Digital, Data Analytics, and Automation: Value Creation Through Digital E&P

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Pushing The Limits Using Closed-loop Real Time Optimization, Production Universe To Maximize Production While Staying Within Safe Operating Limits

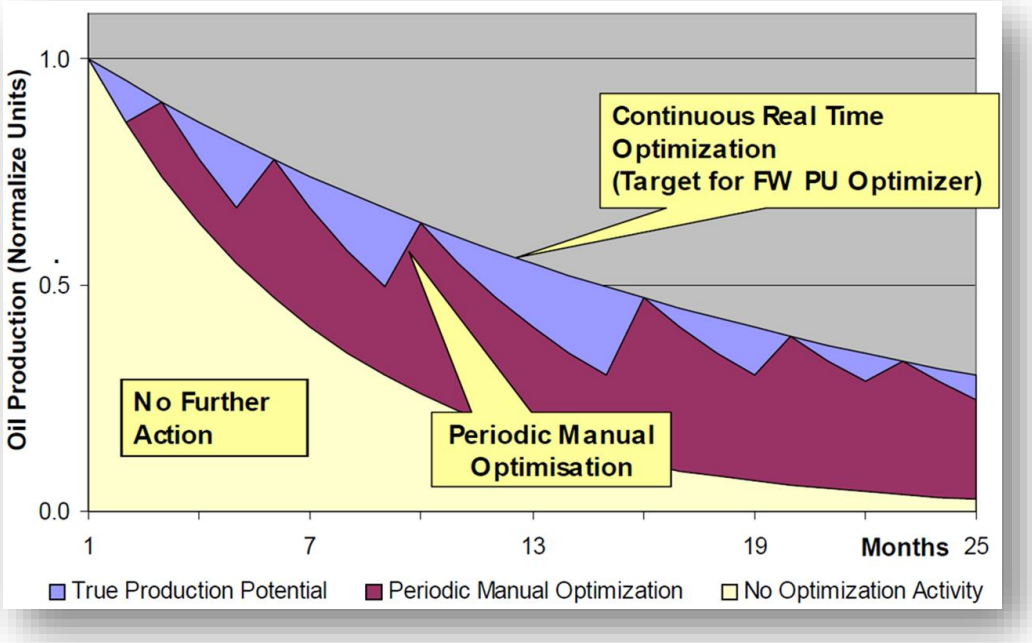
Jan Briers & Jason Kok, iNNOVATEQ

The case for Real-Time Field Optimization

In a typical oil/gas field, optimization is done periodically and manually by the PE

- When new well test data is available; after a workover; as a result of an EBM trigger; …
- There may be static tables (GUF list; creaming curves; …) used by operations too
- But these are outdated the moment one well is closed-in

With (closed-loop) RTO we can achieve being in the **global** optimum 24/7



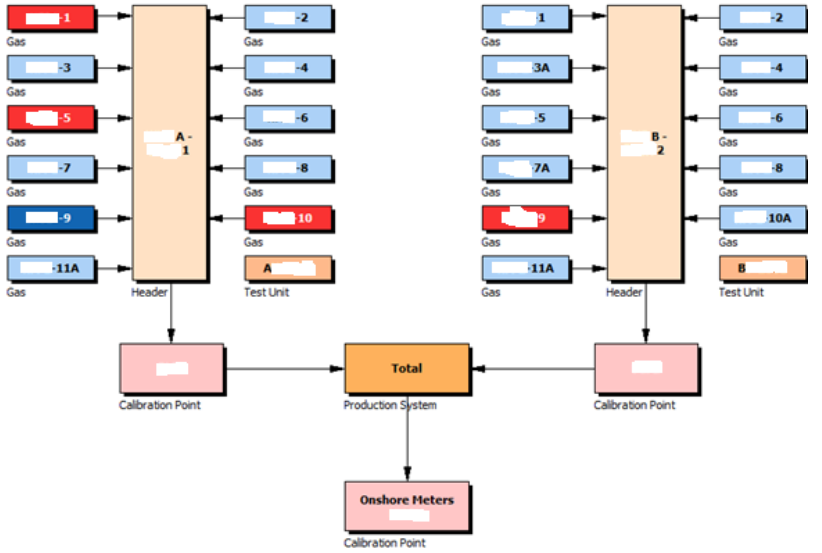
A case study – closed-loop control using Data Driven Models

