Business benefit through the integration of GAP and HYSYS, via a CAPE-OPEN interface

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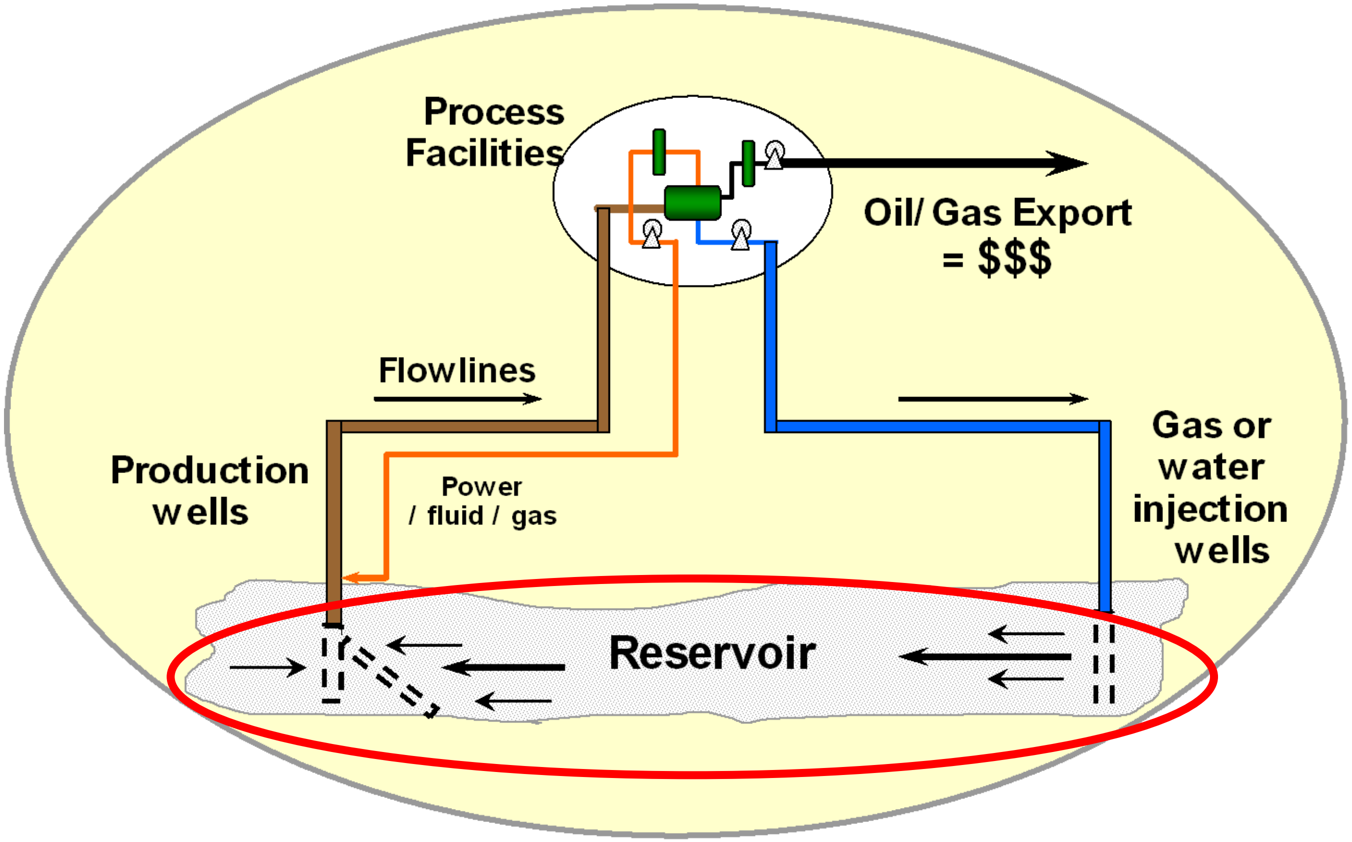
Overview

