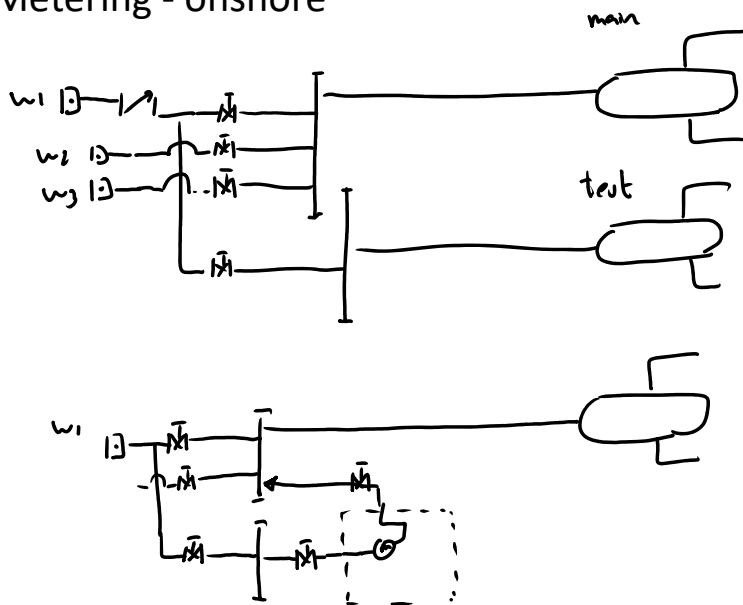


Metering - onshore



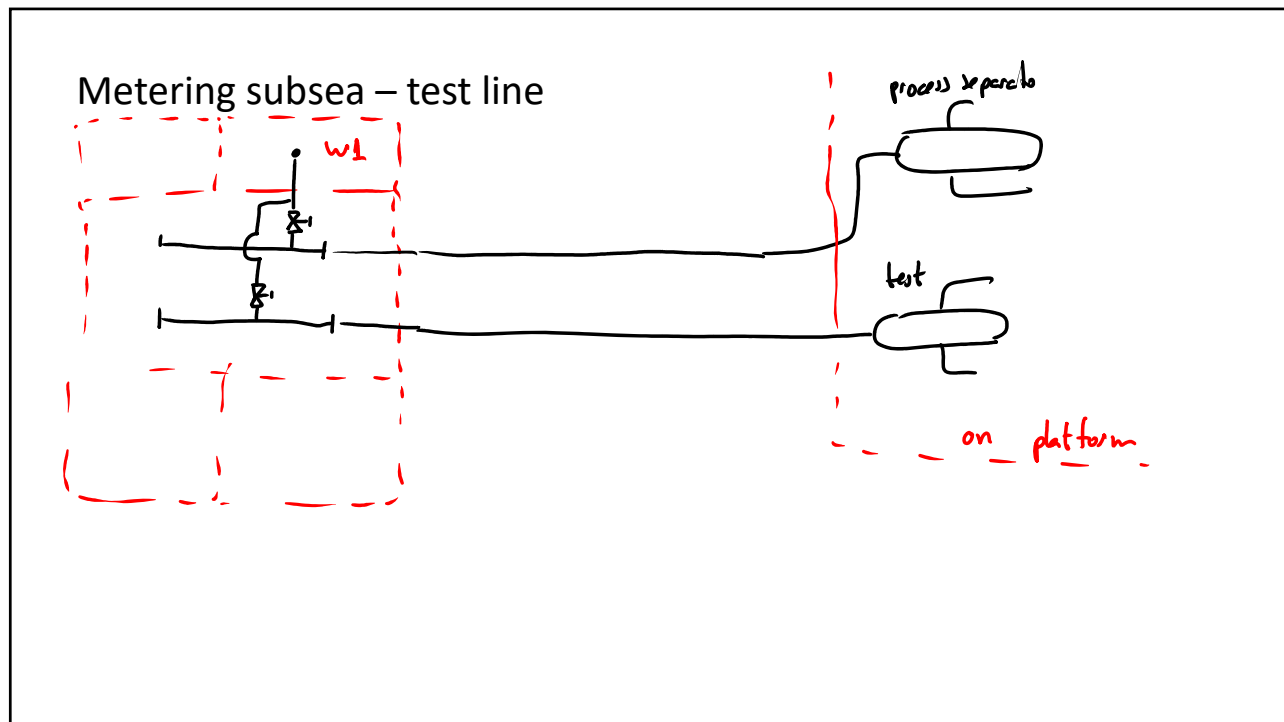
instead of separating, a multiphase meter can also be used, instead of a test separator

