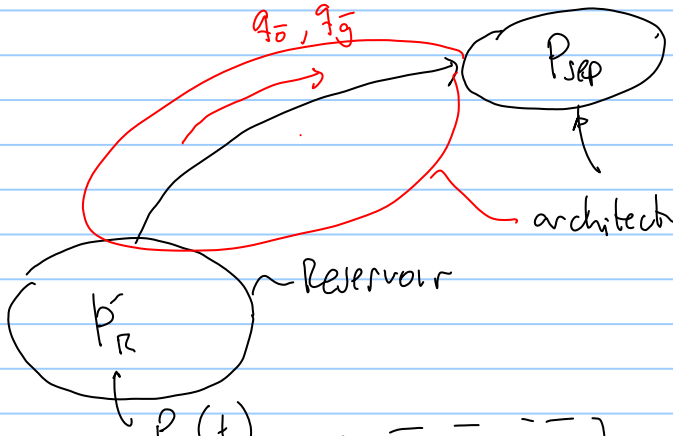
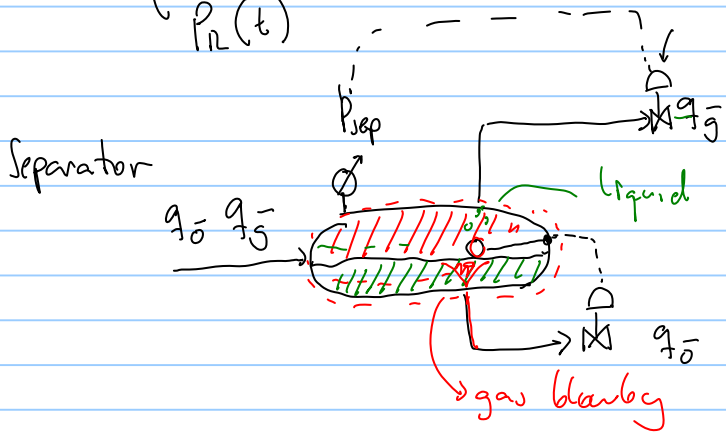
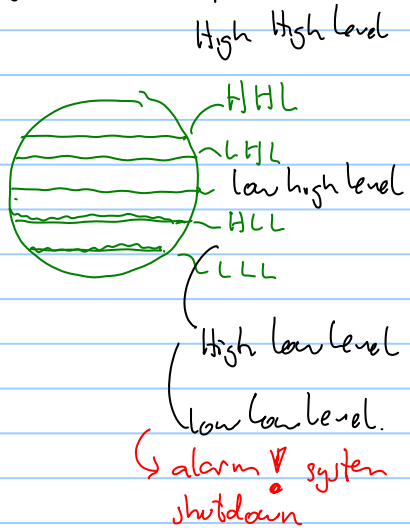
Prof. Milan Stanko