- Introduction
  - Current discipline modelling capabilities
- Business benefits of integrated modelling
  - Case study
- Integrated modelling
  - Commercially available integration environments
  - GAP as a CAPE-OPEN unit operation
  - Reconciling discipline descriptions of fluids
- Clair asset example

Introduction



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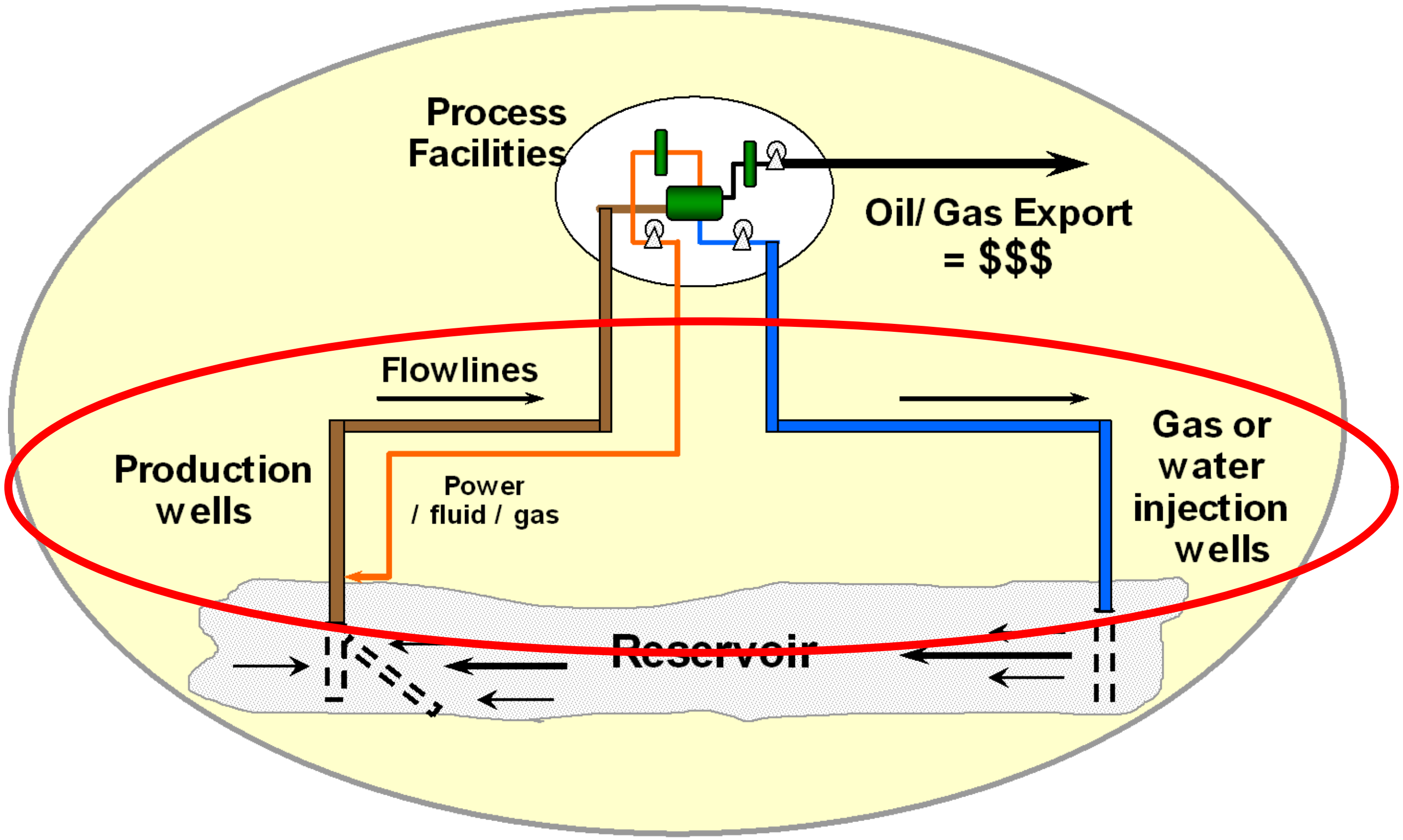