55

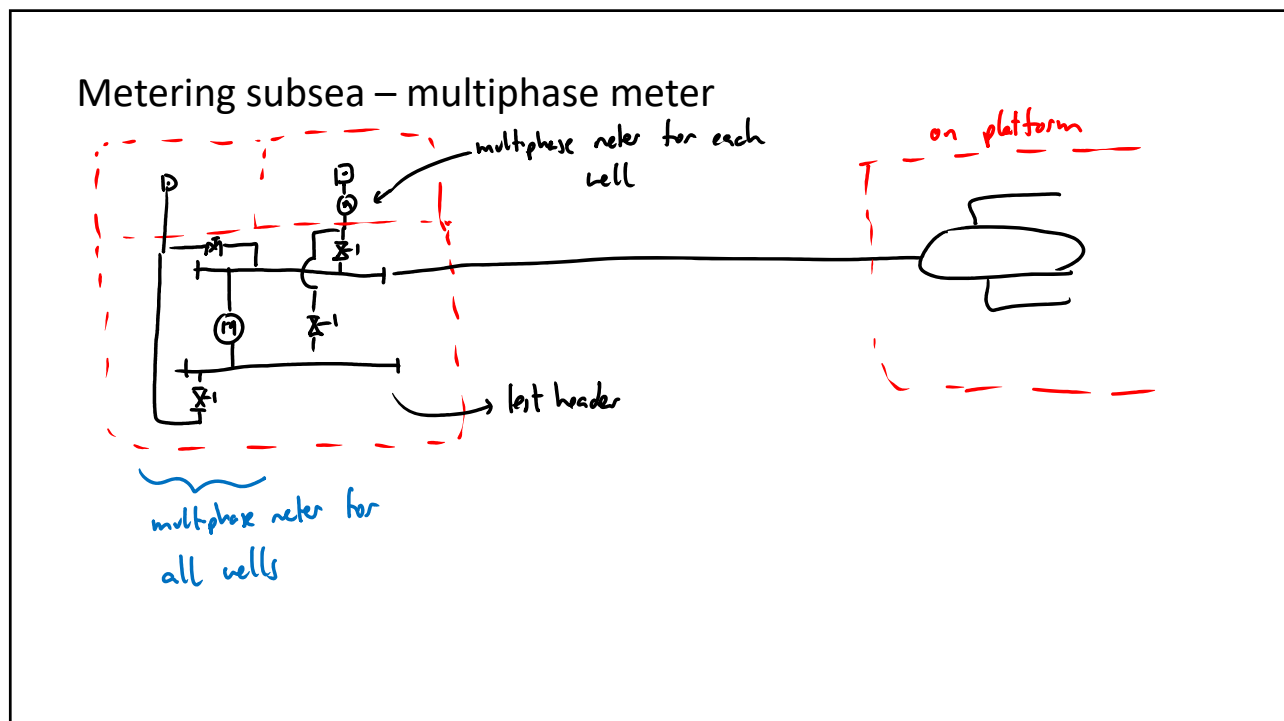
Metering onshore – test separator



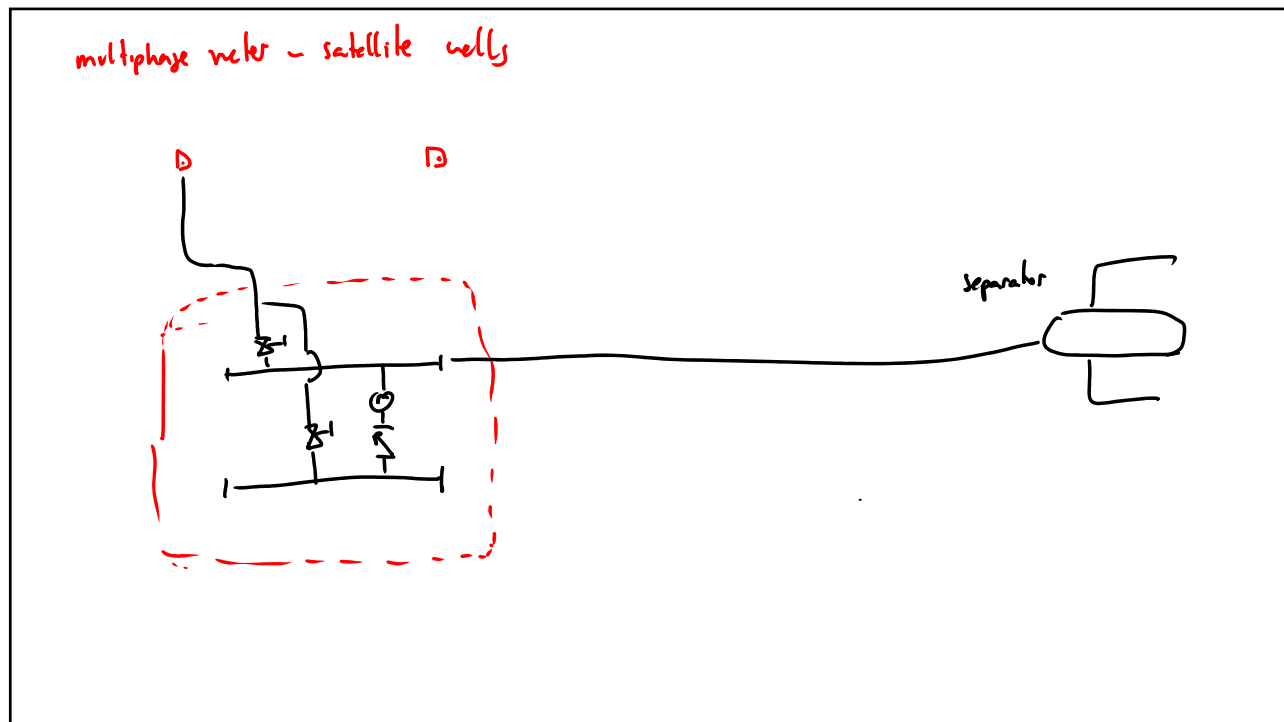
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Metering requirements affect field layout - Brazil

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.