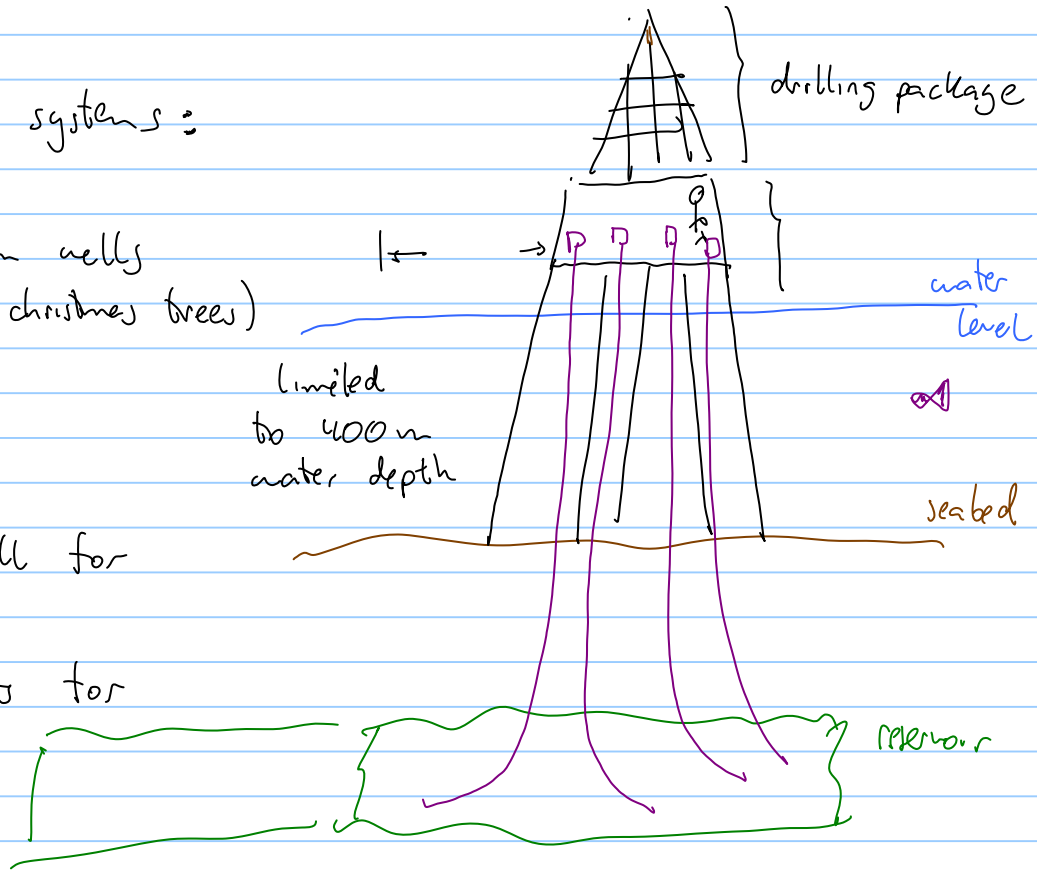


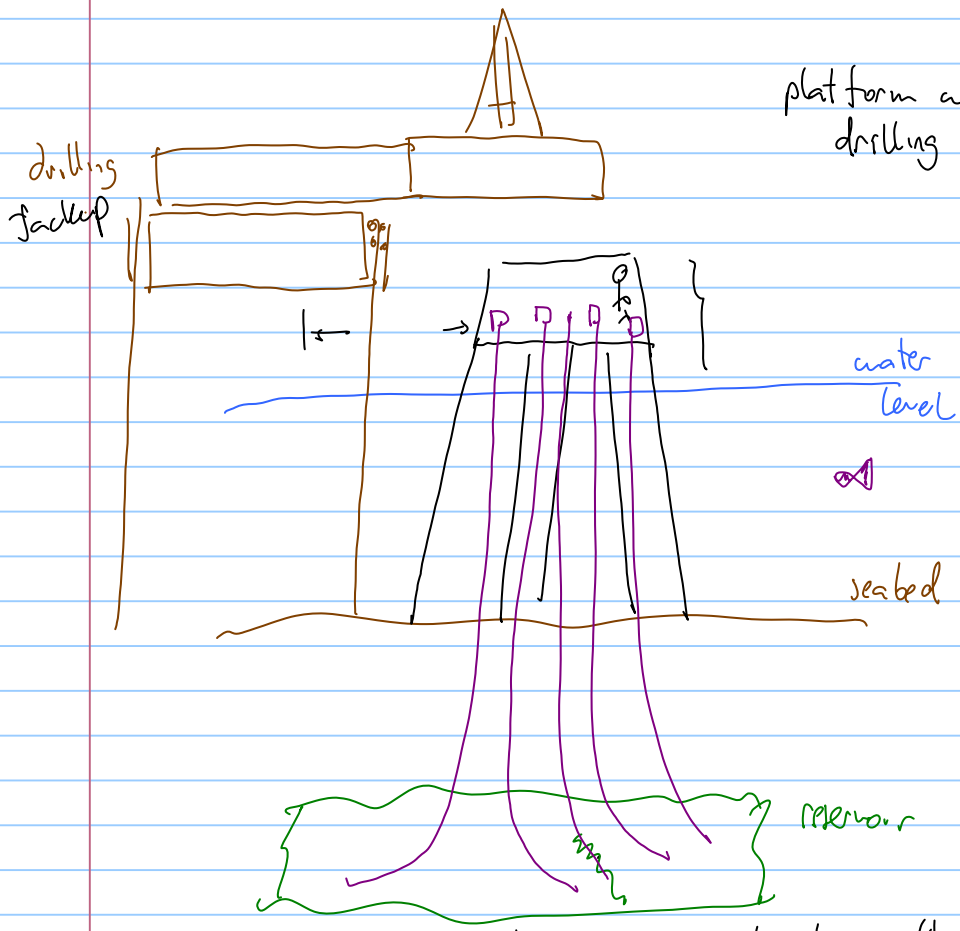




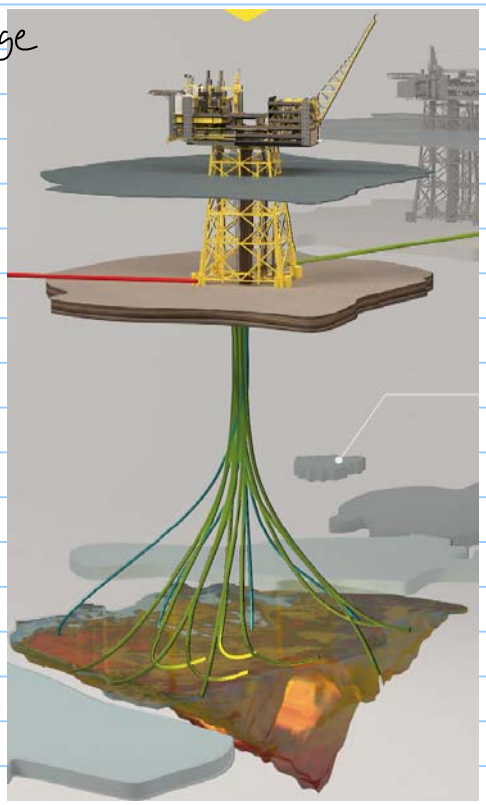
layout of production systems:

- offshore { platform wells (dry christmas trees)
- Easy access to well for intervention
- Limited well slots for infill drilling

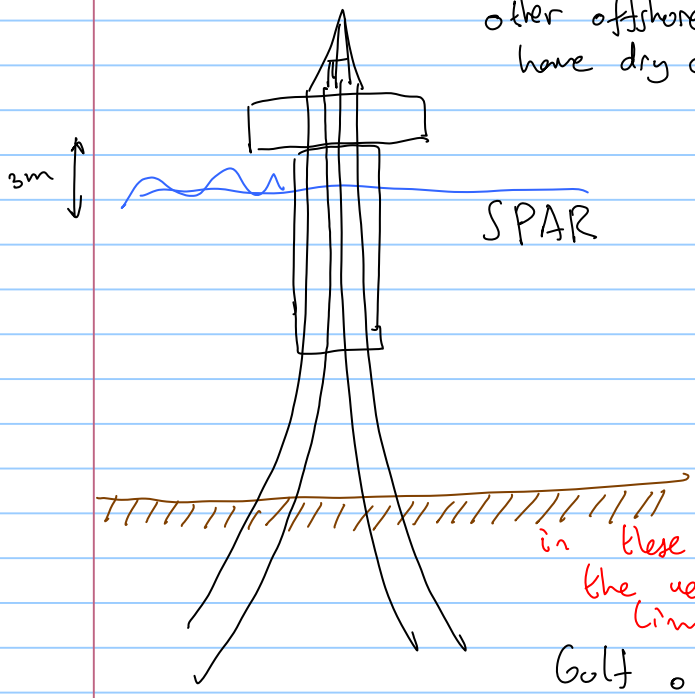




platform without drilling package

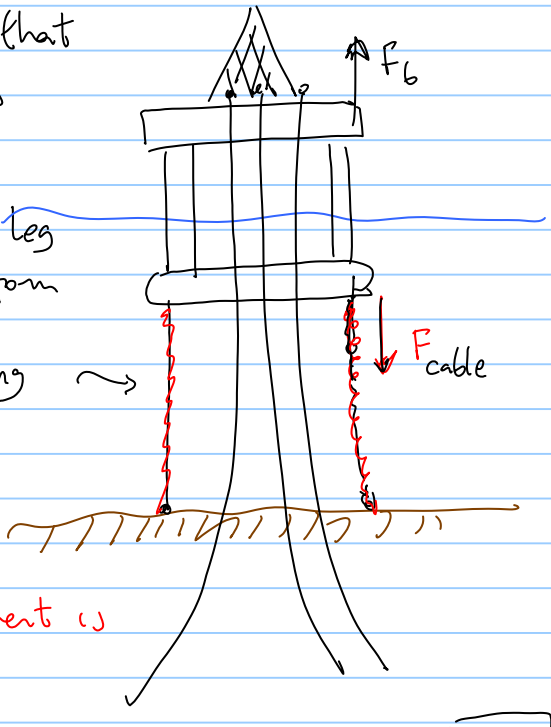


other offshore structures that have dry christmas trees



TLP
tension leg platform

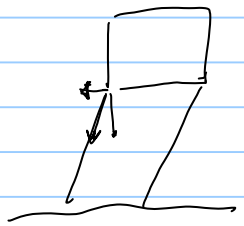
tensioning cable



in these structures the vertical movement is limited

Gulf of Mexico

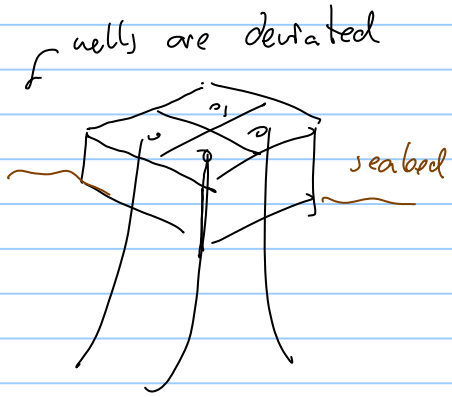
$\sim$ 1700 m water depth max



- Subsea wells

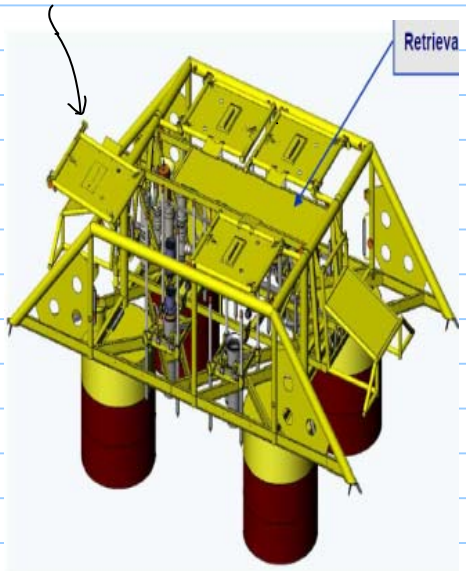
wet christmas trees

- template drilled wells
  - wells are deviated

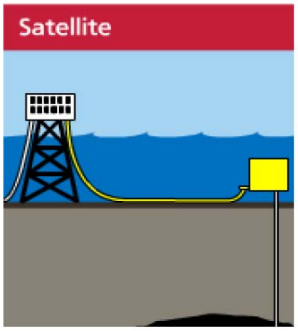


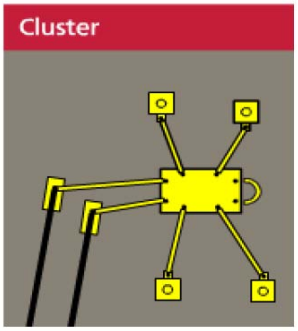
- Satellite wells
  - well are usually drilled above target.

