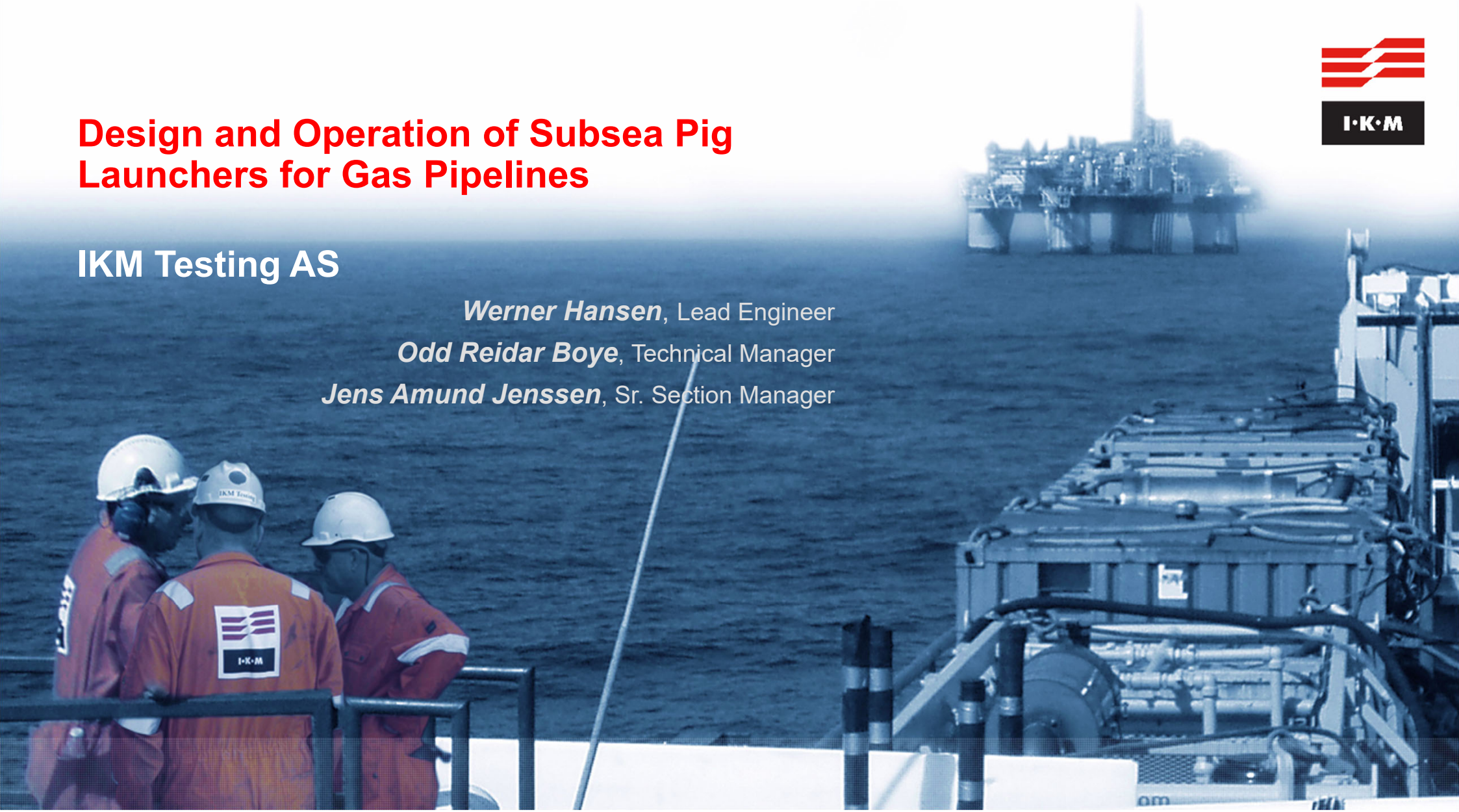
Design and Operation of Subsea Pig Launchers for Gas Pipelines