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.

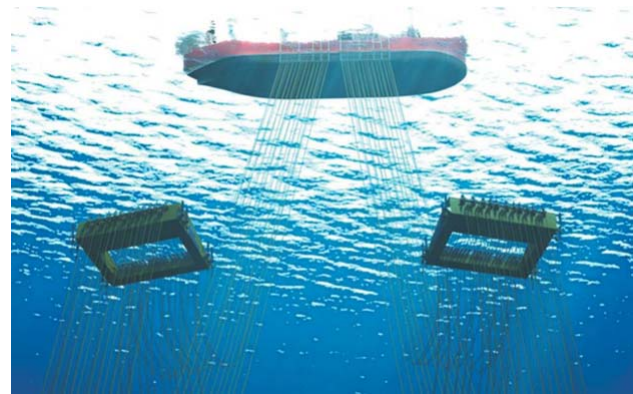
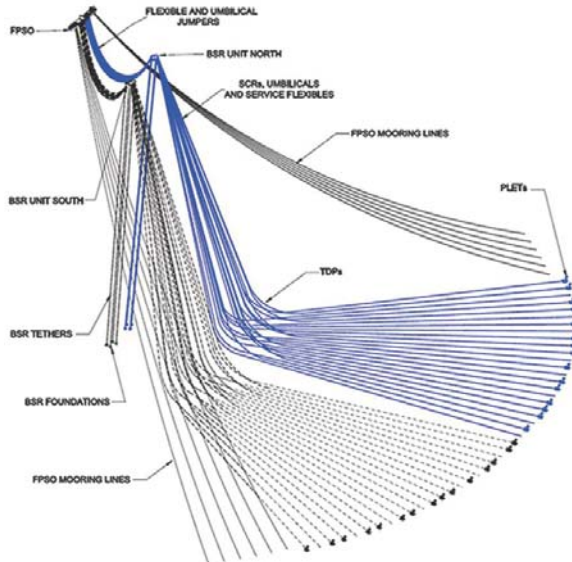
7.2.7.4. Devem ser utilizados separadores de testes ou tanques de testes nos testes de poços. Outros métodos de testes, utilizando novas tecnologias, devem ser previamente aprovados pela ANP.