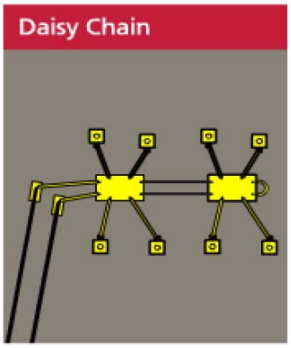
well slot

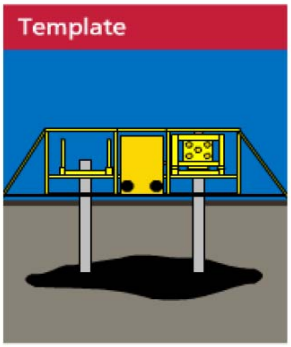


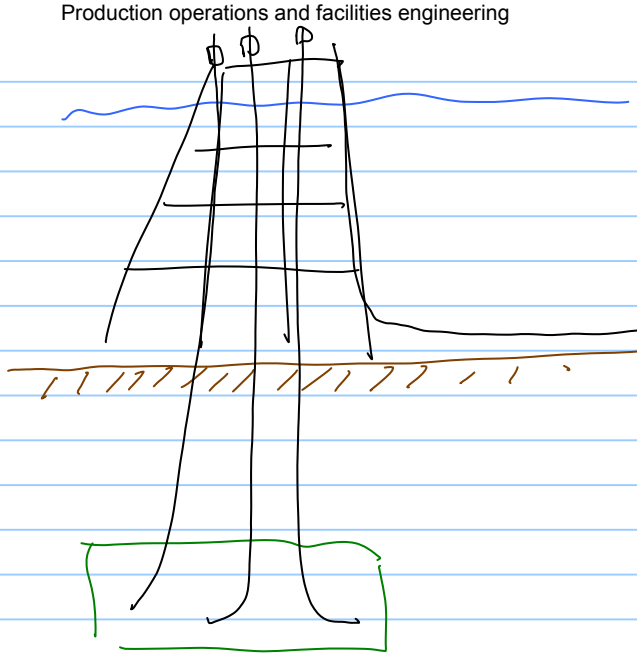
subsea template



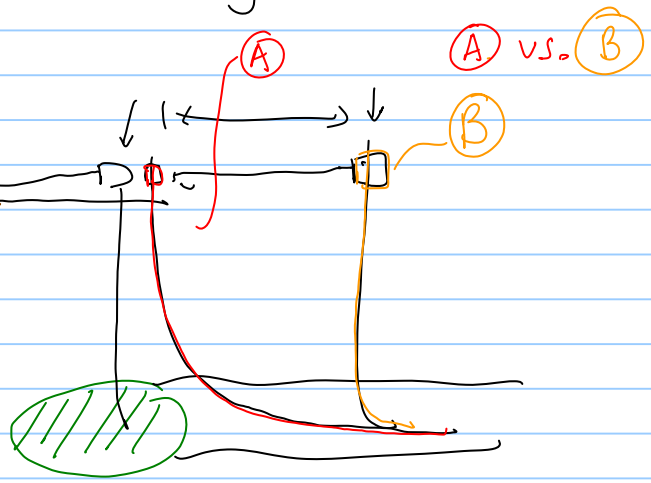




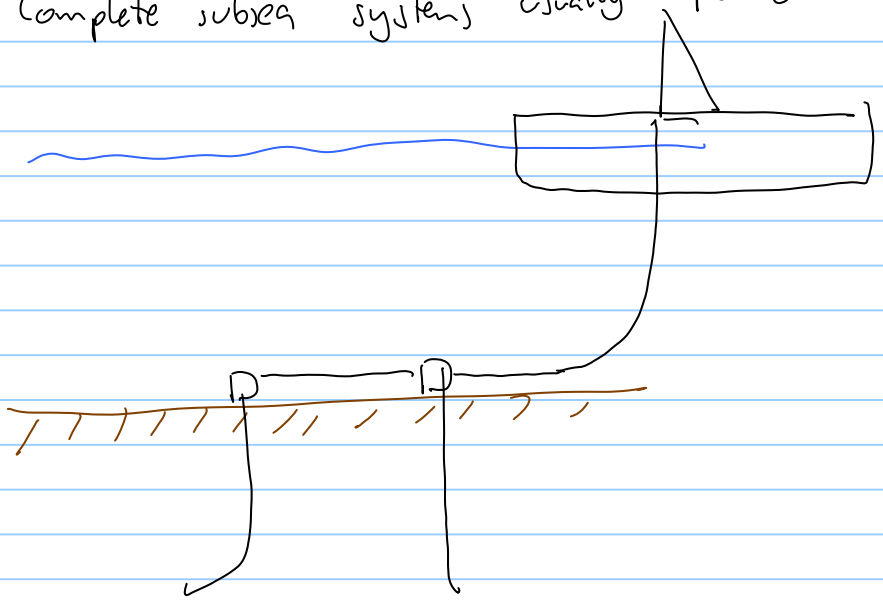




subsea well producing to existing facilities.



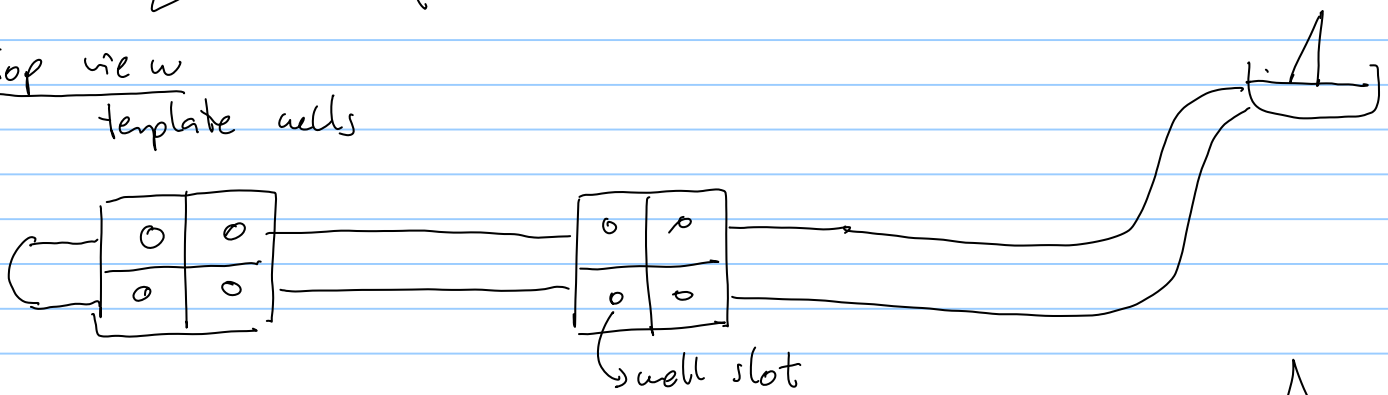
Complete subsea systems usually produce to { FPSO, Semi Sub } → similar to TLP without the tensioning cables.



