THE NORTH SEA RISER INSPECTION PROJECT

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INTRODUCTION

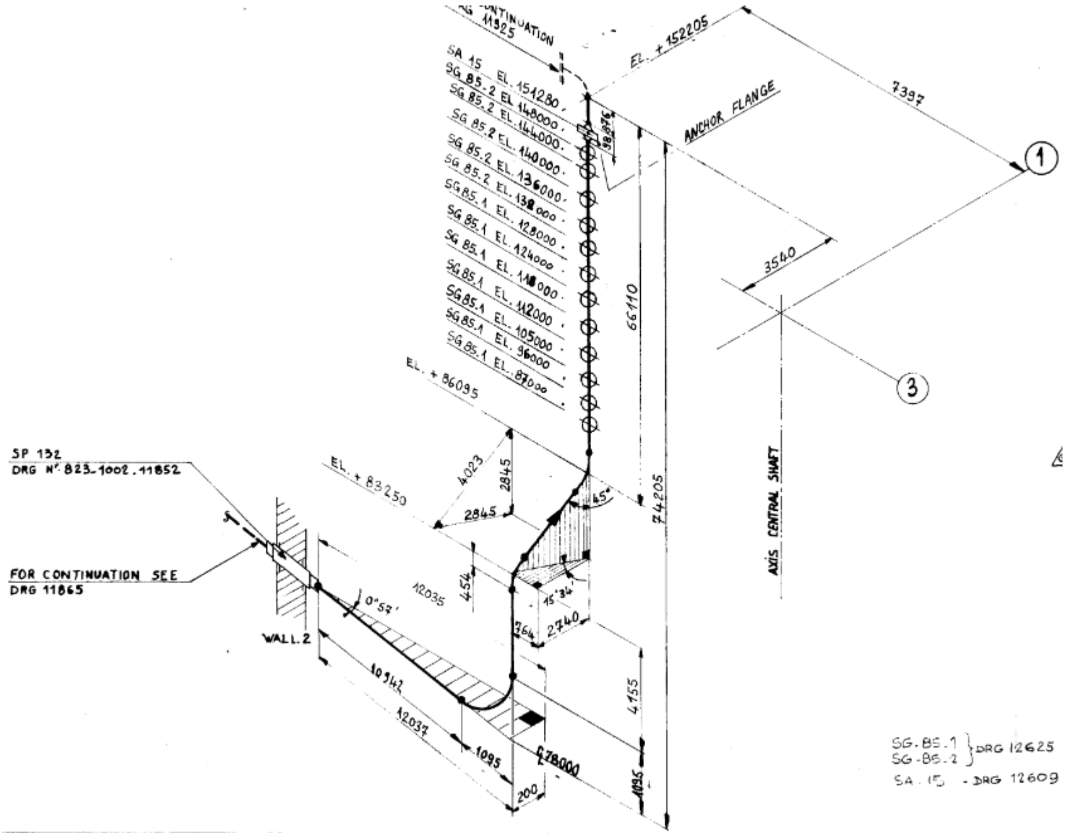
CNR operates a pipeline (25km, 130 barg) that imports gas to the Ninian Central platform operating as a hub in the Northern North Sea, around 386 km north-north east of Aberdeen.

The hub platform, together with another connected platform is used for production as well as processing and commingling of oil coming from surrounding fields.

The imported gas provides fuel for power generation systems, which in turn provide electric power for the platform.