Problem statement:

- Two offshore platforms, each with 10+ wells, provide gas to an onshore plant.
- The 20+ wells have the capacity to exceed that plant demand on a daily basis
- Wells undergo routine multi-rate tests, resulting in a changes in total production
- There is an opportunity to maximize condensate production from all wells

Key information:

- Each well has a different **rate dependent CGR**
- Therefore, this is a clear optimization problem:
  - Objective Function: Optimize Condensate production
  - Constraint: Gas Plant demand + Balanced depletion constraint
  - Controls: wells chokes



What is a Data Driven Model

- Real time production monitoring and optimization solution

What does it do?

- Provides real time well rate estimates (30-60 seconds interval)
  - Using data-driven models built using machine learning from Well Test Data and Well Measurements
- Allows for real time tracking of well production vs export meters

What is it for?

- Well test validation
- Real time surveillance
- Real time optimization

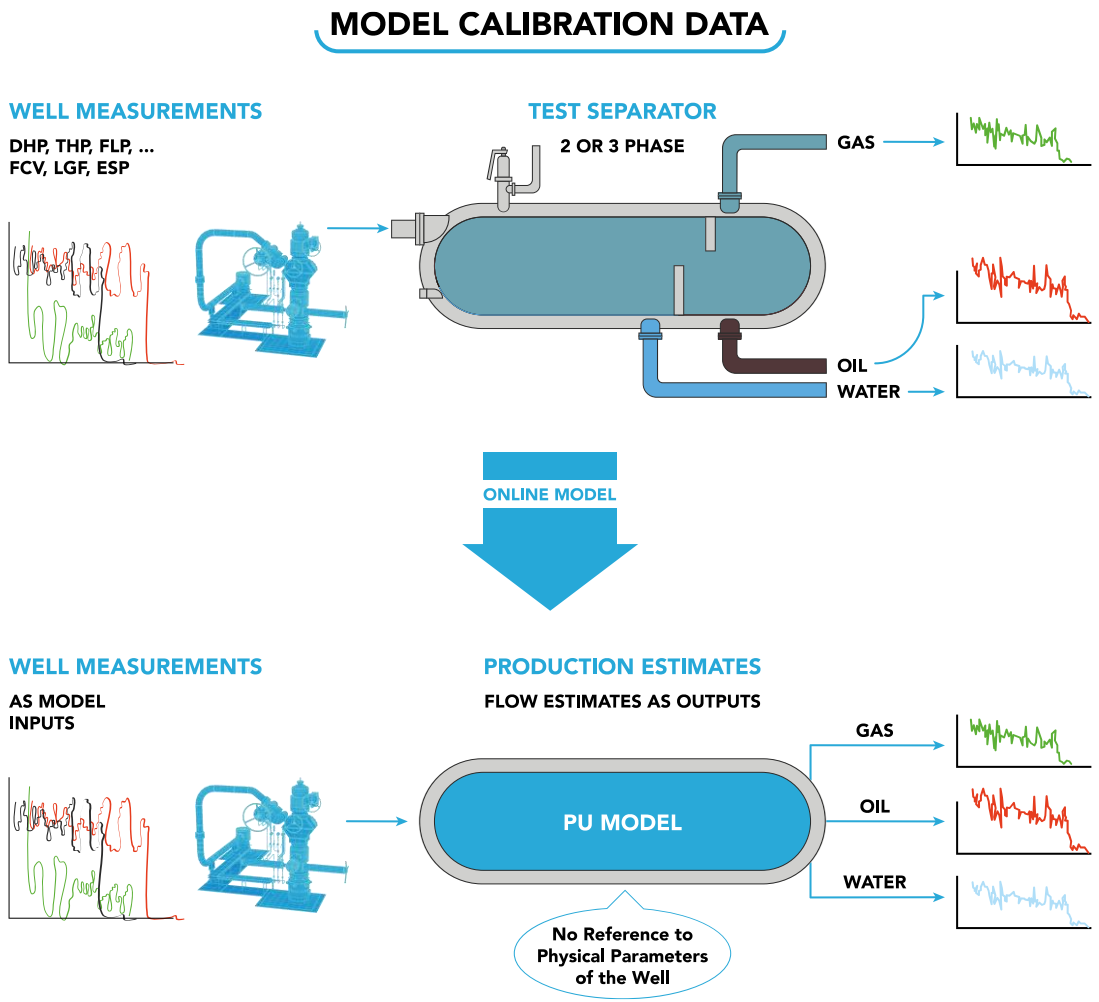
Data driven models, simplicity is the power