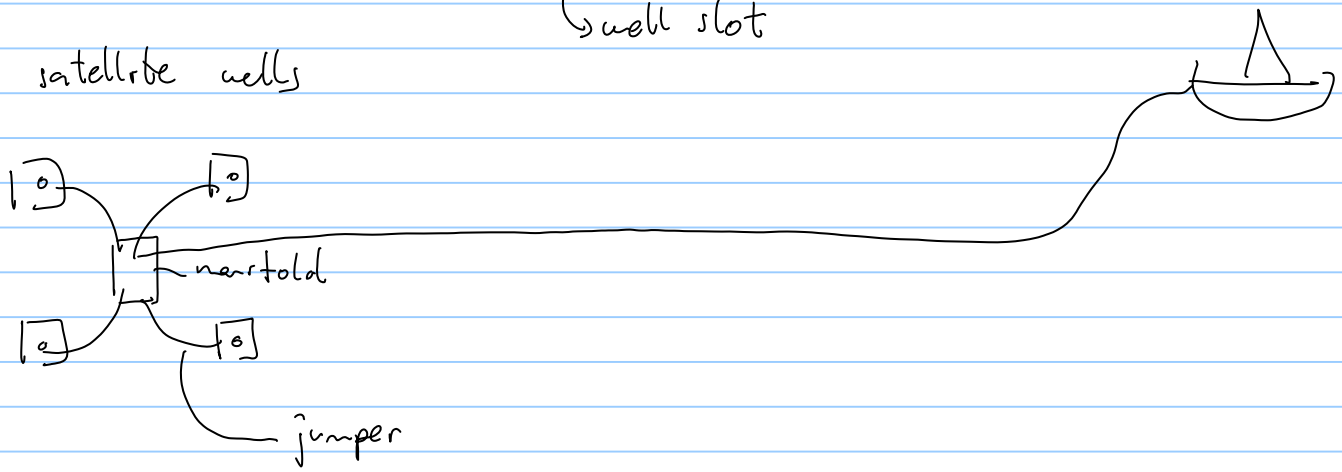
(FPSO) floating production storage offloading

