Kongsberg Oil & Gas Technologies AS

Complex Subsea to Subsea Pigging Operations of Pipelines

Brownfield Seminar
17 September 2015 | Delta Hotel, St. John's, Canada

Presented by:
Per Arild Nesje

Hosted by:
INTSOK Norwegian Oil and Gas Partners

In cooperation with:
Norwegian Embassy Ottawa

Innovation Norway
The Kongsberg Group is involved in the world’s most technology intensive industries

- Drilling & Wells (software)
- Flow Assurance (software)
- Production Assurance (software)
- SPS/SURF engineering (incl. field layout & feed)
- Subsea Structures (Hardware)
Complex Subsea to Subsea pigging

• Operators of subsea pipelines do sometimes find advantages in performing subsea to subsea pigging operations. This type of pigging may be necessary in order to facilitate a specific field layout or concept.

• This presentation will focus on two types of subsea to subsea pigging:
  ✓ Intelligent pigging operations for inspection of the pipelines.
  ✓ Operational cleaning pigging (typical wax removal) using the Subsea Automated Pig Launcher (SAPL) principle.

  ✓ This is an operational pigging system designed for individual subsea launching of pigs, from a barrel/cassette containing several pigs (5-8 off), to a subsea receiver. The process is controlled from a remote control centre, typically a platform.

• Only pigging scenarios allowing full production during the pigging operation is considered (no need for shut down).
Complex Subsea to Subsea pigging

What is the main challenges:

• General for all subsea to subsea pigging operations
  ➢ How do we kick the pig into the production fluid?
  ➢ How do we bleed of the hydrocarbons at the pig receiver in a safe and effective manner?
  ➢ Pollution aspects.
  ➢ The need for a pig tracking management system.
  ➢ Large depths (water may flow into the system).

• Special challenge with cleaning SAPL pigs
  ➢ Added difficulty with bypass pigs. Needs more flow.
  ➢ How do we get rid of the debris
  ➢ Long term storage of pigs subsea (in production fluid).
Complex Subsea to Subsea pigging

Gjøa as an example of how an intelligent pigging operation was performed even though the pipe system was not fully prepared for such an operation:

The main challenge was to find a suitable solution for kicking the pigs into the production fluid.

Gas export pipeline
Water depth approx 360 m
Pipeline diameter 32”
Complex Subsea to Subsea pigging

- It was decided to bring kicker fluid out with the vessel (difficult/expensive to perform subsea modification to re-route production gas).
- The traditional MEG was not allowed by the FLAGS pipeline end terminal at St. Fergus. So naphtha was finally decided as kicker fluid.
- Safety issue with naphtha – had to be stored inside the hose on the vessel.

Deployment of 5” hose c/w Naphtha
The 5” Naphtha hose was connected to the existing Pig Launcher with a new fitted 2” Hot-make hot-break (HMHB) connector.
The pig launcher was modified:

- New start position for the pigs
- The cleaning/gauge pig launches from the forward kicker line
- The InLine Inspection (ILI) pig launches using both the two rear kicker lines
- PEHD plugs are installed behind the pigs in order to fill up the empty space and reduce required naphtha volume.
Complex Subsea to Subsea pigging

The pig launcher modifications was successful even though the 2” piping and the 2” valves was maintained.

However, it should be noted that this resulted in very high flow in the kicker lines. Up to Mach 2 was recorded during testing – i.e. very high!

Conclusion: Valve and piping size of say 6” would have been preferred in the pig launcher for this type of pigging operation.
The gas was bled off at the pig receiver in a controlled manner. (Gas discharge permit was obtained).

Note:  
- The gas plume as it rises to the surface.
- And the gas as it reach the surface.

This is a safety and pollution aspect that may be handled different from location to location and definitely different for pigging of oil pipelines.
Complex Subsea to Subsea pigging

Pig tracking needed to determine pig position. Two different types were used:

- Radioisotope tracking using a small radioactive source attached to the pig.
- Magnetic pig trackers using small magnets attached to the pig.

Both systems use tracking units placed on the outside of the pipe that monitor the pig position as it moves along the pipeline.

On this particular pigging operation both radioisotope tackers on the receiving end failed. The Magnetic pig position trackers worked OK.
Complex Subsea pigging

The subsea automated pig launcher (SAPL) is a system designed for individual launching of pigs, remotely controlled from a control room, typically on a platform.

The internal pig cassette, which enables easy replacement of pigs, can be designed to handle:

- Pre-commissioning and commissioning pigs.
- Wax removal pigs. (main purpose)
- Inspection pigs.
The benefits offered by the SAPL are:

- Subsea launching (no platform required).
- Remote launching (no vessel or ROV required).
- Multiple-pig cassette (reduced number of trips by service vessel).
- No round trip pigging required (improved production uptime, no need for dual pipelines).
- Inspection pigging with the same unit.
- Commissioning with ROV support / control only.
Complex Subsea pigging

The SAPL comprises the following key elements:

- Insert cassette for pigs to be launched. It is inserted into the SAPL in a “pipe in pipe” arrangement, having a pressure retaining connector in its rear end and a hydraulic stab for fluids to the drive pig.
- A drive pig (or piston) is arranged at the rear end of the cassette, pushing the pigs to be launched stepwise forward.
- A displacement cylinder feeding a predefined volume behind the drive pig.
- Piping, valves and actuators.
- Pig positions sensor, one to verify that the first pig in line is in a launch position and a second to verify that the pig has passed the production Tee and is in the pipeline.
- Retrievable subsea control module.
- Electrical and hydraulic flying leads with associated connectors and MQC plates.
Complex Subsea pigging

In order to include a SAPL in the pipeline system it is obvious that many interfaces must be prepared up front. Post installation into a pipeline system that is not prepared for this kind of pigging will be very costly.

Note: The SAPL is patented.
Complex Subsea to Subsea pigging

Conclusions:

• An operator with a field that requires subsea to subsea, or subsea to topside, operational- or intelligent pigging during its lifetime will save much money and grief by planning and preparing for this up front. Many operators focus only on the initial commissioning pigging and neglect the challenge of more complex pigging in the future.

• The two main areas to control are:

  ➢ How do we kick the pig into the production fluid? Ensure that sufficient valve and piping manifold system is installed up front.

  ➢ How do we bleed of the hydrocarbons at the pig receiver in a safe and effective manner. Again ensure that the required bleed-off system is preinstalled.