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

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Metering requirements - Brazil

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<https://www.marinetechologynews.com/news/reviewing-sapinho-system-564661>

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Metering requirements - Norway

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

REGULATIONS RELATING TO MEASUREMENT OF PETROLEUM FOR FISCAL PURPOSES AND FOR CALCULATION OF CO₂-TAX (THE MEASUREMENT REGULATIONS)

Multiphase measurement

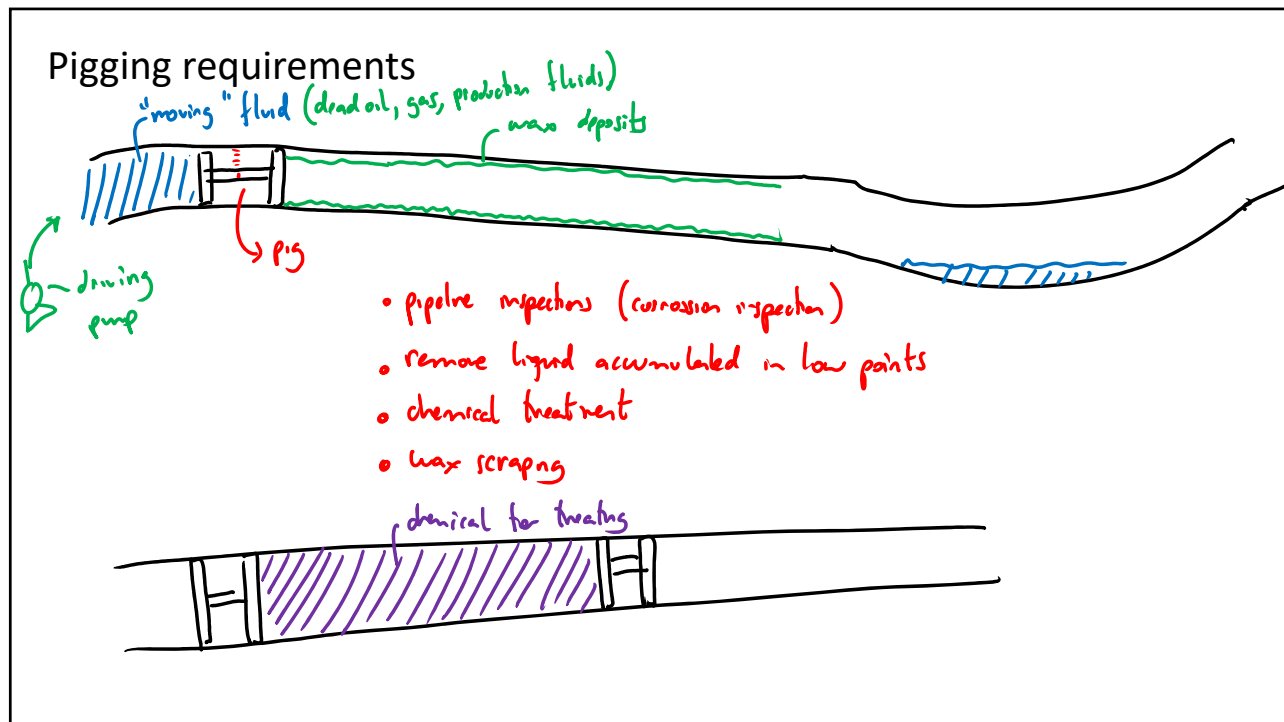
Multiphase measurement may be used if traditional single phase measurement of hydrocarbons is not possible for financial reasons. The multiphase meter can then be used as a fiscal meter.