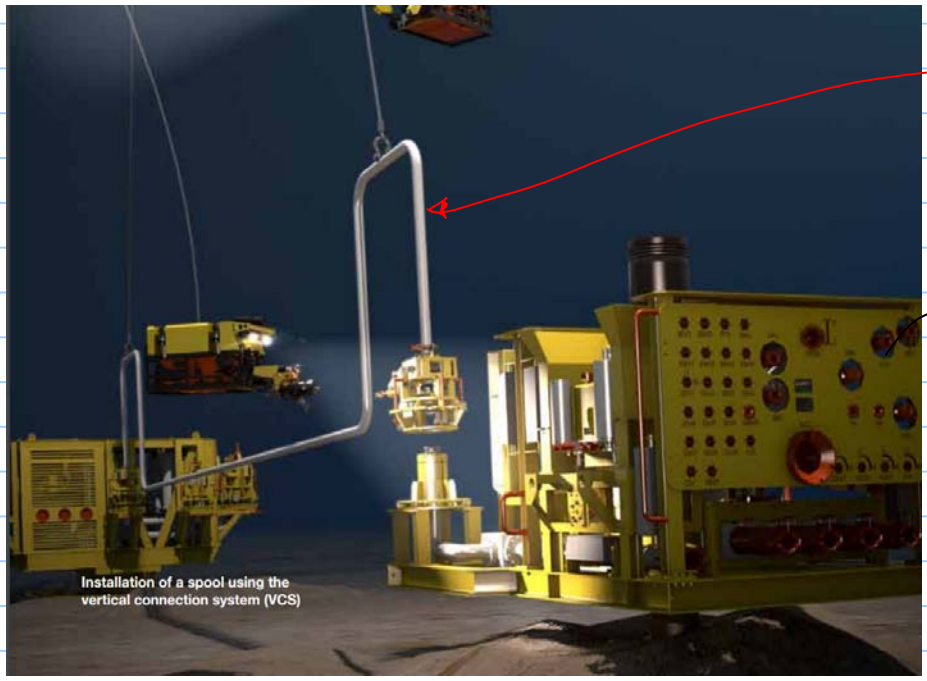
top view

template wells



satellite wells

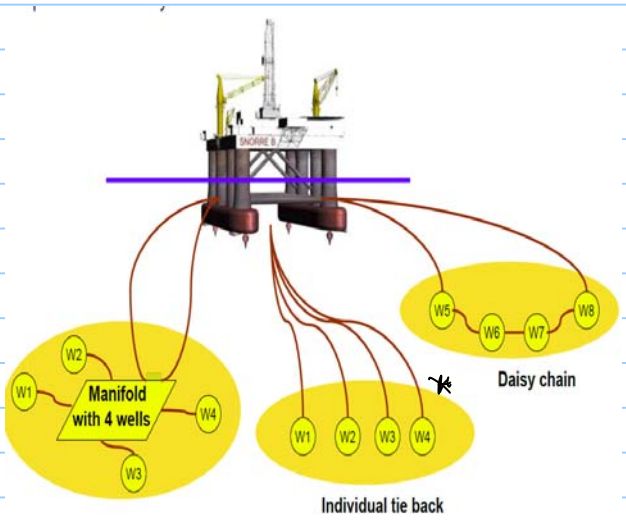


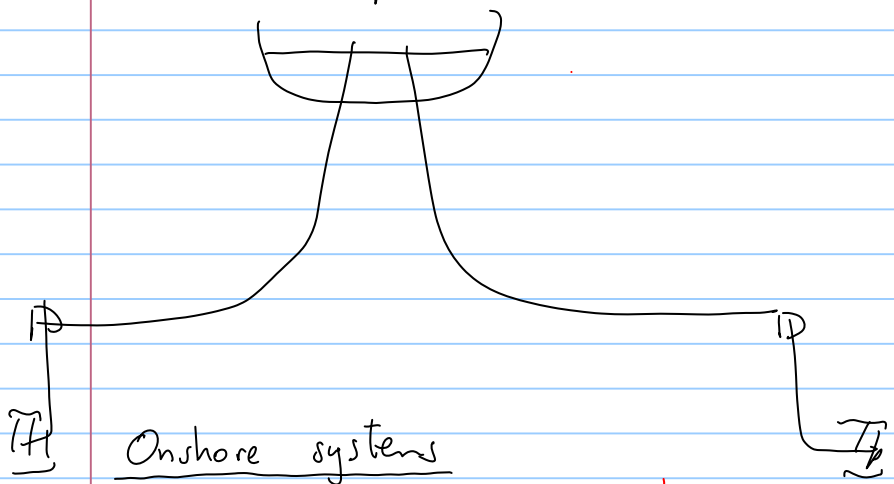


jumper

X-mas tree

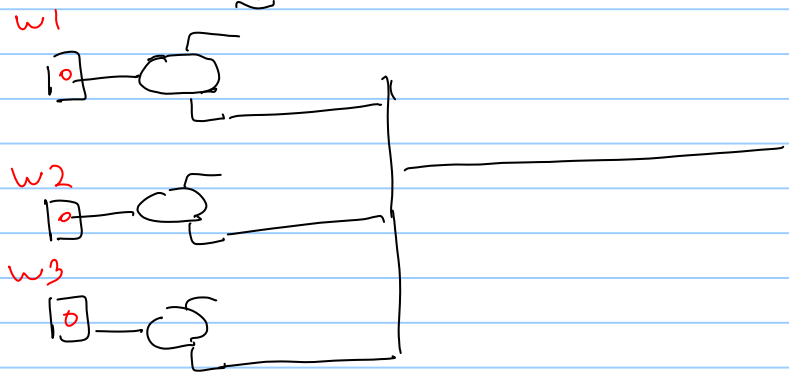
* for example



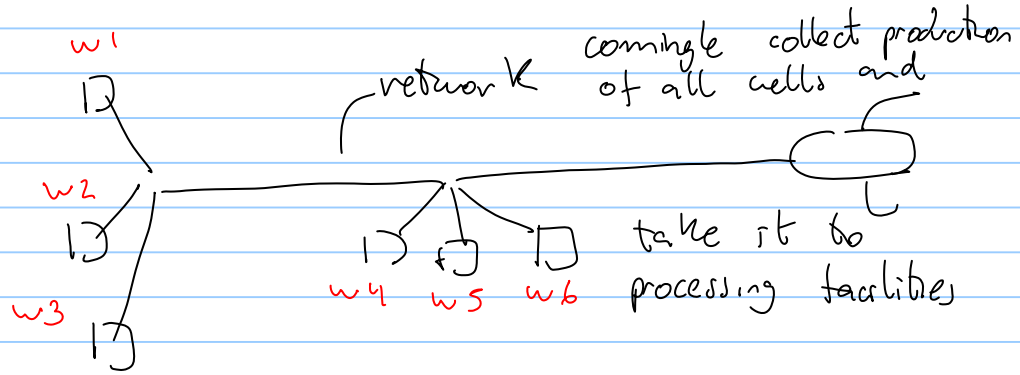


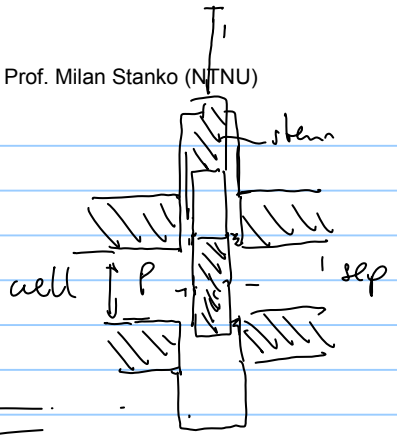
Onshore systems

- Standalone wells

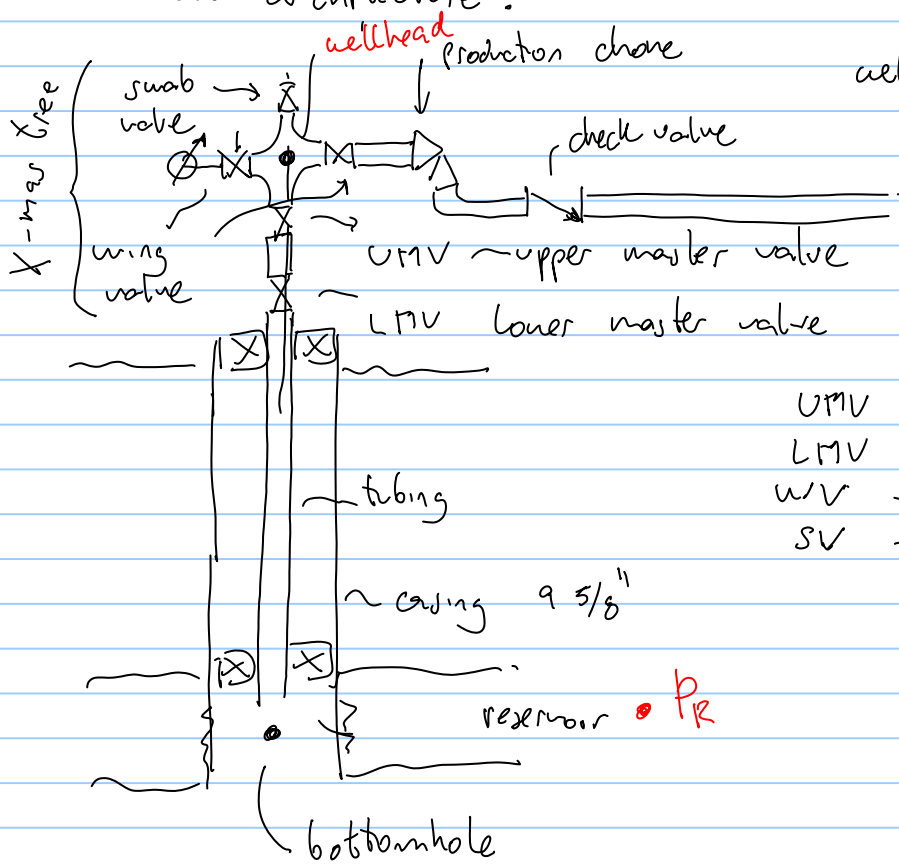


- network





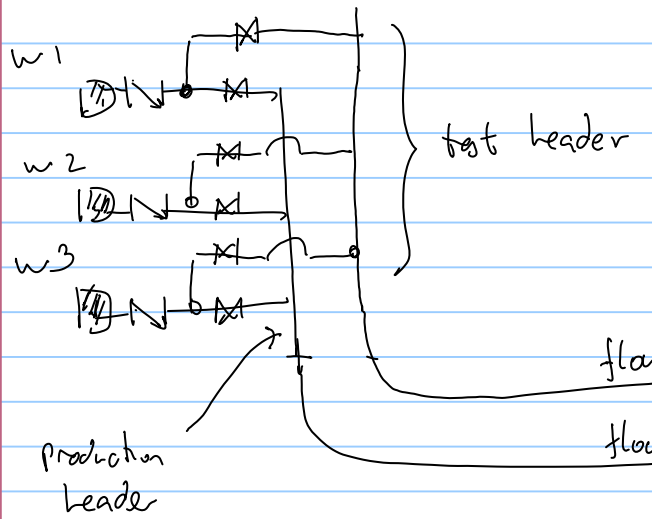
Well architecture:



UMV – on-off valves
LMV – on-off valves
WV – on-of valve
SV – on off valve

Production manifold:

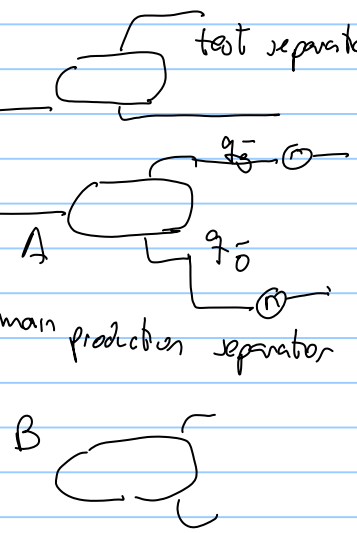
- commingle the production of several wells
- test the well – measure q_o, q_g, p_{wh}



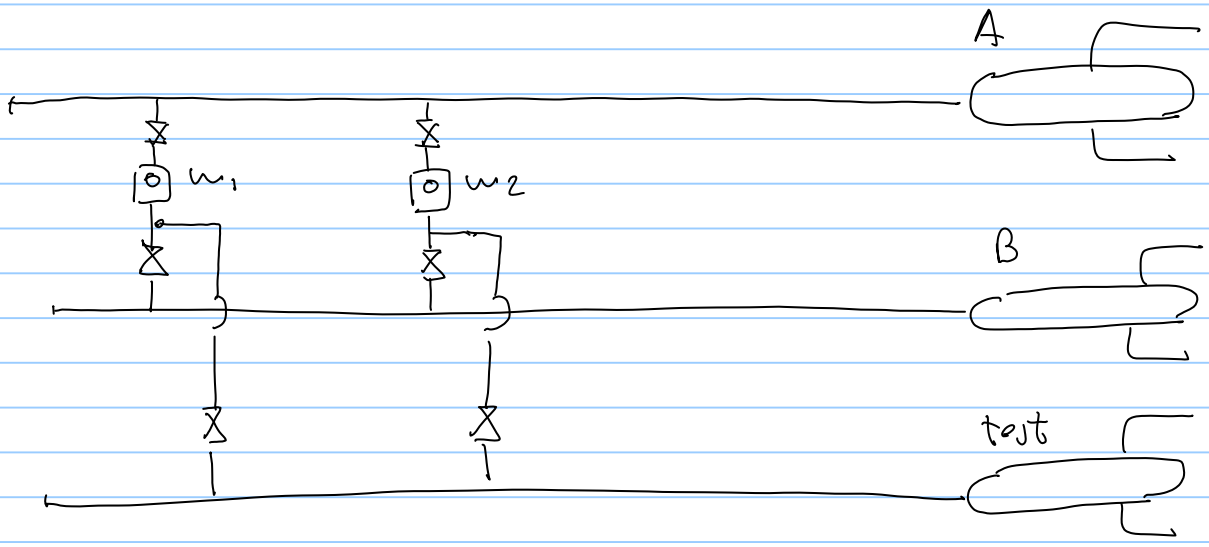
- send the well to different production trains

USD $

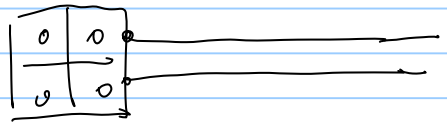
- allocation – split production to different
- determine well productivity
- Reservoir modeling to perform history match