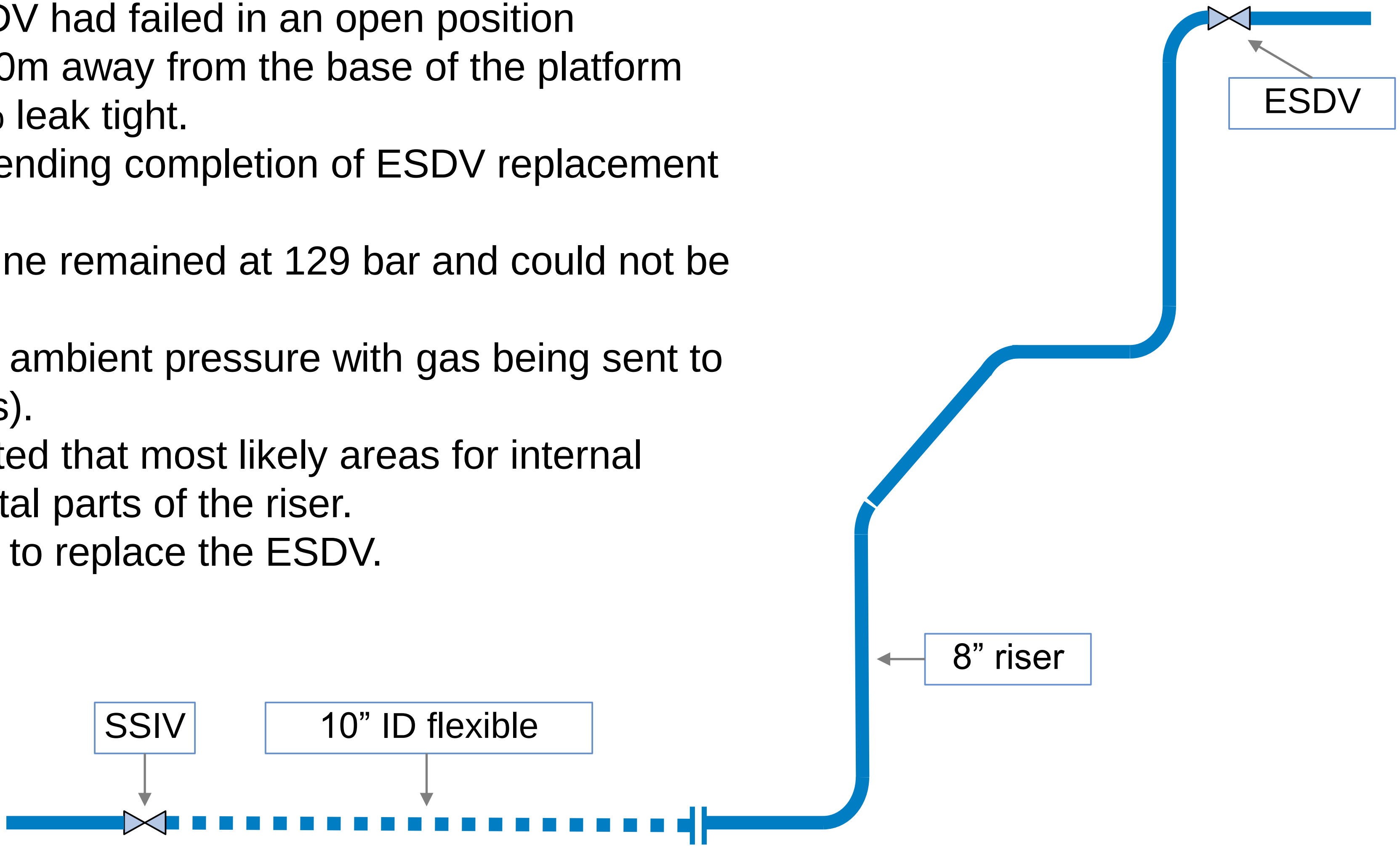
BACKGROUND

- Riser originally used for gas export from 1980-1992, with some gas import.
- Subsea development in 1992 disconnected the riser from its original pipeline and to a new export / import pipeline.
- Significant gaps in data for gas composition / conditions and virtually no empirical data about the internal condition of the riser, resulted in significant uncertainty regarding the integrity of the riser for continued operation and need for internal inspection.



