CASE STUDY:
1001/01

PRODUCT: FLOW-SURE MC

DATE: FEBRUARY 2014

DUAL ZONE SINGLE TRIP DRILL STEM TESTS
SAVE RIG TIME

PRODUCT
FLOW-SURE MC

LOCATION:
North Atlantic

SERVICE:
Well Test Evaluation

BENEFITS:
336 hours rig time saved

Data direct from the sandface

Understanding zonal flow contribution

METROL®
APPLIED INTELLIGENCE

CASE STUDY: 1001/01

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METROL'S PARAGON TELEMETRY SYSTEM WAS USED TO TEST 2 DUAL-ZONE WELLS WEST OF SHETLAND. THE TECHNOLOGY CONTROLLED 20 DOWNHOLE WIRELESS ASSEMBLIES COMPRISING 24 GAUGES AND 4 REMOTE FLOWSURE INFLOW CONTROL VALVES BETWEEN PACKERS 400 AND 800 METRES APART. A TOTAL OF 27 SEPARATE VALVE MOVEMENTS WERE COMPLETED OVER A 53 DAY TESTING PERIOD.

CHALLENGE

The client wanted to conduct Drill Stem Tests (DST) in two subsea wells to confirm fracture and matrix deliverability. The client requested that two zones in each well were tested and cleaned-up individually, with the ability to isolate the lower zone in case it started producing water. The well tests were performed in the Atlantic Ocean and rig availability dictated that they had to be carried out during winter. Due to the sensitive nature of well test operations there is the potential for significant delays which can prohibitively increase cost. The client therefore opted for a single "trip", dual zone well test string design using Metrol's wireless Paragon telemetry system to reduce risk, rig time and cost.

Metrol's Paragon system is the most advanced and widely used wireless telemetry system in the well test industry. It is capable of integrating with almost any downhole or subsea configuration whilst withstanding hostile environments. It is industry proven.

Metrol were requested to provide wireless sensor [OCULUS], downhole valve [FLOW-SURE] & sampler actuation [ORIGIN] systems capable of monitoring and controlling flow from two separate zones before switching to a co-mingled flow

METHOD

The bottom-hole assembly was run with two seal assemblies stung into two Polished Bore Receptacles (PBR) set within the liner and spaced approximately 650m apart. The wells were constructed with 7" slotted liner and the entire lower completion was spaced out from a No-Go positioned at the top of the liner (see Fig. 1).

OCULUS quartz gauges were ported to read internal and external tubing pressure while continually monitoring the reservoir and barriers integrity at each location.

Two wireless Metrol Sliding Sleeves (FLOW-SURE) were positioned in each zone; one multi-cycle device for primary flow control and one single-shot device for operational contingency. Conventional annulus-operated well test tools were located above the packer, along with Metrol's wireless-ORIGIN sampler actuators and OCULUS quartz gauges. Data is always a critical test objective and a carrier equipped with OCULUS quartz gauges was placed half way up the string to check hydrostatic pressure, allowing real time fluid gradients and boundaries to be calculated before sending the firing command to the samplers.

The Metrol PARAGON system, FLOW-SURE wireless sliding sleeves, OCULUS quartz gauges and ORIGIN sampler carriers allowed each zone to be monitored, sampled, opened or isolated remotely, all without the need for wireline intervention.