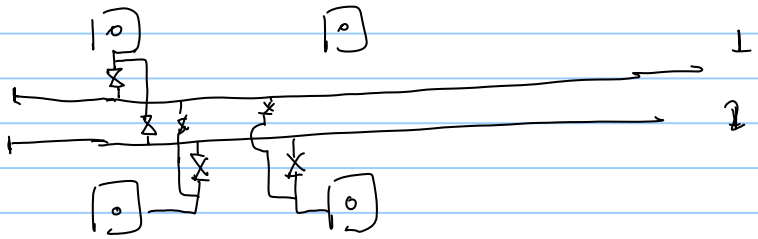


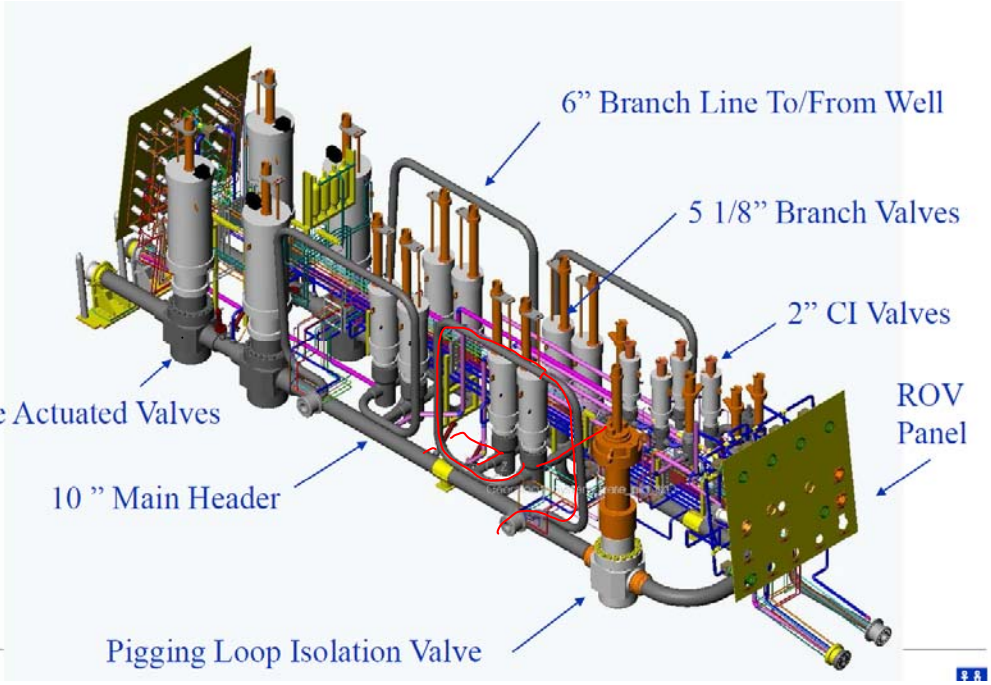
Class exercise 3 wells to 3 separators



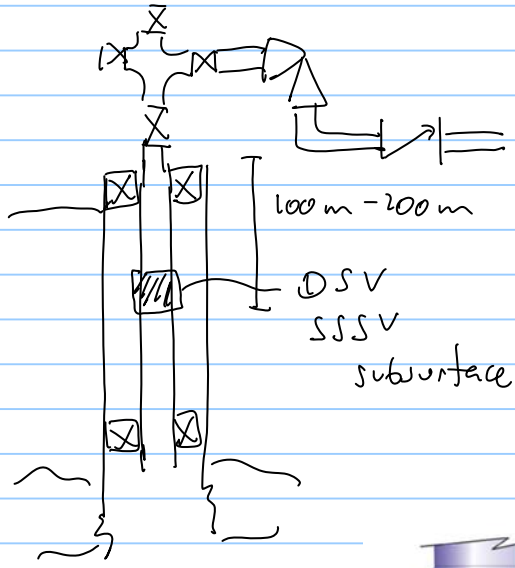
Subsea wells arranged in template. Subsea manifold





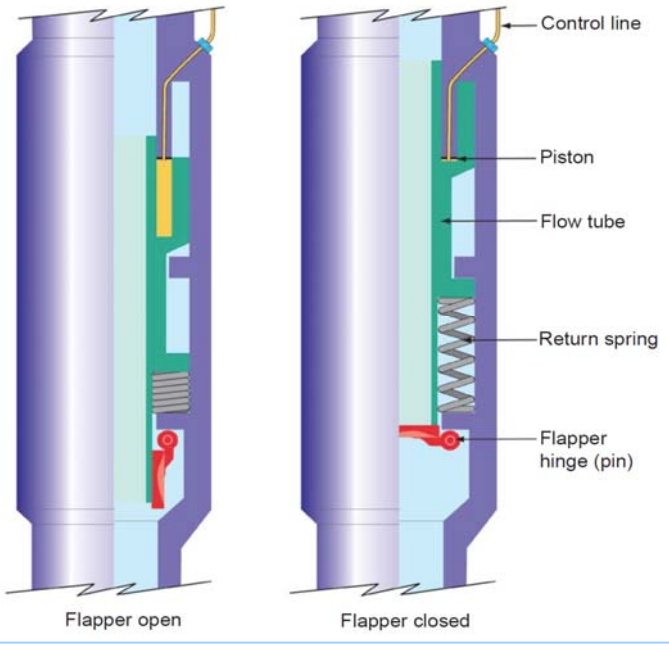


valves of a well DSV downhole safety valve



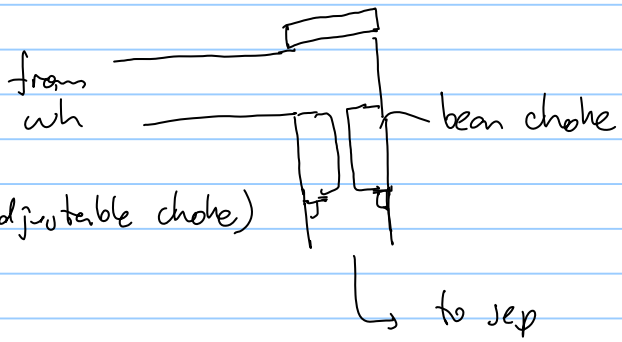
Barrier philosophy

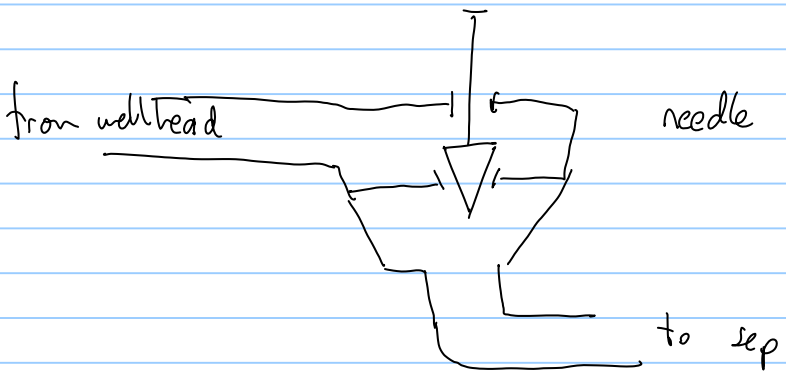
- always 2 barriers between reservoir and environment
- barriers must be physically in different places
- action mechanism must be independent



