Design and Operation of Subsea Pig Launchers for Gas Pipelines

IKM Testing AS

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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
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/Closing 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.

Zero injuries - an overall objective!
Main Pumping Equipment

Example Case - Launching with MEG
- 220bar system pressure
- Minimum flowrate of 100m³/h > ~1.7m³/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

Zero injuries - an overall objective!
Safety Systems

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

Zero injuries - an overall objective!
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.

Zero injuries - an overall objective!