Models are maintained by Programmers

- Limited network knowledge needed to setup
- Works with badly calibrated readings
- Fallback models to handle temporarily missing data
- Accounts for changing PVT data through decline models
- Builds optimization scenario's with constraint functions, not a full network

1 min per oil, water and gas rate prediction **<u>enables Real time surveillance</u>**

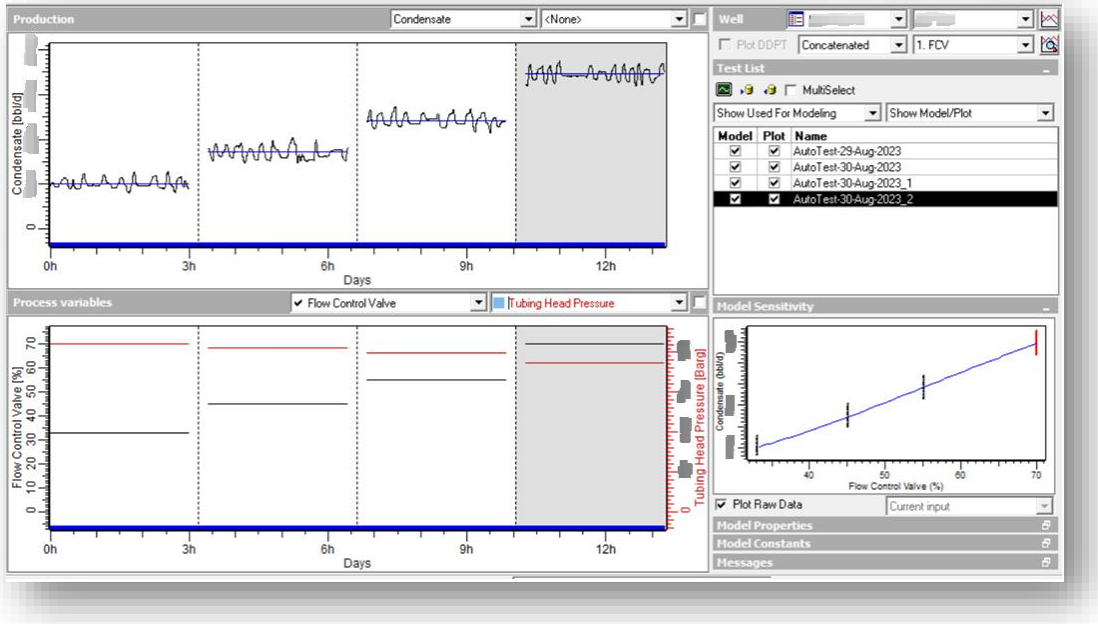
- Allows fast bad actor identification (upstream browsing)
- Fast response on diagnostics workflows assigned to individuals monitored on SLA's
- Calculates optimization scenarios based on cost functions and network constraints without full network model