IKM Testing AS

Werner Hansen, Lead Engineer

Odd Reidar Boye, Technical Manager

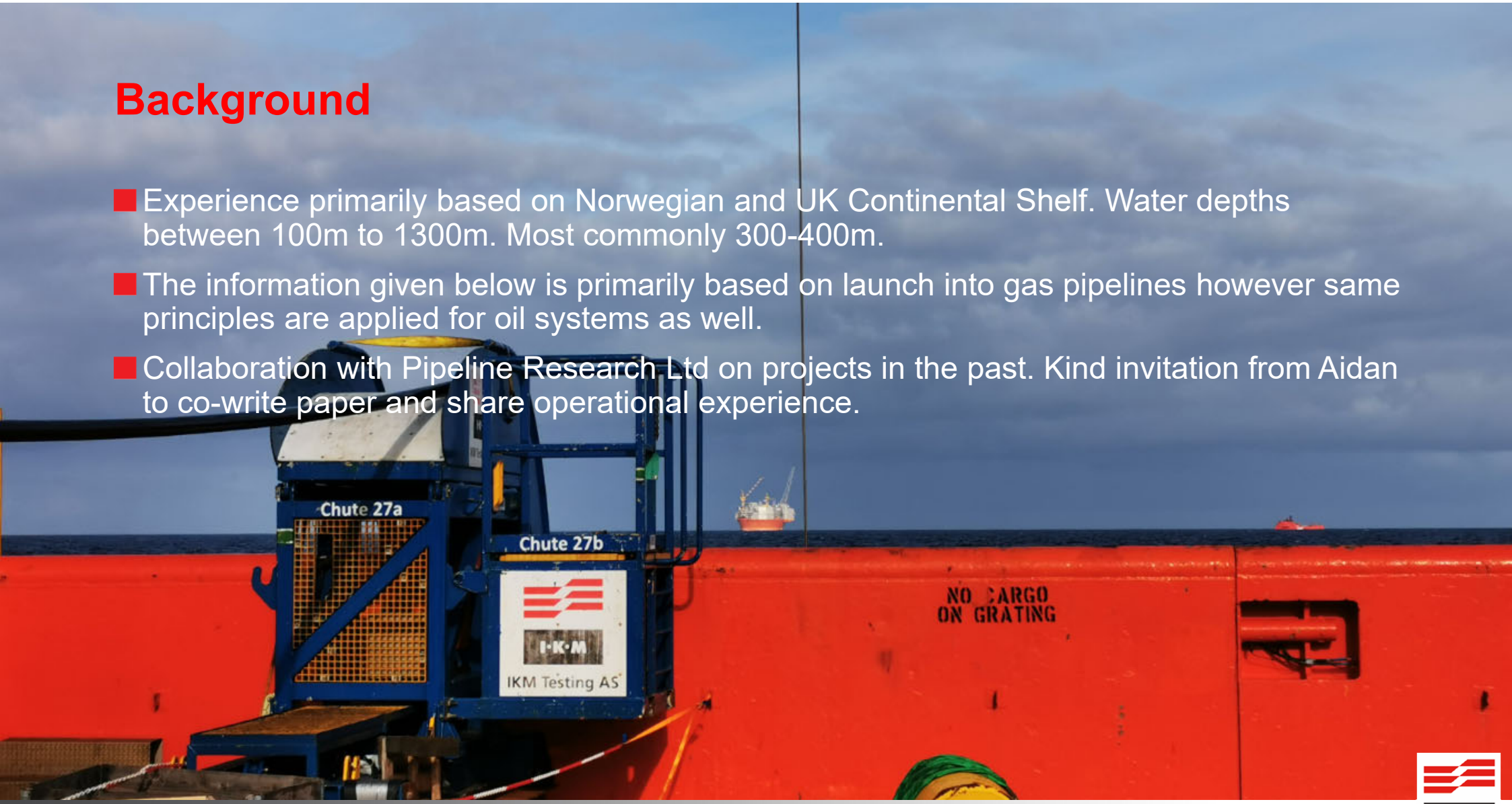
Jens Amund Jenssen, Sr. Section Manager

Background

- IKM Testing have seen increased frequency in work towards live systems. Typically Temporary Decommissioning as preparation to ILI-pigging, Operational Pigging or Permanent Decommissioning.
- Corresponding trend on FEED and Detailed Studies for future fields.
- Pipeline and Well Service related operations planned and executed by same department. Cross over of principles and design. Same equipment in use.

Background

- Experience primarily based on Norwegian and UK Continental Shelf. Water depths between 100m to 1300m. Most commonly 300-400m.
- The information given below is primarily based on launch into gas pipelines however same principles are applied for oil systems as well.
- Collaboration with Pipeline Research Ltd on projects in the past. Kind invitation from Aidan to co-write paper and share operational experience.