MULTI ZONE WELL TEST CONFIGURATION

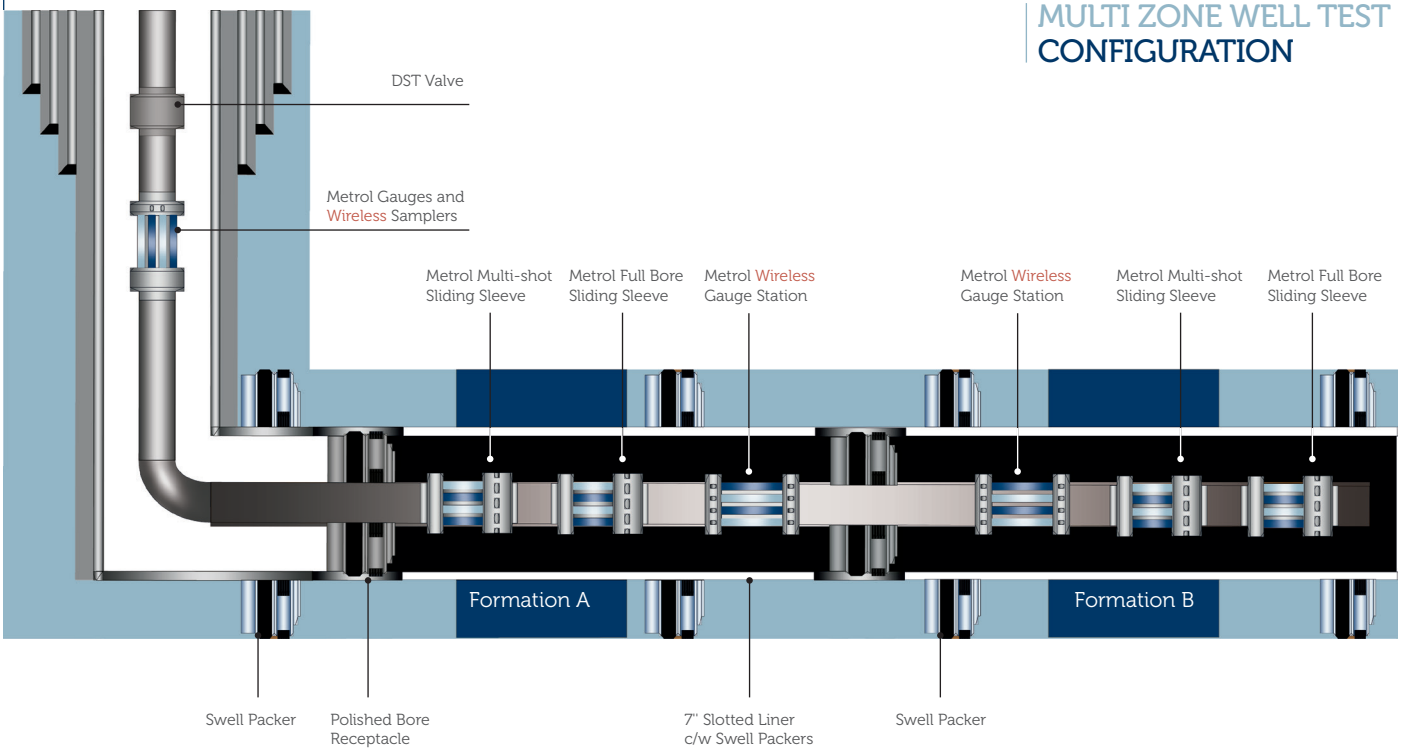

Fig. 1

Multizone well test schematic

RESULTS

Metrol remotely confirmed the precise FLOW-SURE valve status after the string was displaced to nitrogen. The well was then opened up and an 11 hour flow period followed by initial pressure build-up was performed. At this point the weather deteriorated and the subsea test tree was unlatched and the rig moved almost 500 metres from the well, as per safety procedures.

Whilst unlatched, Metrol wirelessly monitored the pressure from all 24 in-hole gauges, including the upstream pressure of the closed sliding sleeves in the upper zone.

After confirming the well pressures were stable, a wireless open command was sent to the upper zone sliding sleeve, preparing the string for the next stage of the well test program. All this was performed, wirelessly, while remaining unlatched at the subsea test tree.

The valve open command was initiated using Metrol's TRITON ROV Deployable Sonar and wireless telemetry stations mounted on the rig's BOPs.

The Metrol downhole data and valve movements allowed trapped hydrostatic pressure between the packers to be bled off and the pressure equalised. This occurred approximately two hours before the subsea tree was re-latched, meaning both sleeve movements were completed offline, while DST operations were waiting for the weather to improve, thus making significant rig time savings.

The wireless sleeve movements were positively confirmed by acquiring Position Sensing Tool (PST) data in addition to pressure and temperature data from the gauges (see Fig. 2). These pressure data validated the electronic information already received from the PSTs sleeve positions sensors.