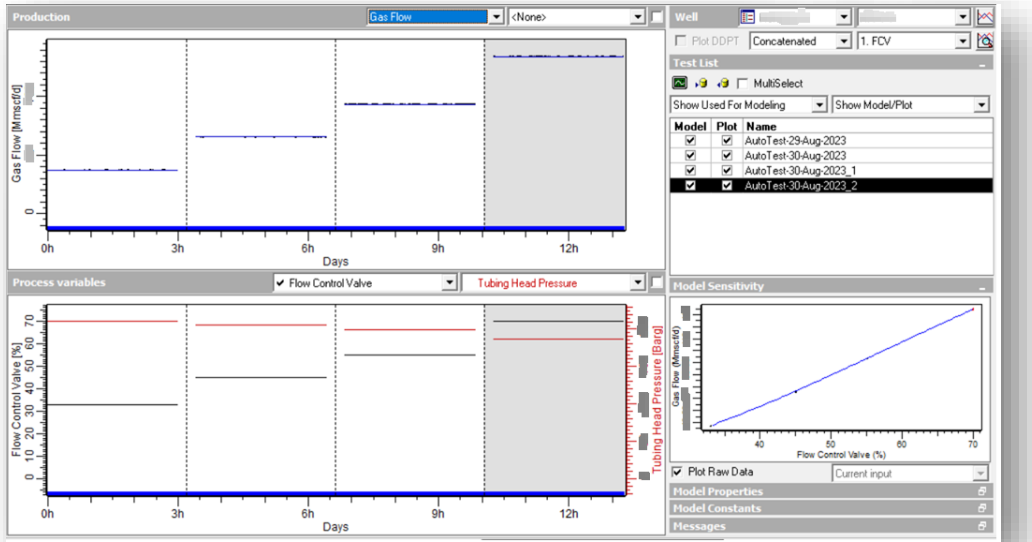


RTO Building blocks – well models

Models need to accurately estimate/predict the well production

- Not only the flow rate, but also BSW / CGR / WGR…
- And not forgetting CO2, H2S, Sulfur, API Gravity, …
- As well as allow constraints on e.g. drawdown…