Operational Challenges - Introduction

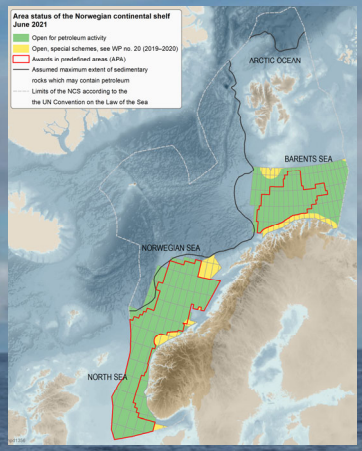
- Launching pigs into live gas pipelines, introduces some challenges that differ from launching pigs during ordinary pre-commissioning operations
- The presence of Hydro Carbon (HC) gas will, in addition to the requirements for the pig launcher, dictate some specific requirements to the systems and equipment that can be used:
  - Surface unit / vessel
  - Pressure integrity and HC-gas control
  - Down line system
- Norwegian regulations used as basis for IKM Testing's approach and solution.
  Viewed as conservative in most cases, also for operations outside of the Norwegian Continental Shelf (NCS)
- This presentation focuses on subsea launch/pumping of pigs into live HC systems with equipment located on a mobile facility at surface in proximity of the subsea pig launcher.

Operational Challenges – Surface Unit / Vessel

- Norwegian Petroleum Act defines the operation (pig launch into live gas system) as a "petroleum activity" and would normally require a drill rig or a Mobile Offshore Unit (MOU) to be used.
  - Expensive
  - Availability can be limited

- The Petroleum Safety Authority's (PSA) Framework Regulations allows for application of maritime regulations in offshore petroleum activities, provided
  - Compliance with relevant Norwegian Maritime Authority (NMA) regulations
  - Compliance with Classification Society Rules
  - The level of safety is equal to or better than the requirements of the PSA

- Construction Support Vessels (CSV) may consequently be used; increasing available alternatives significantly (over MOUs) at much lower costs
- **Barrier control over (any) wells can however not be held by the CSV**

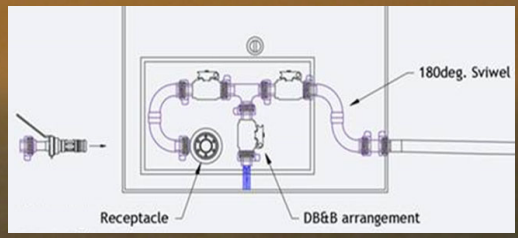


PETROLEUM SAFETY AUTHORITY NORWAY

Sjøfartsdirektoratet
Norwegian Maritime Authority

Operational Challenges – Pressure integrity & HC-gas control

- To ensure sufficient safety of the operations, several components and procedural steps can/may be applied
  - Non-return valve(s)
  - Fail/Close Valves
  - Double Block/Bleed (DBB)
  - Local pressure monitoring of launcher
  - Testing of local subsea barriers
  - Over-pressure methodology approach, well operation principles
  - HC-gas detector(s) on deck

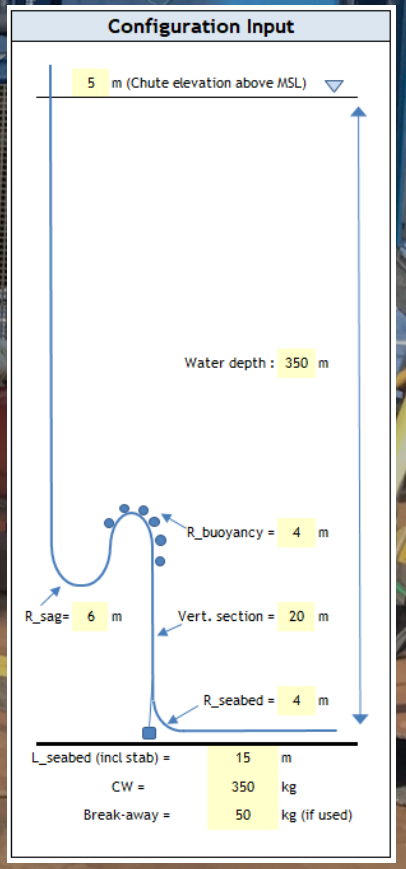


- HC-gas is, for this type of operation, not planned on deck/surface.
  (More complex solutions will be required, however also this is fully possible)
- Standard practice has been established and is commonly accepted with most NCS operators.