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.

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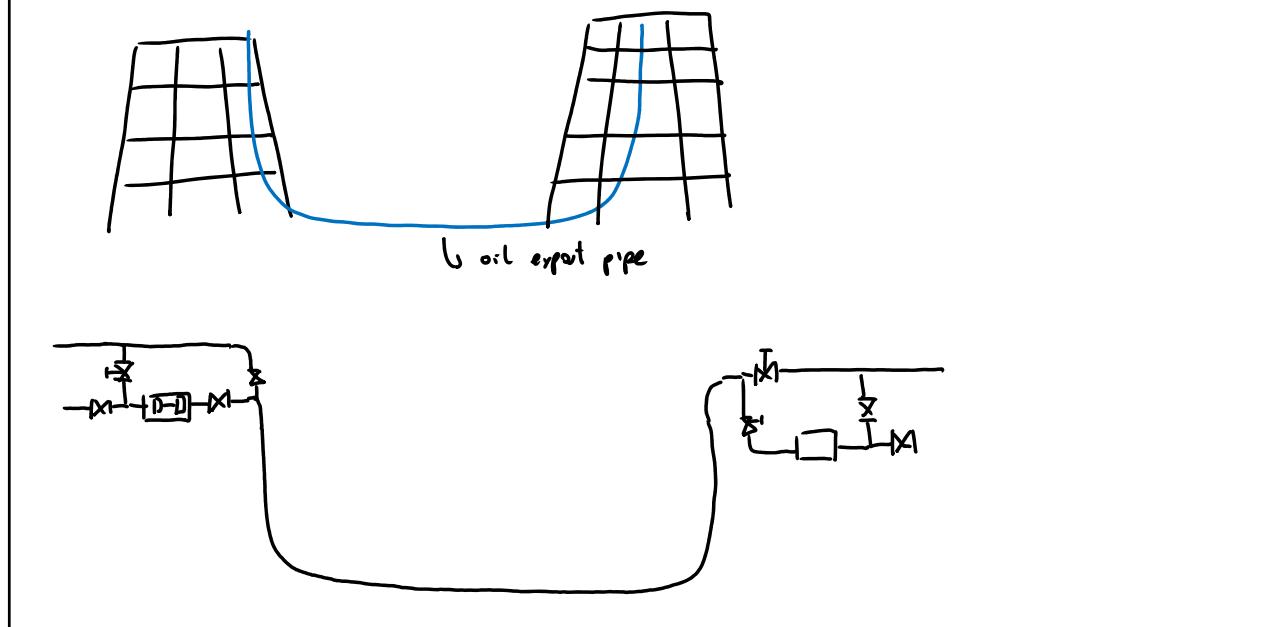