ISSUE

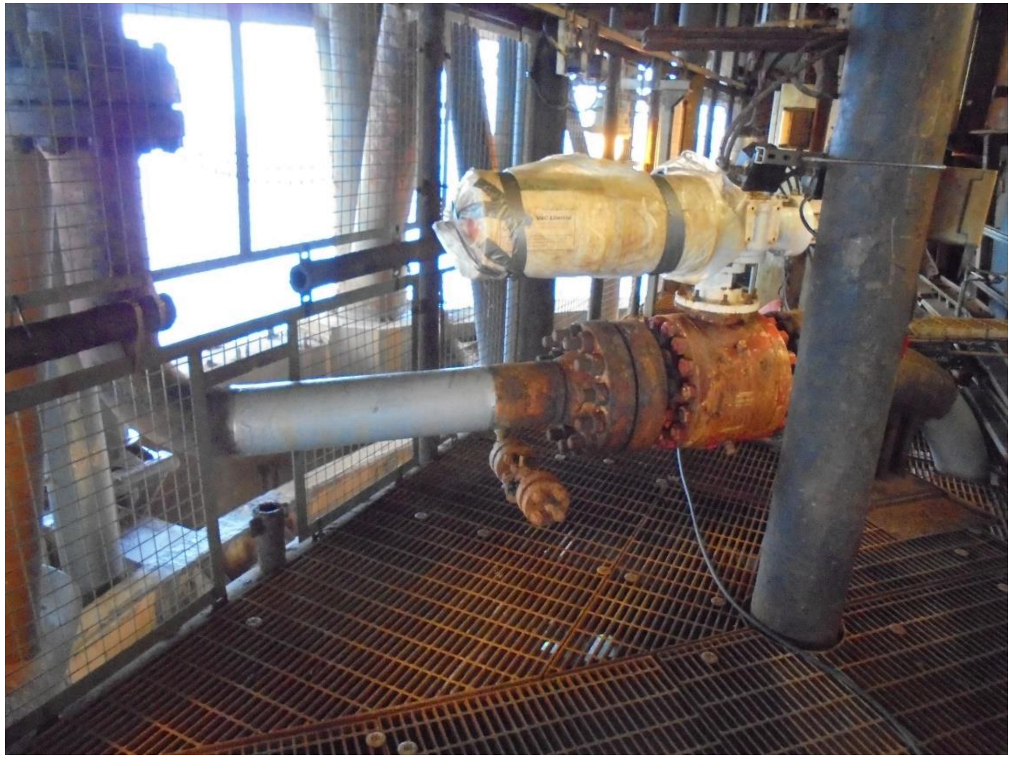
- Riser topside isolation ESDV had failed in an open position
- The SSIV situated app. 230m away from the base of the platform was known not to be 100% leak tight.
- The pipeline was shut-in pending completion of ESDV replacement and inspection.
- The upstream feeder pipeline remained at 129 bar and could not be depressurized.
- Riser was regularly bled to ambient pressure with gas being sent to the flare (0.03 bar/24 hours).
- Corrosion modeling predicted that most likely areas for internal corrosion were the horizontal parts of the riser.
- Phase 1 of the project was to replace the ESDV.



PIGGING CHALLENGES

The line is not piggable using conventional uni-directional ILI tools:

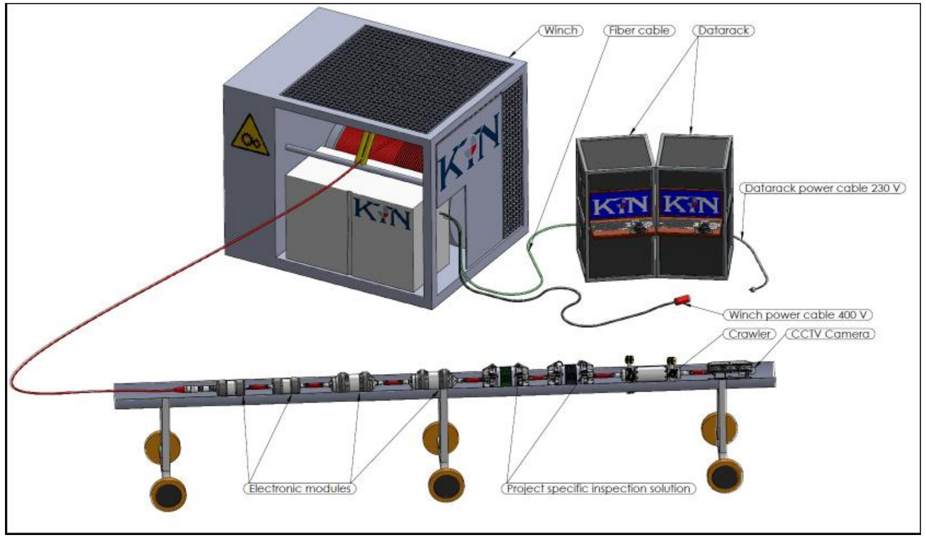
- There was not a permanent topsides pig trap installed,
- There were no subsea pig receipt facilities,
- There was only one access point from the topside platform pipework, with very restricted access (overside),
- The line was not flowing,
- The 8 ˝ rigid steel riser is connected to a 10.5” internal diameter flexible pipe subsea which meant the line was dual-diameter,
- Complex riser geometry, with three 90-degree bends and two 45-degree bends, with significant horizontal sections between,
- Additional subsea valve isolation was ’possible’, but not without considerable risk (manual valve may not operate, or re-open after completion – had not been operated in 20+ years).

