity to be able to perform a sound PVT calculation.
- Design of inlet pipes to ensure similar conditions if multiple meters are used in parallel.
- Flexibility in the system for handling varying GVF (gas volume fraction).
- The planned method for condition monitoring and/or planned calibration interval shall be described.
- The planned method and interval for sampling and updating PVT data shall be described.

When the multiphase meters are part of the fiscal measurement system, they shall be treated as other fiscal measurement equipment and the administrative requirements which apply pursuant to these Regulations shall therefore be fulfilled.

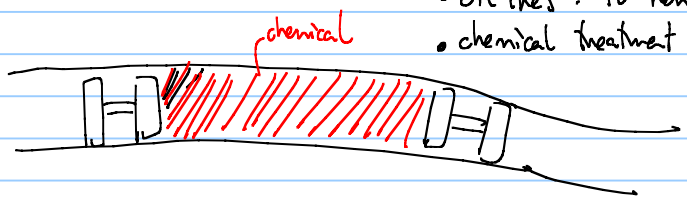
if multiphase meter is to be used multiphase meter on manifold



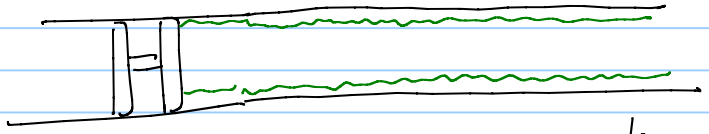
- Need for pigging : Send pig in the pipeline / flowline / manifold
  - gas line : to remove liquids



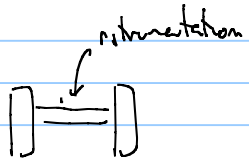
  - oil lines : to remove water
  - chemical treatment



- wax scrapping

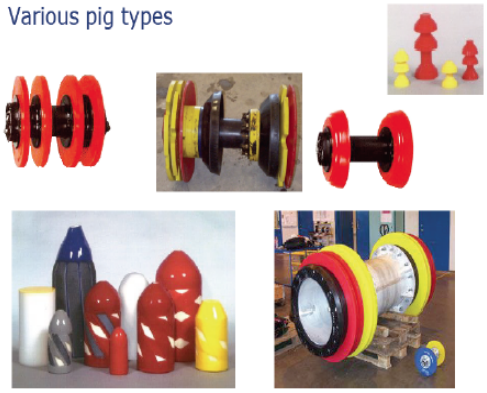


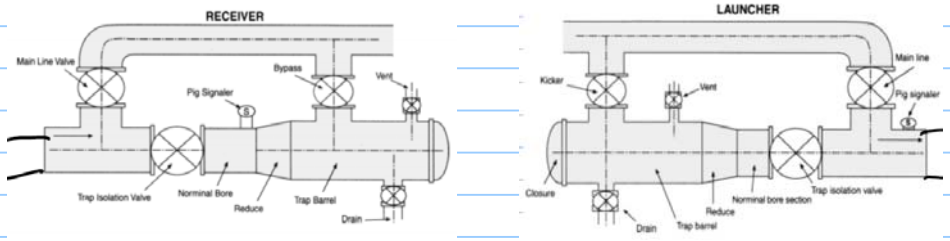
- cleaning
- inspection



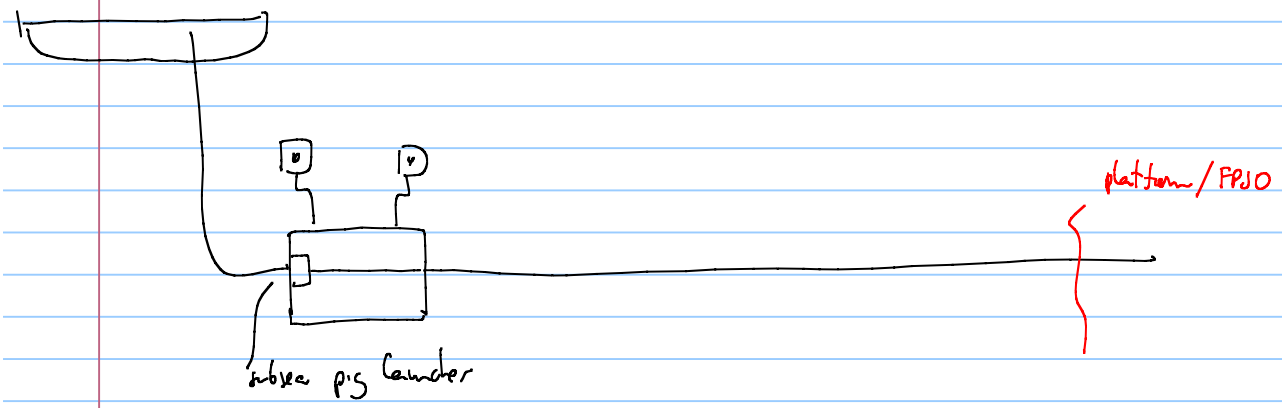
Wax plug-North Sea line pigging

Various pig types





Pigging can also be performed by subsea launcher



- If frequent pigging is expected → a pigging loop must be deployed
  If pigging is not required often / pipeline is very long → subsea pig launcher

Pigging is typically done on oil export flowlines to remove wax deposits