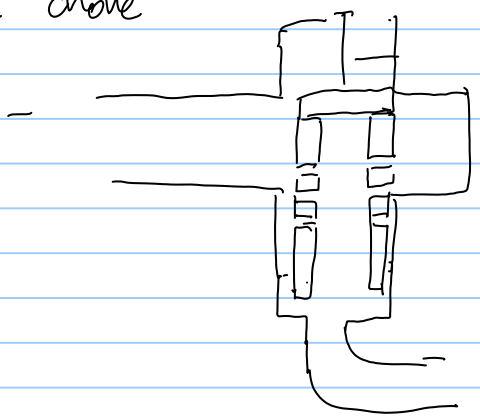
Onshore system

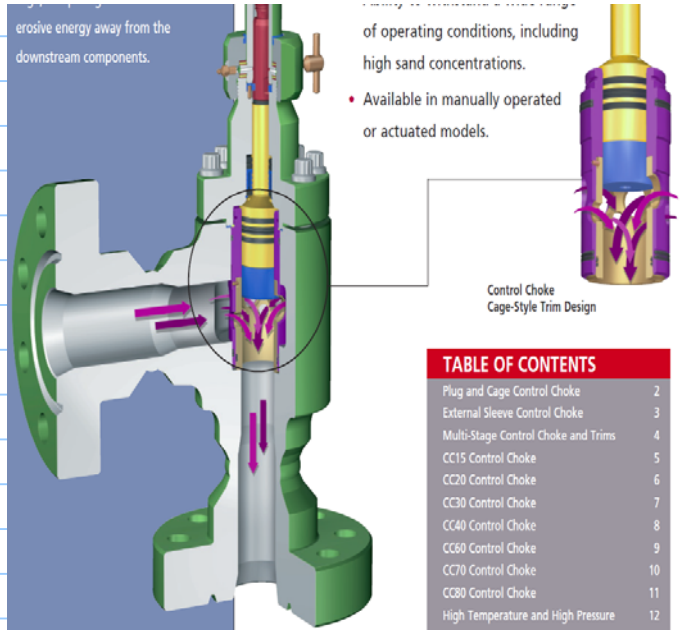
production choke
- fixed opening
- variable opening (adjustable choke)



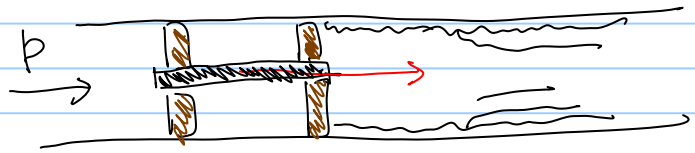


Cage choke





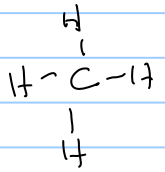
Need for pigging.

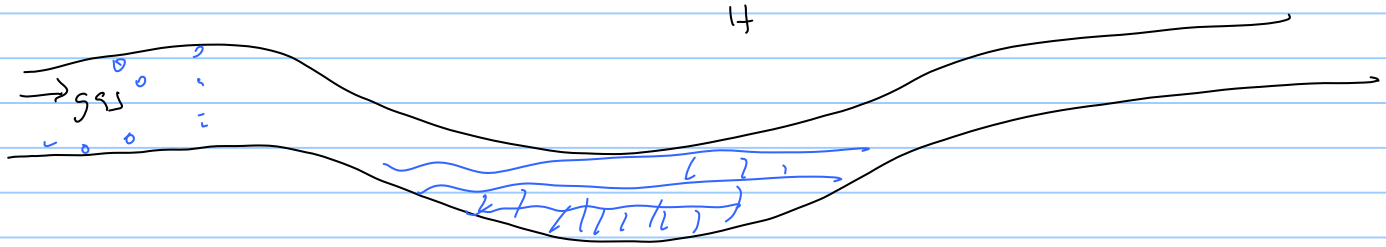


- remove accumulations on the pipe wall { wax heavy hydrocarbon fraction

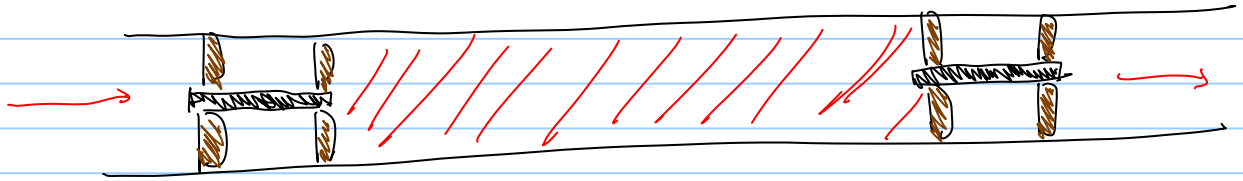
C_1, C_2, C_{11}, C_{20}

- Remove liquid accumulation



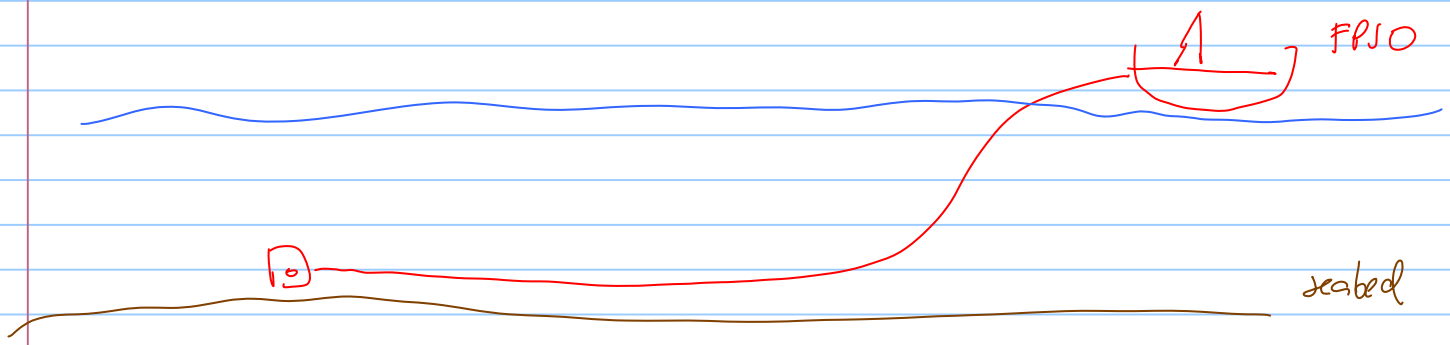


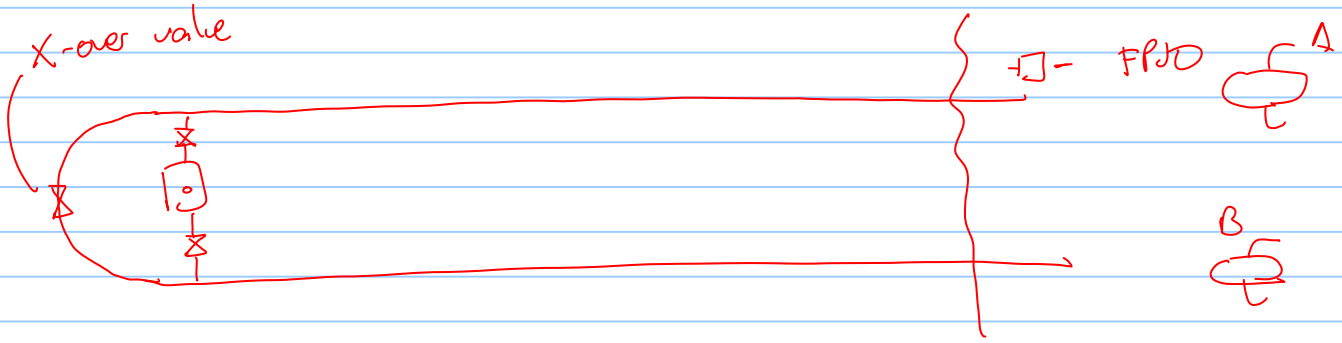
- inspection of pipeline integrity (corrosion) thickness, etc
- treatment of inner pipe wall