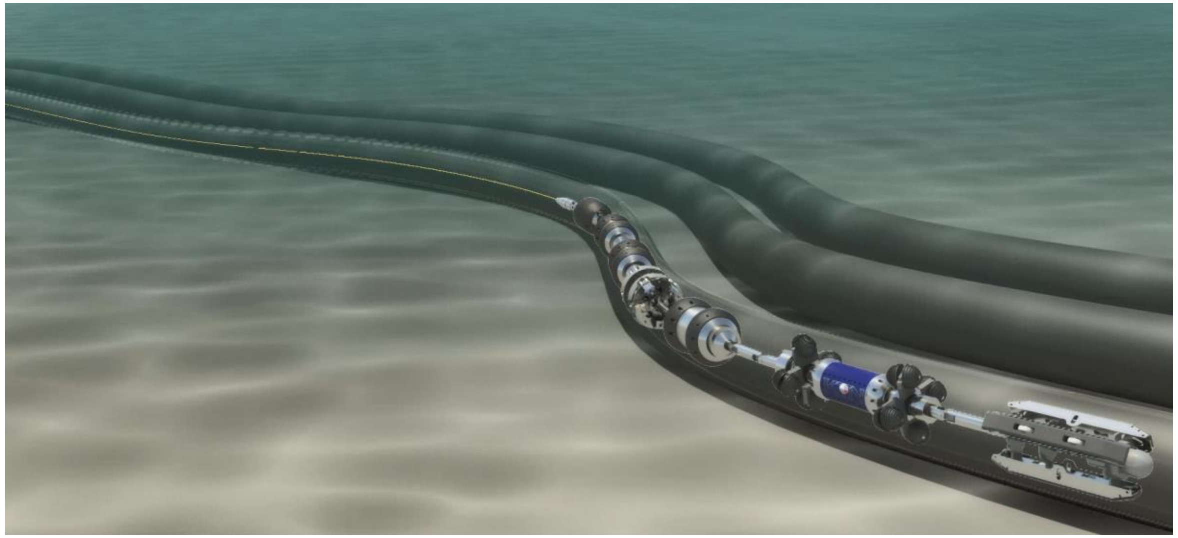


SOLUTION ENGINEERING

A tethered UT inspection solution was assessed but ruled out because

- The tether would require the newly installed ESDV valve to remain open during the inspection, which was considered to be unsafe (SSIV known to pass);
- Flooding the riser with liquid would be required but there would be no way to recover the medium after completion of the inspection, and there was no way to manage the return liquids through the existing gas process plant,
- The gas ingress from the passing SSIV would hinder the UT measurement.