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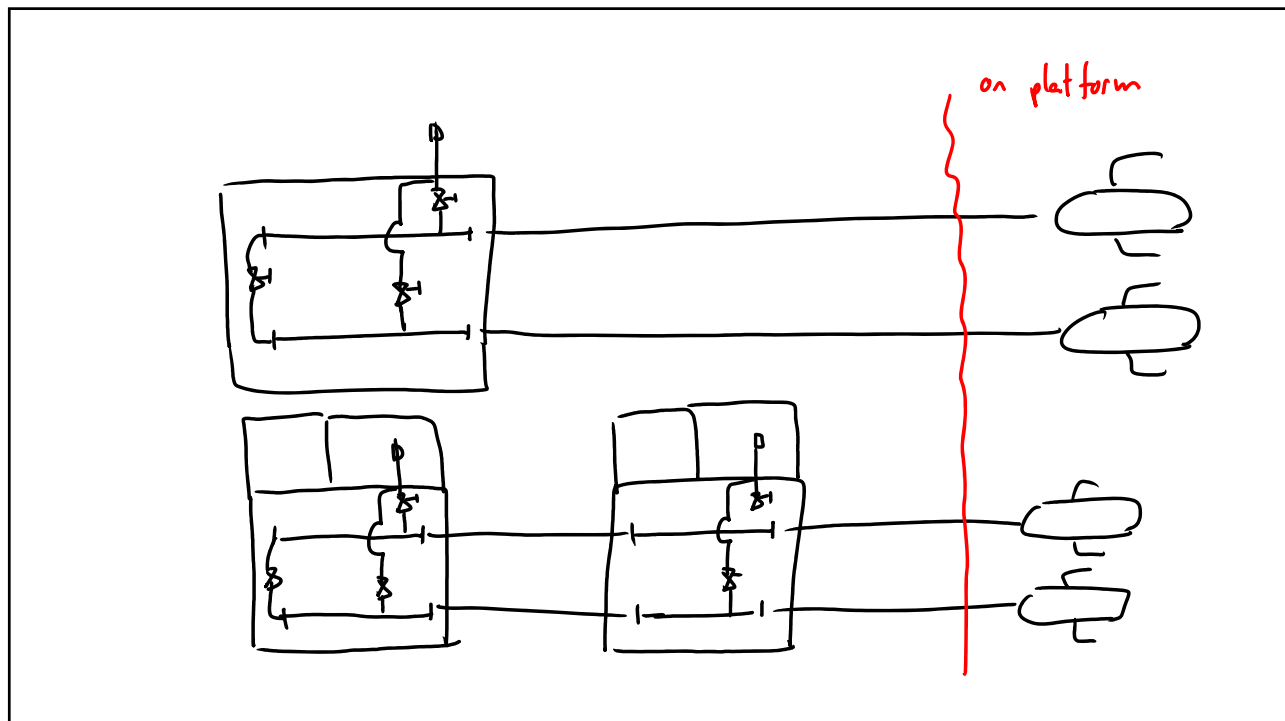


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Pigging loop and subsea pig launcher