336

HOURS RIG TIME SAVED

27

SEPARATE WIRELESS VALVE MOVEMENTS

4

ZONES TESTED INDEPENDENTLY

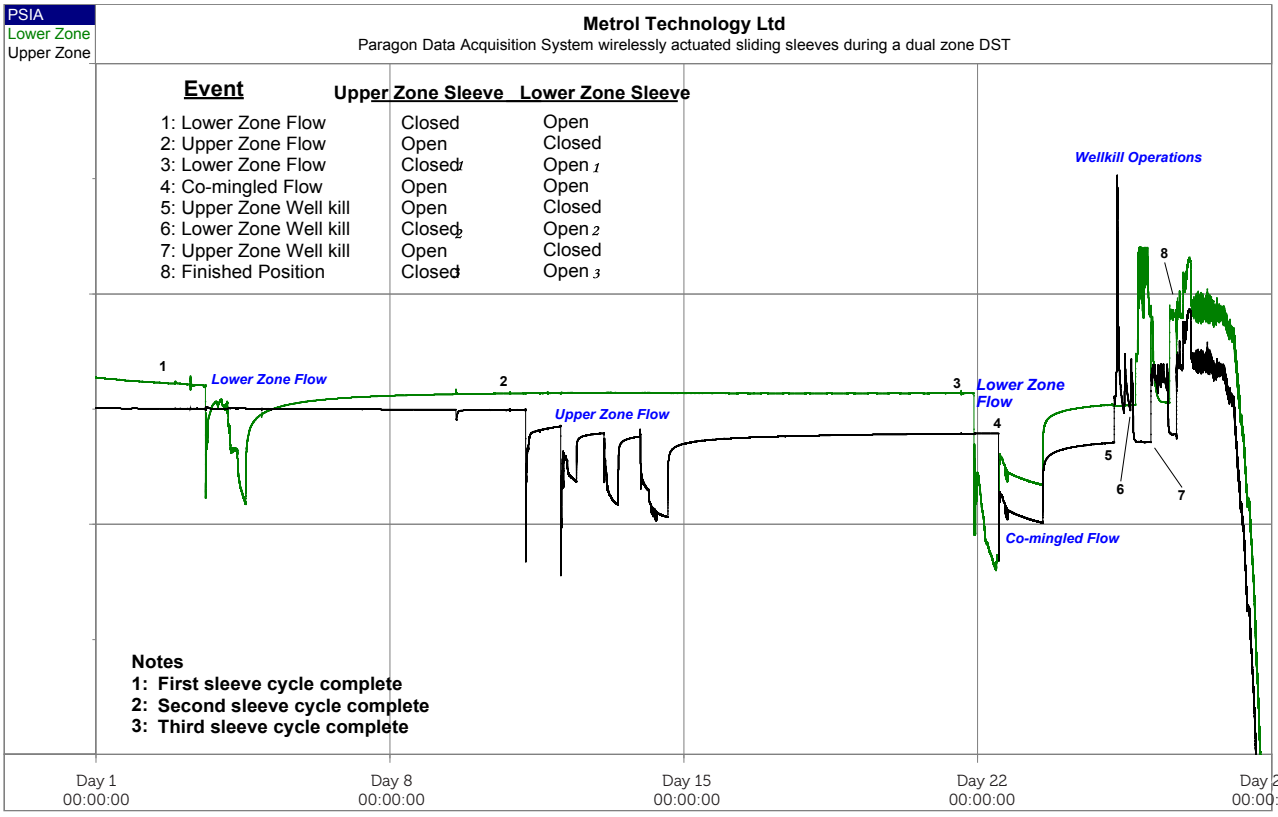

Fig. 2

Paragon Data Acquisition System wirelessly actuated sliding sleeves during a zone DST

RESULTS CONT...

Over the two well tests a total of 27 valve movements were conducted. The tests were completed successfully with all tools functioning as expected. Significant rig time was saved by only having to run a single DST string, and the risks associated with pulling out and running in hole with a second DST string were removed. Using the Metrol wireless pressure gauges the client was able to determine how the two zones related to one another by flowing them individually and concurrently.

Due to unforeseen circumstances in the second well test, Metrol verified downhole pressure and valve positions allowing an unscheduled flow and pressure build-up 8 hours into a commingled flow. The resulting flowing build up provided invaluable data for reservoir analysis.

Metrol played a significant role in the successful conclusion of both well tests and allowed the client to considerably improve operational efficiency.

Three of the most notable success factors of the test were:

- Wireless data provided by the Paragon system improved safety by verifying the integrity of the barrier envelope and confirmed zonal isolation.
- The wireless system was used to actuate the Metrol wireless sliding sleeves to allow a zonal build-up during a commingled flow.
- The understanding of the geology and zonal connectivity was increased.
- Removing the requirement to run separate DST strings to test the individual zones saved 336 hours rig time.