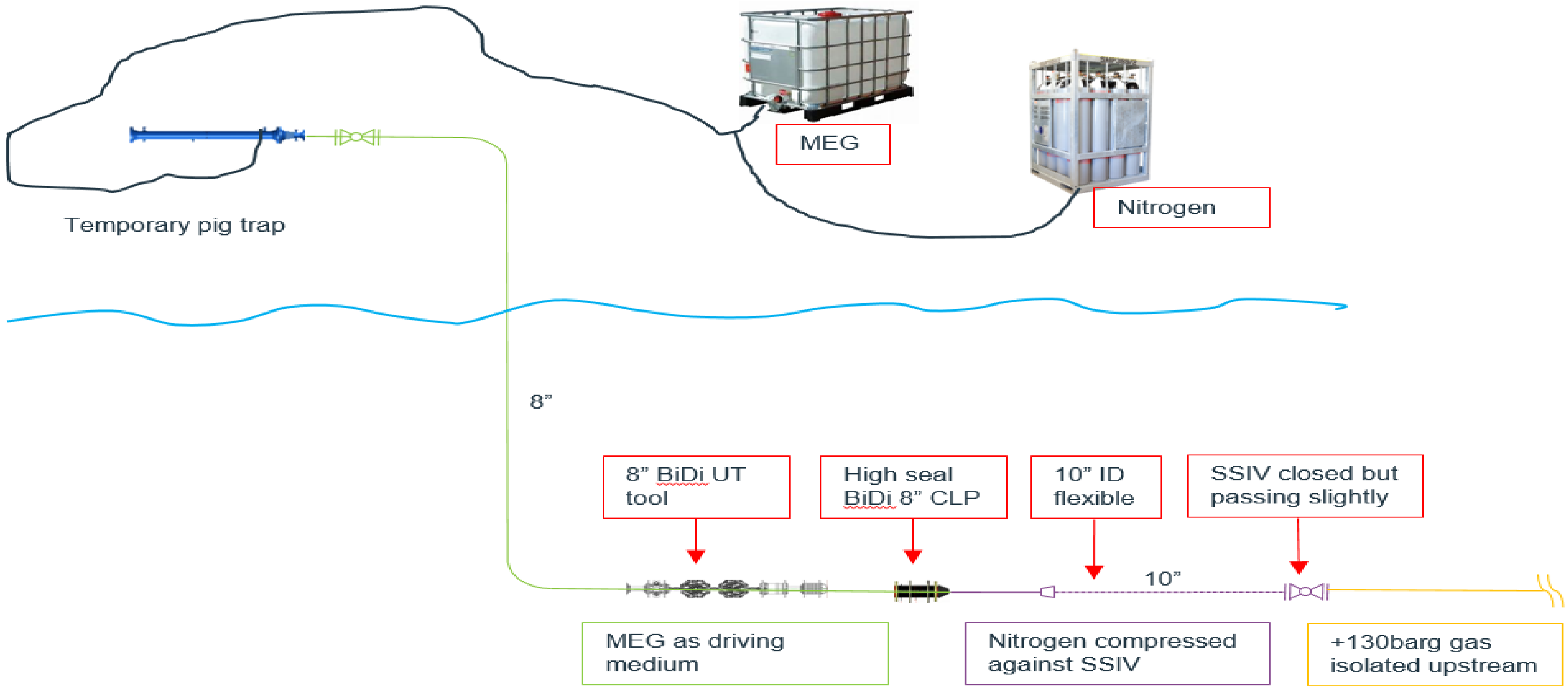




INSPECTION APPROACH

The team finally settled for a rather unique way to inspect the riser:

To pump a free-swimming bidi UT tool in a liquid batch using an external pump into the riser and return the pig train using nitrogen pressurized against the SSIV.



PROCEDURAL CONTROL OF TOOL POSITION

Good seal & control of tool position required

- In case of bypass the required pressure to push back the tool may not be available anymore
- In case of bypass the gas would hinder the UT measurement
- The rigid steel riser is connected to a 10” ID flexible hose app 16 m from final bend of riser at the base of the platform subsea

Ideally subsea tracking would have confirmed tool location but this would require ROV assistance which was not possible given the time frame and weather conditions

Additional complication - the actual WT of the top riser bend was found to be 19 mm instead of 7.9 mm as per isometrics, resulting in an internal bore change which had to be considered in the design and operation of the pig train.

