FEESA Ltd
Consultancy Case Studies

Phased Use of Maximus for Flow Specified Network Life of Field Optimisation

ABSTRACT

Maximus can be used as a very effective tool to carry out a rapid optimisation of a flow specified network utilising the Life of Field approach.

The example presented is the expansion of an existing project (as in Figure 1) to a system with a total of 51 wells, 8 platforms and 4 trunklines. The platforms feed gas into trunklines and the gas is transported to shore for processing and export.

The challenge with optimising the network is that it is not intuitively apparent, given the number of platforms involved, when the design cases occur. The system had a number of constraints that had to be considered when optimising the design:

- Pipeline design pressure was limited to 900#,
- Maximum pipeline diameter available for the type of pipe was 26”NB,
- The offshore platforms are NUI, therefore offshore activities were to be minimised.

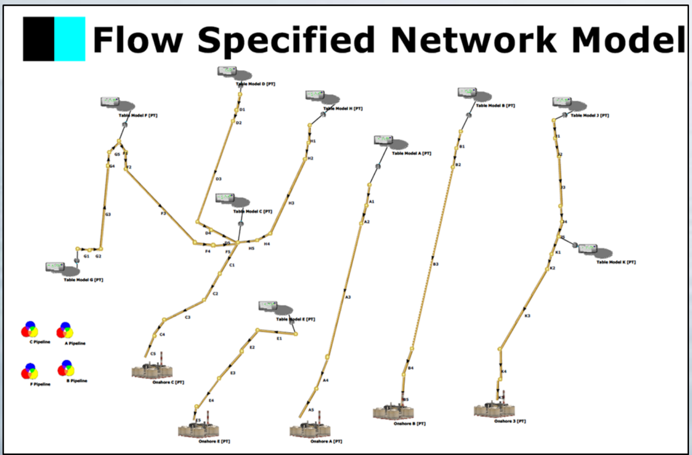

Figure 1. Flow specified Network Model

APPROACH

Production profiles were prepared by the subsurface discipline using a standard commercial simulator. The Flow Assurance discipline was tasked to develop an optimised network design with the minimum of input information. Due to project timetables, the exercise was required quickly.

Production data was available on a well by well basis. This was assimilated to produce individual production profiles for each of the 6 platforms. To enable “Life of Field” modelling, this data was input into a Maximus “Table Model” where for each time step, the following data were reported:

- Fluid Composition
- Flowing Temperature
- Date
- Gas flowrate
- Gas Oil Ratio

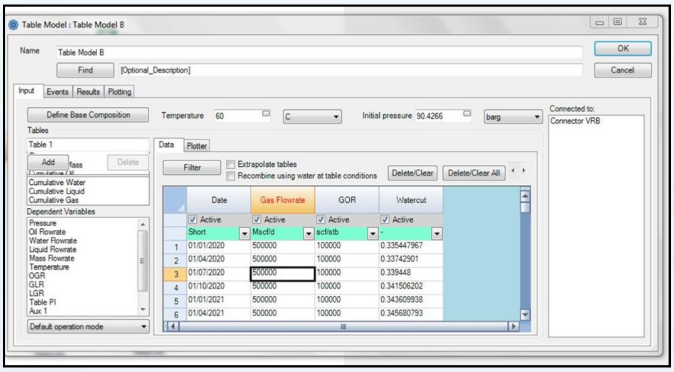

Figure 2. Table Model Dialogue Box.

Using available data for platform locations and pipeline bathymetry, a network model was constructed. Simple event logic was used to change the arrival pressure at the onshore facility to represent the start-up of Onshore Compression as per the assumptions in the original production profile. Scandpower’s OLGA© 2P Correlation was used for the
pressure drop calculations.

The model was run and Maximus’s plotting capability was used to create plots of key data, such as:

- Gas, oil, water flows through life
- Pressure at key points in the network
- Temperatures
- Gas velocity
- Liquid holdup

As the system was likely to be erosion velocity limited post compression, Maximus’s data logging capability was used to log key data for erosion calculations. Run time for a 20 year life at quarterly time steps (80 steps in all) took about 40 minutes.

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RESULTS

The initial network configuration was found to be unsuitable as the diameters used by the original screening study resulted in huge liquid holdup issues in later life. Using Maximus's ability to rapidly run Life of Field simulations, multiple runs were carried out to produce an optimised network.

By using modified production tables, which could be cut and paste rapidly into the table models, sensitivity cases on CGR and WGR were run to assess the robustness of the design.

INTERACTION WITH SUBSURFACE DISCIPLINES

The Maximus model was a useful tool for assessing the deliverability of the production profile proposed by the sub-surface team. By using the "Reservoir Hydraulic Tables" feature, it was possible to generate Hydraulic Table text files for use by the Reservoir Engineers in their reservoir models. Since these tables were generated using the OLGA 2Phase correlation, there was a high confidence in their accuracy.

Some of the proposed profiles generated by the reservoir model were very "Peaky" resulting in over-sized pipelines that were highly prone to liquids build up as the rates declined. By inspection of system backpressure, gas velocities and liquid hold-up through life, the surface team was able to feed back to the sub-surface team recommendations with respect to suitable peak flows for certain of the fields in the development to avoid unnecessary over-sizing of the pipelines.

Another area where the Maximus model was used to inform the reservoir model was Onshore Gas Compression Timing. The initial reservoir model assumption was that compression started across the entire field at the same time. This assumption could potentially result in unnecessary expenditure of both CAPEX and OPEX so the Maximus model was set up to drop arrival pressures at the onshore plant, only when the flow had reduced to the erosional limit of the pipeline at the lower pressure.

By varying onshore arrival pressures to simulate Onshore Gas Compression, an approximate timetable for phasing of Onshore Compression was developed and provided for use in the reservoir model.

THE TWIN IPM APPROACH

Once the network configuration had been defined, the hydraulic tables and compression timing fed back to the reservoir model, the next stage was to upgrade the Maximus model to a fully pressure specified system to enable assurance of the system behaviour through life.

Using the output of the reservoir model, Reservoir Tables for each well were developed, where key performance parameters such as Completion PI, Reservoir Pressure, CGR, WGR were defined as dependant parameters of Cumulative Gas Production.

These Reservoir Tables were linked to hydraulic models of each well and were substituted for the original Reservoir Tables containing the production data. The fully pressure specified model was then run to see if it could reproduce the production profile generated by the reservoir model.

It was found that the VLP tables used in the subsurface model tended to under-predict the pressure losses in the well tubing and that the proposed profile was not deliverable. The Maximus model was used to generate new VLP tables for the subsurface model based on the OLGAS correlation. This in turn was used by the reservoir simulator to regenerate the production profile. The revised production profile could now be matched using Maximus, showing that the profile was now hydraulically deliverable.