Operational Challenges – Down line system

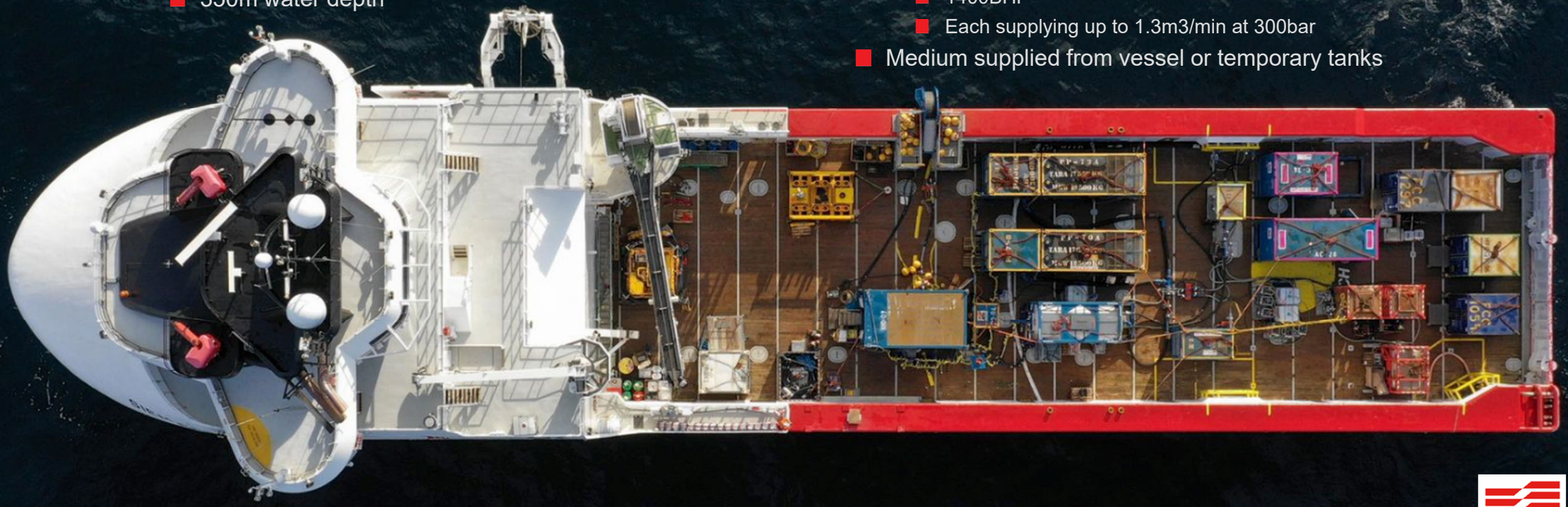
- The down line system needs to be designed and adjusted to the specific details of the offshore/subsea field and system
  - Suitable hose types (typically well intervention)
  - Thorough configuration design with control of external forces
  - Collapse control
  - Hot Make / Hot Break (HMHB)
  - Subsea handling
  - Environmental conditions – weather limitations

- Self-supportive down lines preferable due to flexibility, ease of installation/recovery and less requirements to support systems onboard.



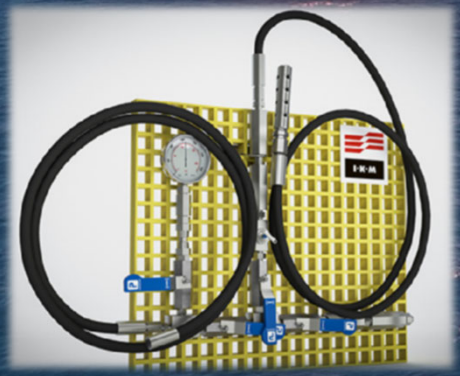
Main Pumping Equipment

- Example Case - Launching with MEG
  - 220bar system pressure
  - Minimum flowrate of 100m^3/h > ~1.7m^3/min
  - 350m water depth
- Typical vessel based pumping spread:
  - 3" downline for pigging - 400 - 420m downline
  - Diesel driven triplex pumps
    - 1400BHP
    - Each supplying up to 1.3m3/min at 300bar
  - Medium supplied from vessel or temporary tanks



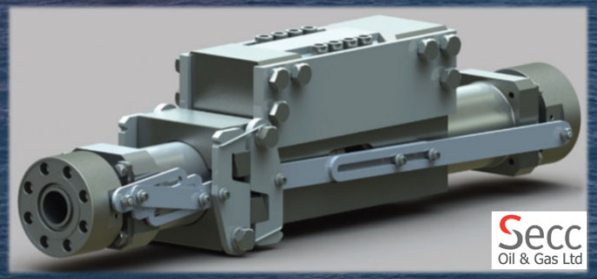
Barrier Testing Equipment

- Typical barrier verification equipment
  - Electrical test pumps
  - 1" downline with integrated HPU
  - Subsea Pressure and Monitoring Manifold (SPAMM) to allow pressurisation and logging



Safety Systems

- Non-return valves – Temporary or permanent
- Fail-close valves – Locally or remotely operated
- Emergency disconnect couplings – Self sealing



Nitrogen Setup

- Launching with nitrogen
  - Smaller downline required
  - Potentially larger deck space needed
  - Additional pumping units depending on system pressure
  - Additional personnel and higher activity on deck during operation.