TESTING

Cleaning Tool:	UT ILI Tool:
Launch pressure ~ 1.5 barg Flip pressure in 200mm ID straight section ~ 2.6 barg Flip pressure in 187mm ID 5D bend ~ 2.3 barg Running pressure 200mm straight ~ 1 barg Running pressure 187mm straight ~ 1.8 barg Running pressure 187mm 5D bend ~ 2.5 barg Running pressure 182 mm 6D bend ~ not tested Forward speed – 0.1 m/s Reverse speed – 0.1 m/s	Launch pressure ~ 2.0 barg Flip pressure in 200mm ID straight section ~ 3 barg Flip pressure in 187mm ID 5D bend ~ not tested Running pressure 200mm straight ~ 1.5 barg Running pressure 187mm straight ~ 3 barg Running pressure 187mm 5D bend ~ 5 barg Running pressure 182 mm 6D bend ~ 7 barg Forward speed – 0.1 m/s Reverse speed – 0.2 m/s – 0.5 m/s

PRESSURE REQUIREMENTS FOR RETURNING PIG TRAIN

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Pressure requirements for returning pig train from subsea to topsides

Hydrostatic head in riser (150.46m elevation) MEG	16.78	Barg
Hydrostatic head in pumping spread (60m elevation of hoses)	6.72	Barg
Estimated Pressure for High Seal Pig to pass HW bend	7	Barg
Estimated Pressure for UT tool to pass HW bend	7	Barg
Total:	37.5	Barg
Conclusion to pack riser with N_2 to……..	**40**	**Barg**

RUNNING PROCEDURE

In order to ensure the majority of the riser could be expected whilst minimizing the risk of the front sealing pig or worse the UT tool entering the flexible, the running procedure was formalized using bore maps and drawings of the riser and then optimized and calibrated by performing multiple runs in the riser.

After each intermediate UT tool recovery the data would be downloaded from the tool and uploaded to ROSEN server to determine the tools stop position.

- Compare recorded tool distance with the volume pumped.
- Compare signals in welds and bends with the riser drawings.

OFFSHORE EXECUTION

Nitrogen was pumped into the riser at 40 bar prior to the start of the pigging operation in order to pack the line. Next the seal pig was introduced into the temporary launcher then pumped 10-15 meters into the riser topsides, using a fixed volume of MEG and then returned by choking the MEG pressure. The sealing pig was removed and condition checked. An external pig tracker was used to confirm pig location.

This initial pig run using the seal pig provided confirmation that pumped volume/ pig tracking was operating as expected.

Next the pig train consisting of high seal pig and UT tool was launched and pumped for a total of 20 m into the riser. The train was returned and the UT tool data was downloaded and the recorded distance from the tool was compared to flow data from the pumping spread and confirm that the procedural volume and distance pumped matched the riser isometric drawings.

The operation was a repeated at a number of pre-agreed distances (77m, 120m) backed up with procedural control. Seal pig and ILI tool separation was maintained at about 10m.

OFFSHORE EXECUTION

One of the key drivers behind this sequential approach was to understand the behavior of the two pigs (high seal pig & ILI tool) in the riser, especially during the transition through the pipe bends, in order to maintain the separation between the pigs during the return up the riser (to avoid clashing). The team would have liked to reduce the separation to a minimum, in order to maximize the inspection coverage, but it had to be maintained at 10 meters.

Ahead of the final inspection run to capture as much riser as possibly safely; CNR, the pumping vendor and ROSEN worked together to agree the final inspection distance and adjusted the procedure accordingly based on the knowledge gained on the incremental inspection distances.

Two of the pig runs resulted in the ILI tool stopping at the topsides valve during the return process; caused by insufficient momentum with the return flow path choked too low.

Resolved by pumping the pig train back into the riser for 10m, before completing the return to topsides using the nitrogen pressure in the riser.

RESULTS

The final inspection run was completed with the distance the ILI tool recorded being 173m into the riser stopping a safe distance from the flexible riser (distance to riser-flexible flange was 194m). Seal pig estimated to stop 5m from flange.

The UT Tool was safely launched and received and the data checks undertaken to confirm acceptability. The data was transferred using wi-fi from the platform on to ROSEN’s server and due to the criticality of the project, ROSEN data experts provided 24 hour coverage during the scope resulting in the final report of the metal loss recorded by the ILI tool being issued to CNR less than 48 hours after the inspection tool was recovered from the pipeline so that CNR could return the pipeline to service without further costly delays.

No corrosion-related metal loss anomalies were detected in the riser section inspected.


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