The Metrol PARAGON wireless telemetry system run in conjunction with Metrol's FLOW-SURE wireless valves and ORIGIN sampling system allowed multiple zones to be tested using a minimal amount of rig time with enhanced sand face understanding while reducing risk to the well.

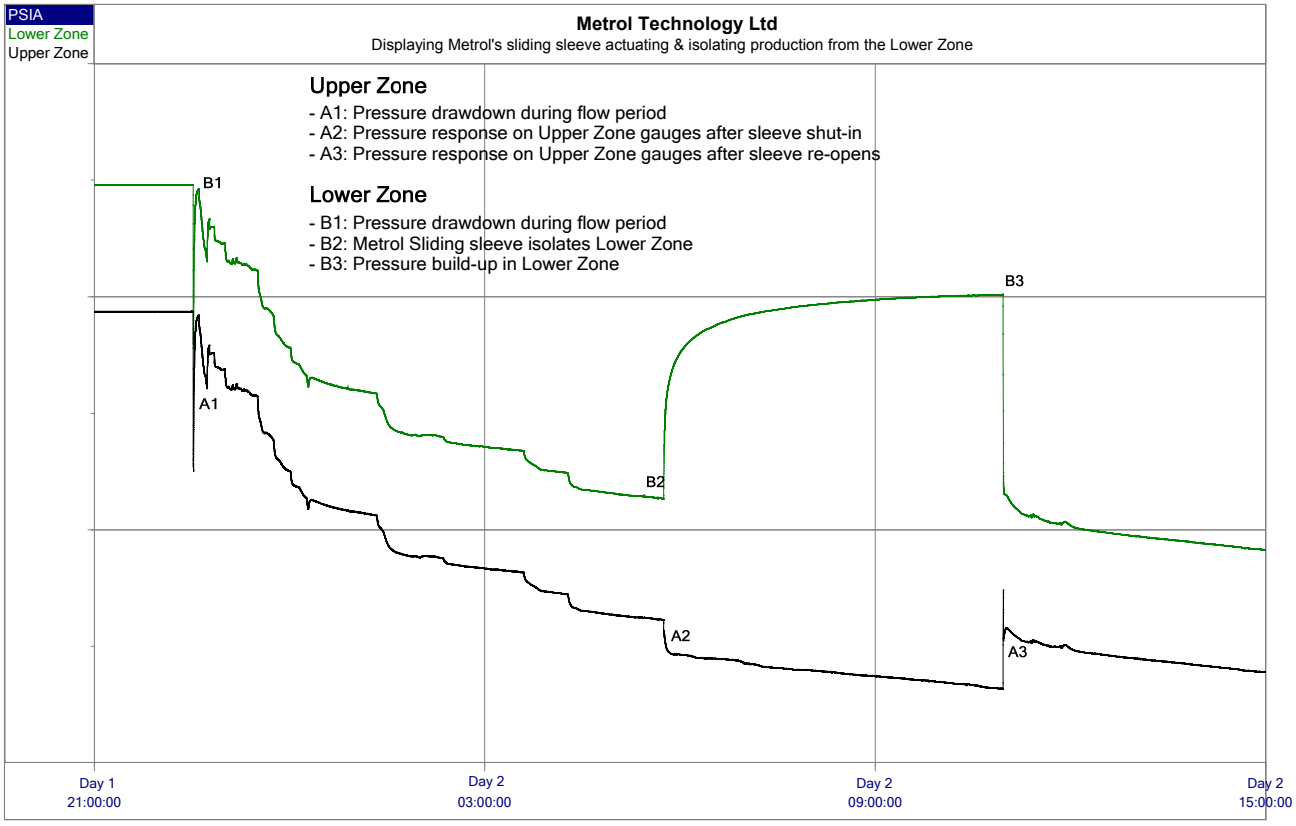

Fig. 3

Metrol's sliding sleeve actuating and isolating production from the lower zone

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Howe Moss Place
Kirkhill Industrial Estate
Dyce, Aberdeen
AB21 0GS, Scotland, UK

T +44 (0)1224 772771
E sales@metrol.co.uk
www.metrol.co.uk