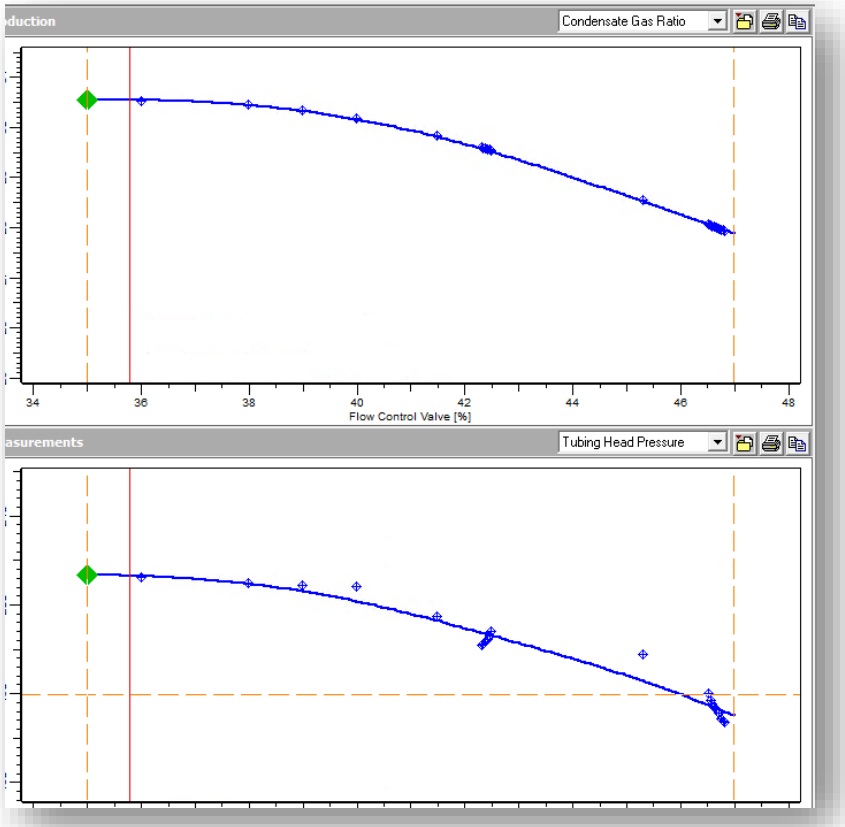


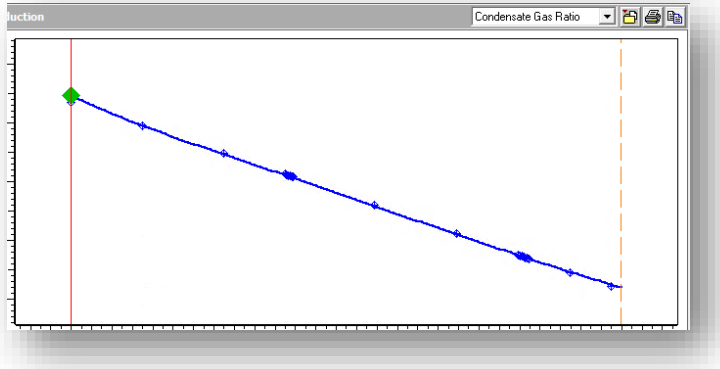


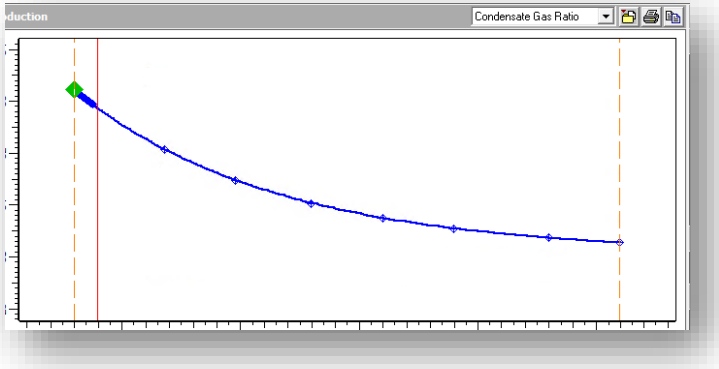
RTO models and constraints

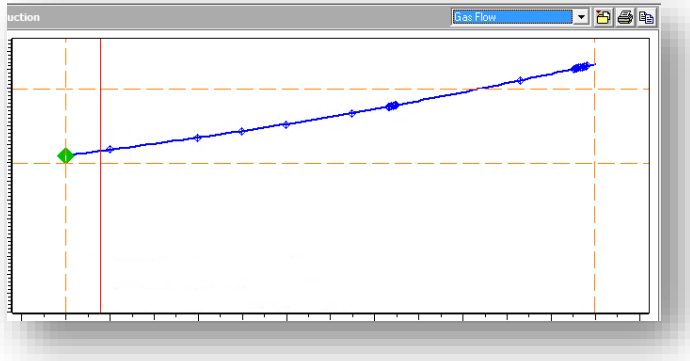
Wells all have different CGR that changes with flow