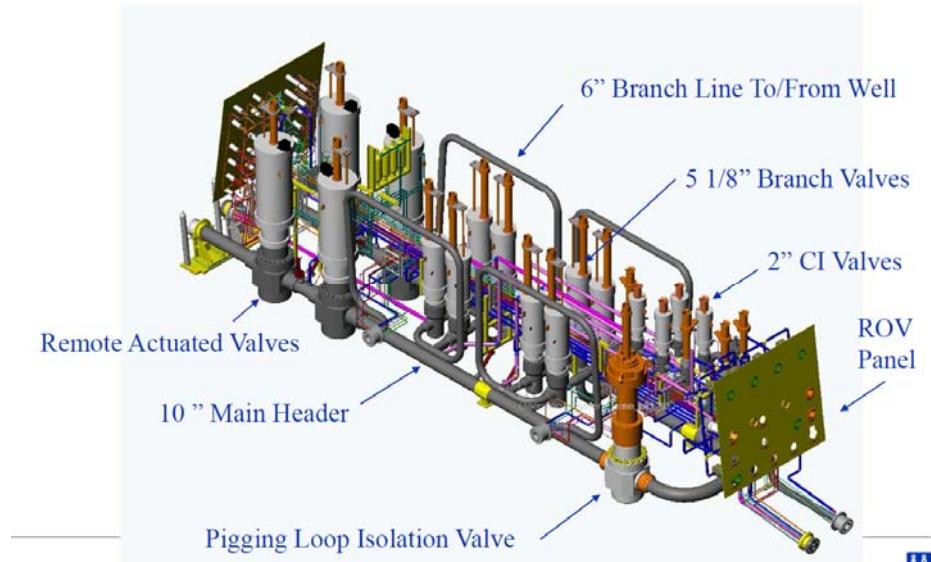


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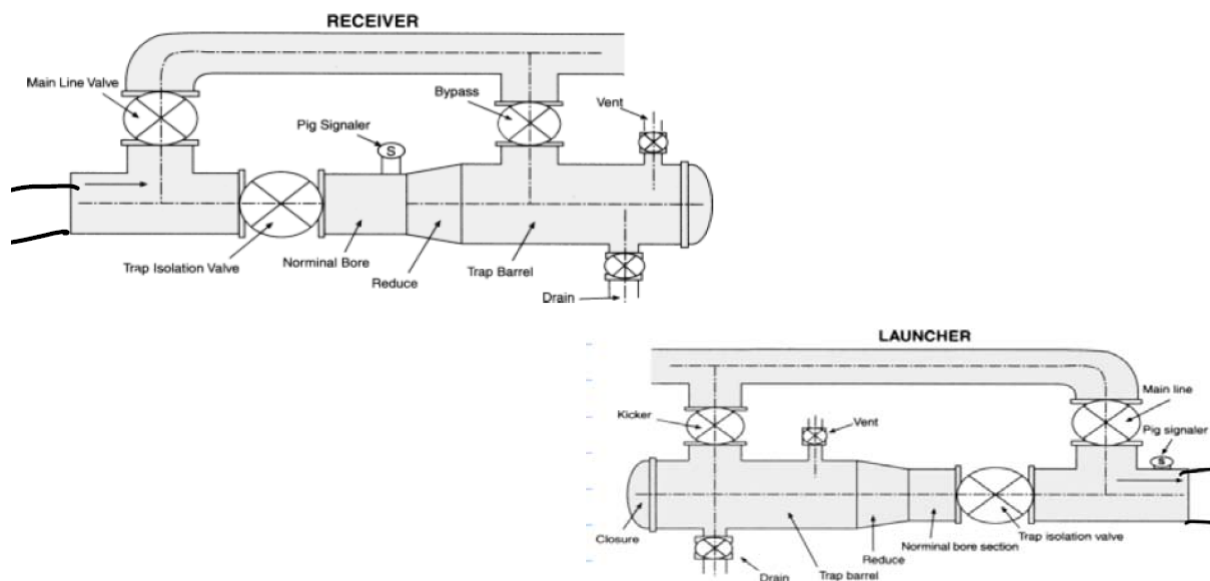
66

The pigging valve



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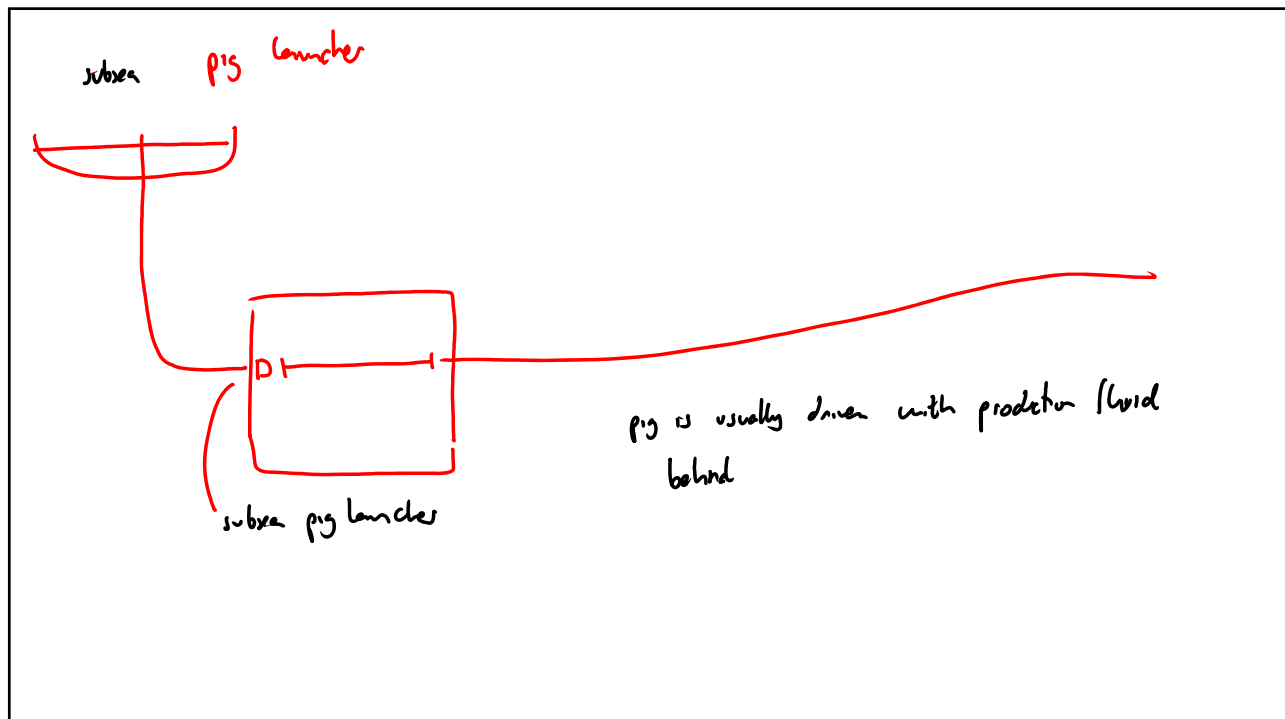
Pig launcher and receiver