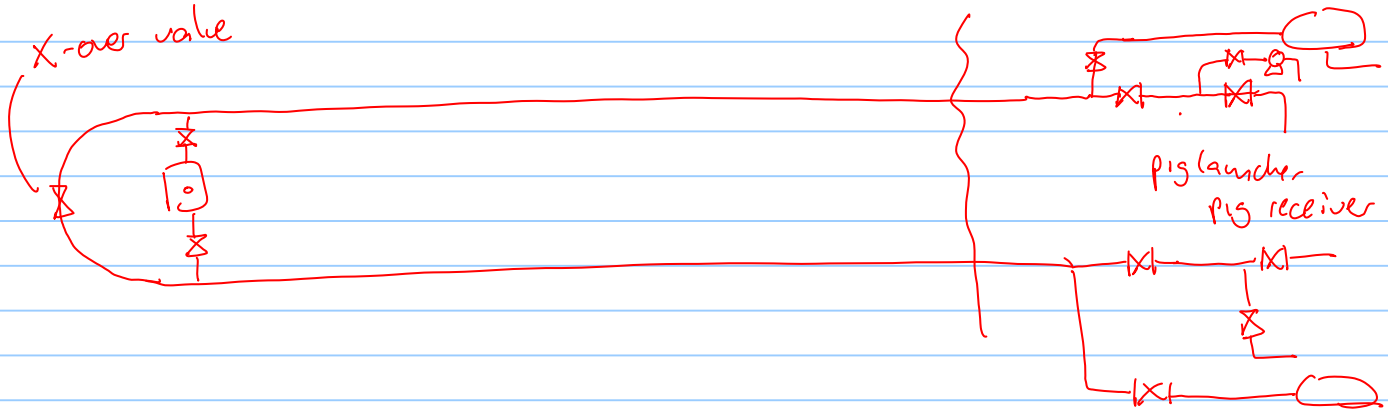


Various pig types

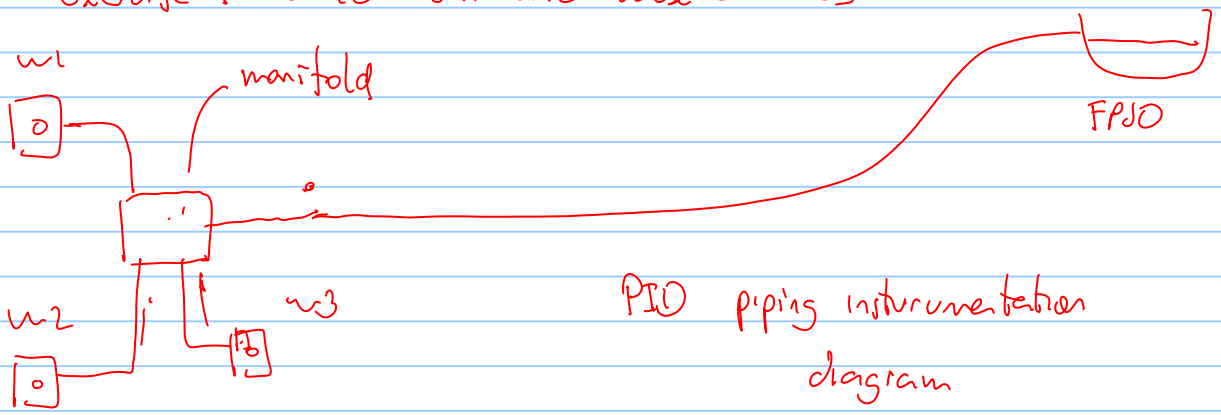
Wax plug-North Sea line pigging


FPSO
seabed


X-over valve
FPSO
A
B


X-over valve
pig launcher
pig receiver

- Home exercise : three satellite subsea wells



PID piping instrumentation diagram

1 multiphase meter inside the manifold

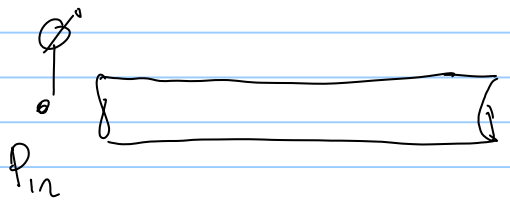
please provide a schematic (flow diagram) to be able to test individually each well

---

flow equilibrium : NODAL Analysis

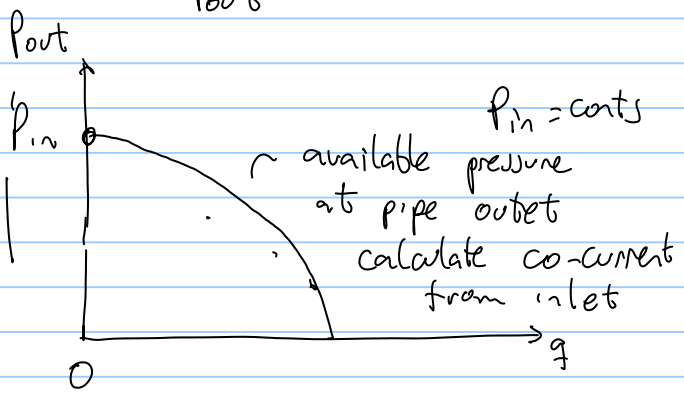
Inflow - outflow balance

Horizontal pipe



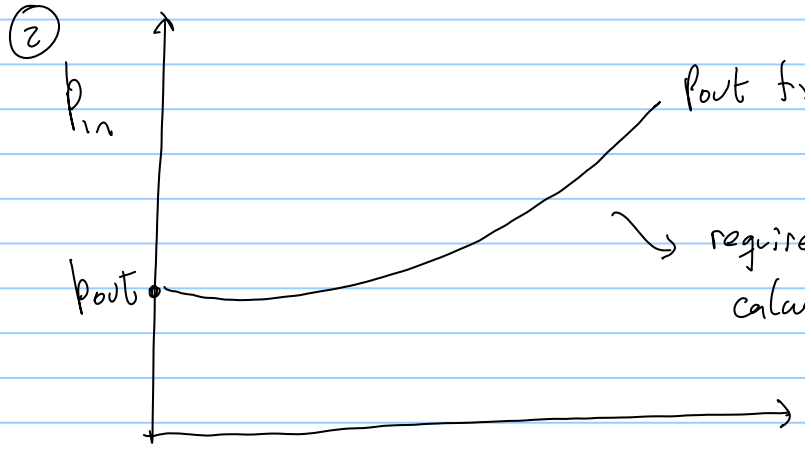
$$p_{out} = p_{in} - |\Delta p_{friction}(q)|$$

① fix p_{in}, change q, obtain p_{out}



fix p_{out}, change q obtain p_{in}

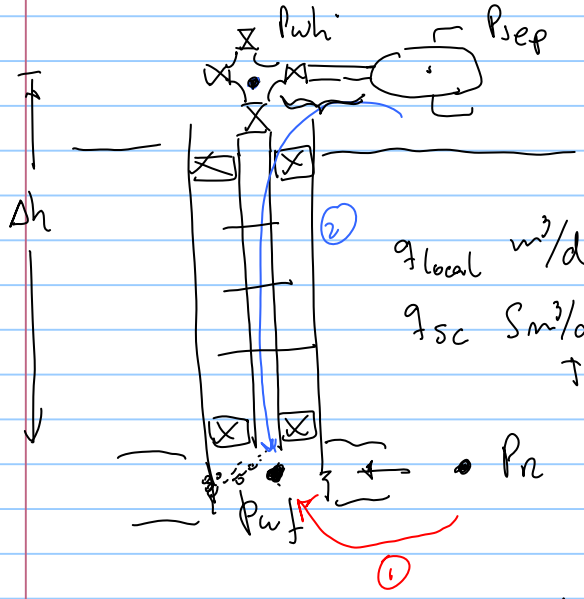
②



$$p_{in} = p_{out} + |\Delta p(q)|$$

→ required pressure at pipe inlet calculated counter-current from pipe outlet

③ give P_R, P_{out} → calculate q



q_{local} m^3/d

q_{sc} Sm^3/d

$T_{sc} = 15.56°C$
$60°F$

$p_{sc} = 1.01325$ bara
14.7 psia

$q_{sc} \propto \dot{m}$