- Goal is to maximize the condensate production and stay within safe OE





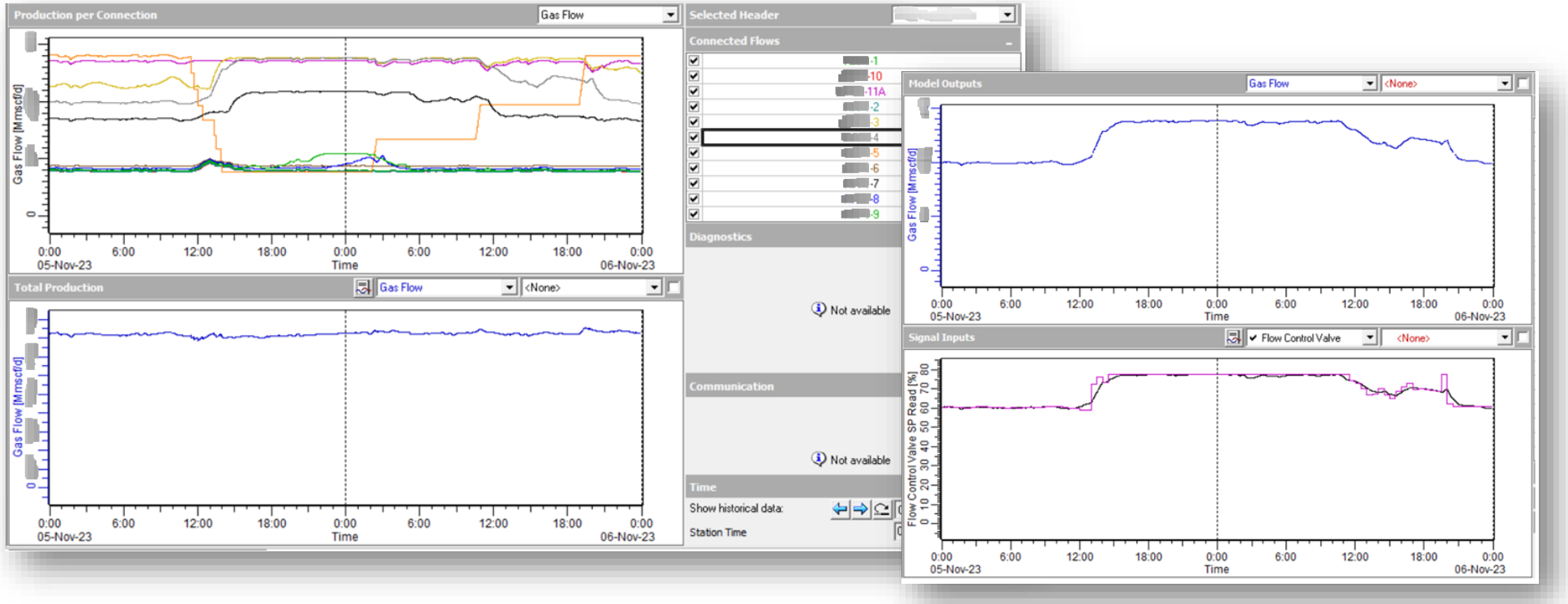




RTO day-to-day results

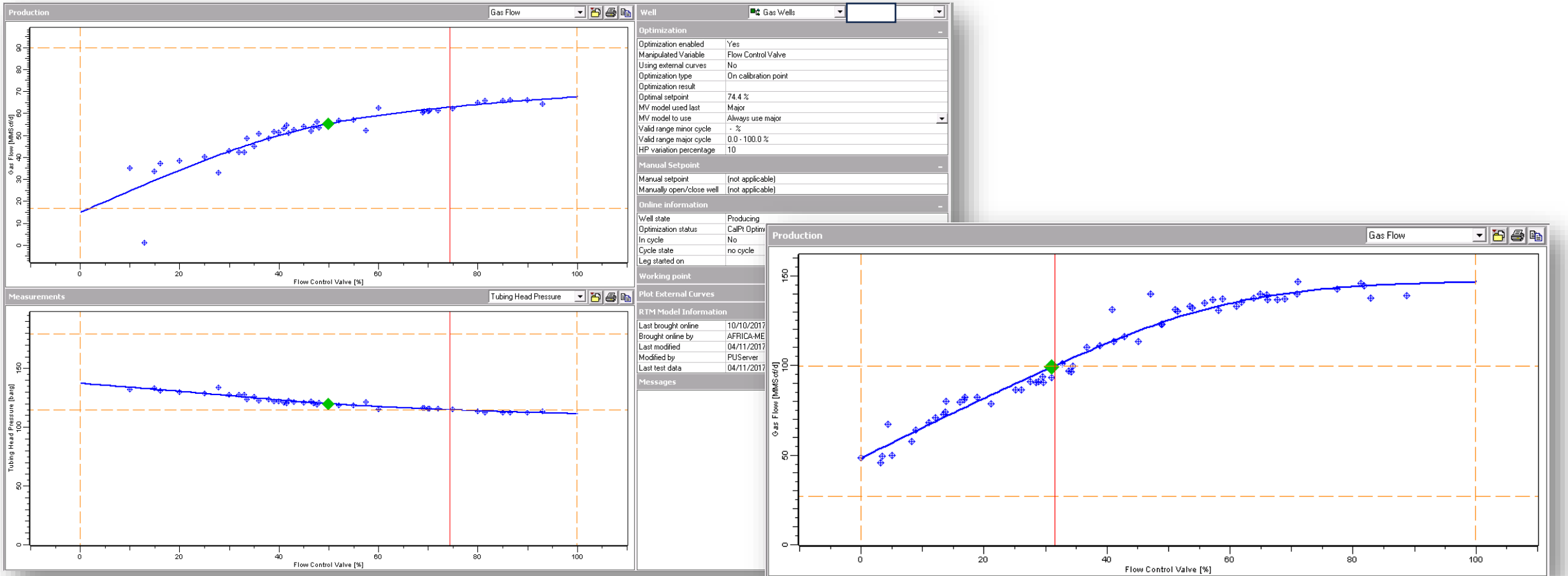
During normal operations, a well undergoes a multi-rate test