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Pigging - video

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Summary table

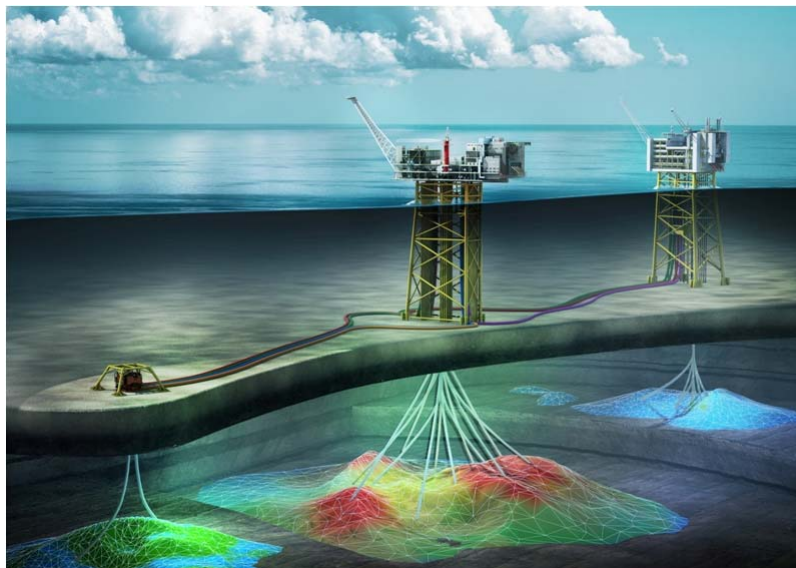
	Dry X-mas trees	Wet X-mas trees
Deep water (1700 m+)		X
Reservoir is "spread" or multiple reservoirs		X
Frequent well intervention	X	
Flow assurance concerns	X	
Plans for infill drilling (and coping with reservoir uncertainty)*	X	X
Progressive production startup		X

Jacket, GBS, SPAR,
TLP

ALL

71

Combinations can be used



<https://www.akerbp.com/en/our-assets/production/ivar-aasen/the-development-solution/>

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Some selection criteria for offshore structures

- Water depth
- Type of X-mas tree
 - Well intervention needs
 - Tubing replacement
 - Completion modifications
 - Artificial lift (ESP)
 - Infill drilling needs
 - Reservoir spread and structure
- **Need for oil/condensate storage**
- Marine loads – Oceanographic environment
 - Wind, waves, current

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Need for liquid storage

No or limited storage	Steel Jackets, Semi-subs, TLPs, Spars ²⁰
Medium - Large storage (up to 2.5000.000 STB)	FPSOs, GBS

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Other selection criteria for offshore structures

- Previous experience
- Riser issues
- Topside upgrade flexibility
- Manufacturing workshop availability
- Maturity of technology
- Maintenance and OPEX