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Extended Abstract

Production Quantification Through Full Field Modelling – Case Study

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1 Case Study

One of the major challenges with subsea systems is the limited availability of information. Wells flow commingled, and identification of individual well contribution require special attention both in design and operation. Some subsea tie-backs are also commingled across licenses or even national borders, and the subsea metering systems become part of the fiscal system regardless of their accuracy and robustness.

Lundin Petroleum Norway and FMC Technologies executed a study to test the potential of using all relevant field instrumentation to estimate the true flow rates produced. In this case Lundin also wished to estimate the historical production rates to independently compare against measured flow rates from the multiphase meters installed. This was achieved by utilizing the FlowManager™ steady state multiphase flow simulator to build a network model of the production system, from reservoir to topside.

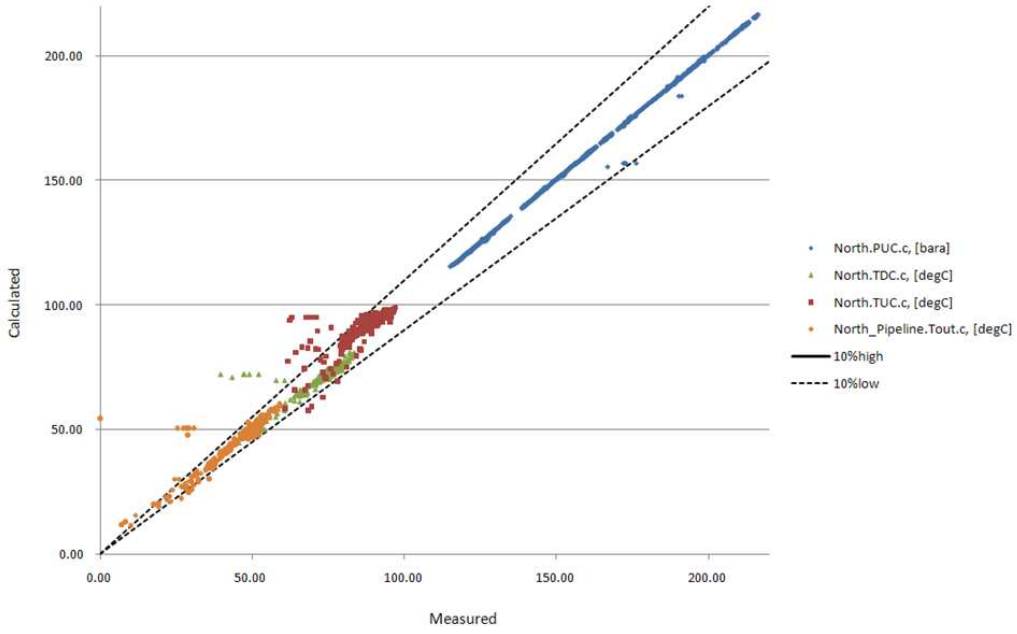

Figure 1: Calculated versus sensor responses

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The results from this study confirmed the strengths of this approach and its ability to quantify flow rates independently of dedicated metering solutions. This approach can be extended to incorporate dedicated meters to quantify the flow rates with higher accuracy and precision.
The relative success of the study spurred an effort into quantifying the distribution of uncertainty in the upstream production system.

2 Utilize the available information

The information from a subsea system comes from sensors, meters and fluid samples followed by characterization. It is important that these components play together in the systematically correct way in order to have sustainable information control during the entire production life of the field.

With the increased amount of instrumentation it follows a need for proper system analysis. When measurements fail or redundant measurements are deviating, which do you trust? There is only one true solution for the actual flow rates produced, but often only local interpretations, i.e.at locations where flow meters, pressures and temperatures are available. Are they consistent? All representations of local flow conditions can be taken into account, and the true solution should be quantifiable with higher accuracy and precision compared to full submission to single measurements.

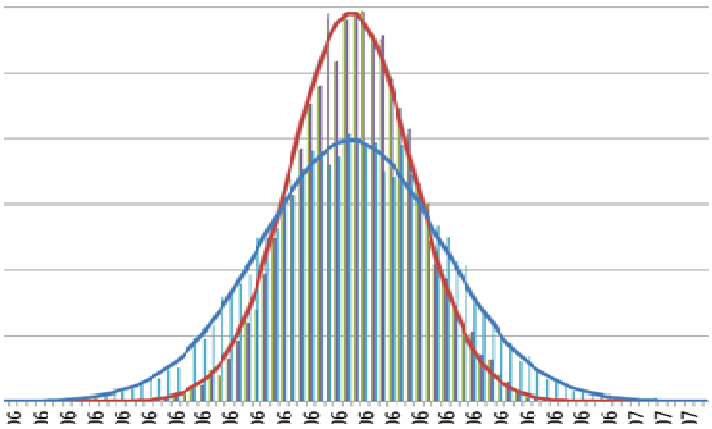

Figure 2: Quantifying accuracy in all measurements

Uncertain and inaccurate measurements require a data reconciliation process to fully exploit the available information and to detect low quality measurements.

All measurements in the production system including wells and flow lines are included in the analysis. Each of the sensors is assigned accuracy according to their specification. In this way all sensors influence the solution. The new approach adds new statistical information to system metering and reconciliation such as gross error checks, sensitivities, co-variances and accuracies on estimated results.

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3 Target

The target is to obtain an improved overall flow metering system for consistent and robust well flow allocation, with ultimate goal to obtain subsea fiscal metering quality, or at least an undisputable system solution that determines the correct solution with known estimates of standard deviation throughout the system, easily auditable by all relevant parties.

The approach is towards subsea metering, but the technology is also fit for purpose for topside well allocation when production from different reservoirs or wells with different partners is mixed upstream the fiscal metering station. Depending on available downhole instrumentation it can also be used for zone allocation.