- RTO will compensate chokes on other wells, keeping total gas flow constant while maximizing condensate production and maintaining safe OE's



Reaching optimum while staying in OE limits

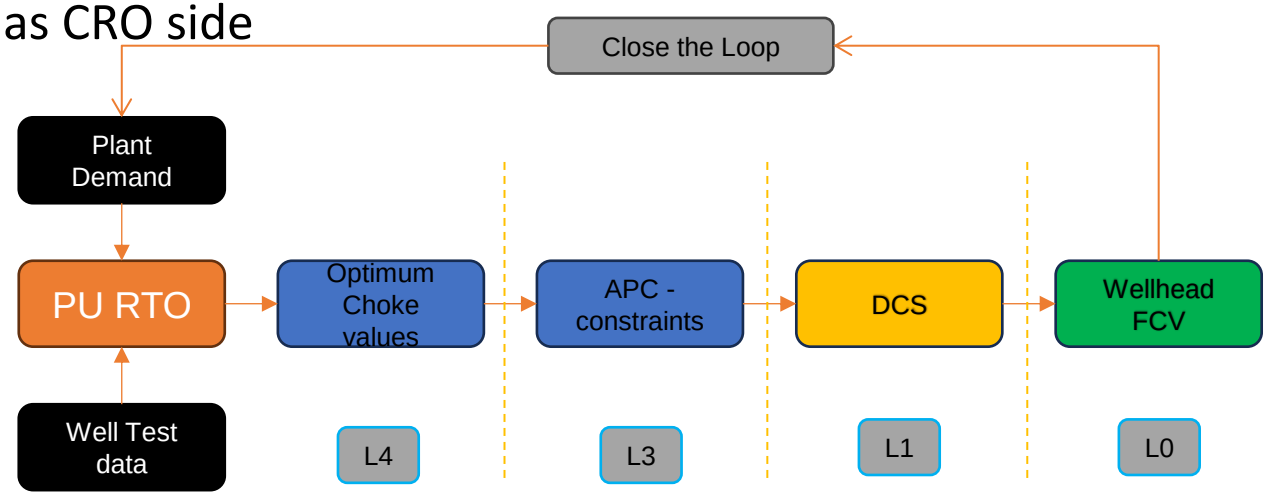
At al times we need to make sure to keep the wells inside safe OE limits



Other considerations

When deploying a real-time RTO system, it is important to consider the following

- Well defined workflow for model updates, which includes QA/QC
- IT security in sending setpoints from the RTO system to the field (DCS)
- DCS always needs to have final say
  - Centrally managed store of well OE limits, accessible by RTO and DCS
  - DCS needs to control all OE of the facilities as well
- Focus on change management, both on PE side as CRO side



Thank you

Questions?