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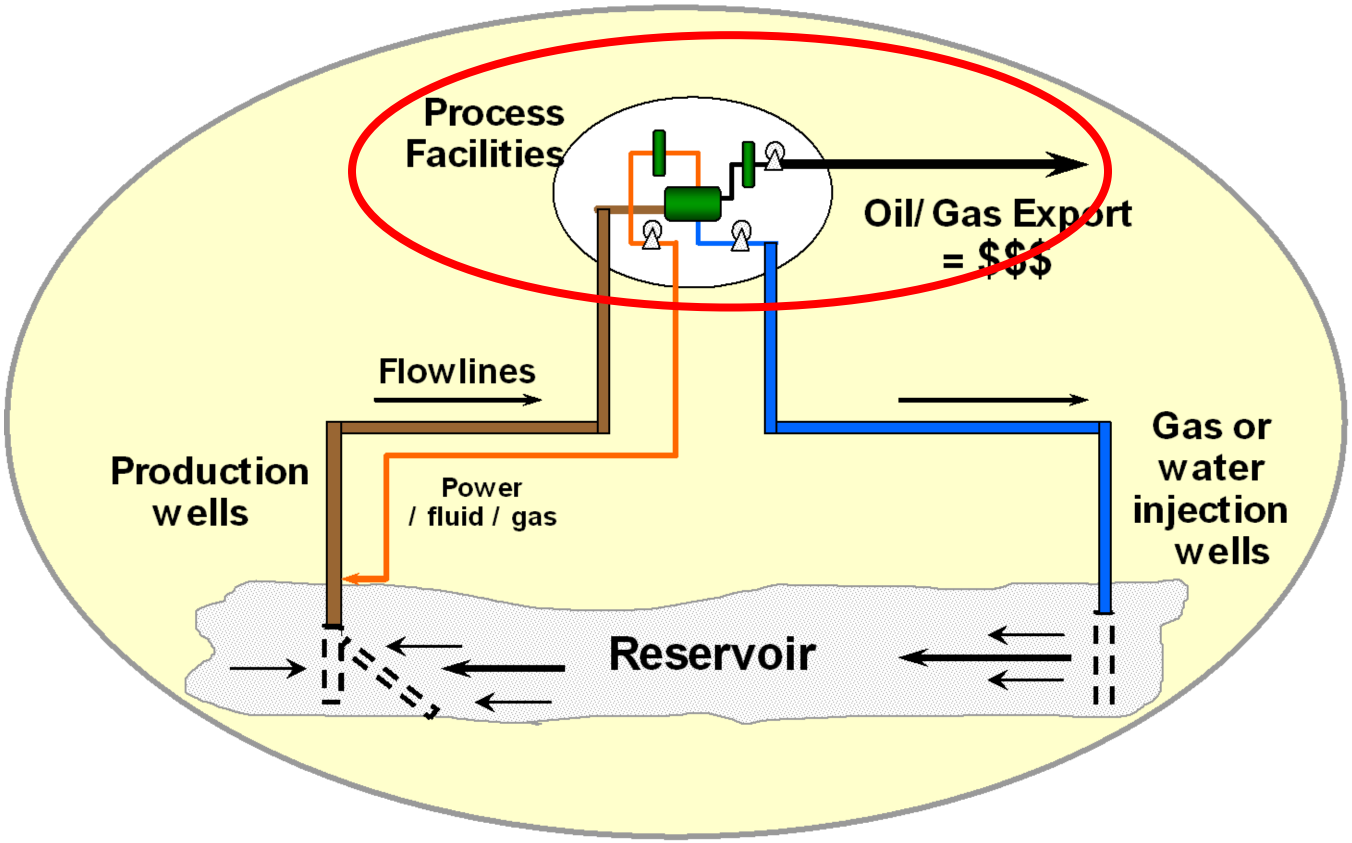

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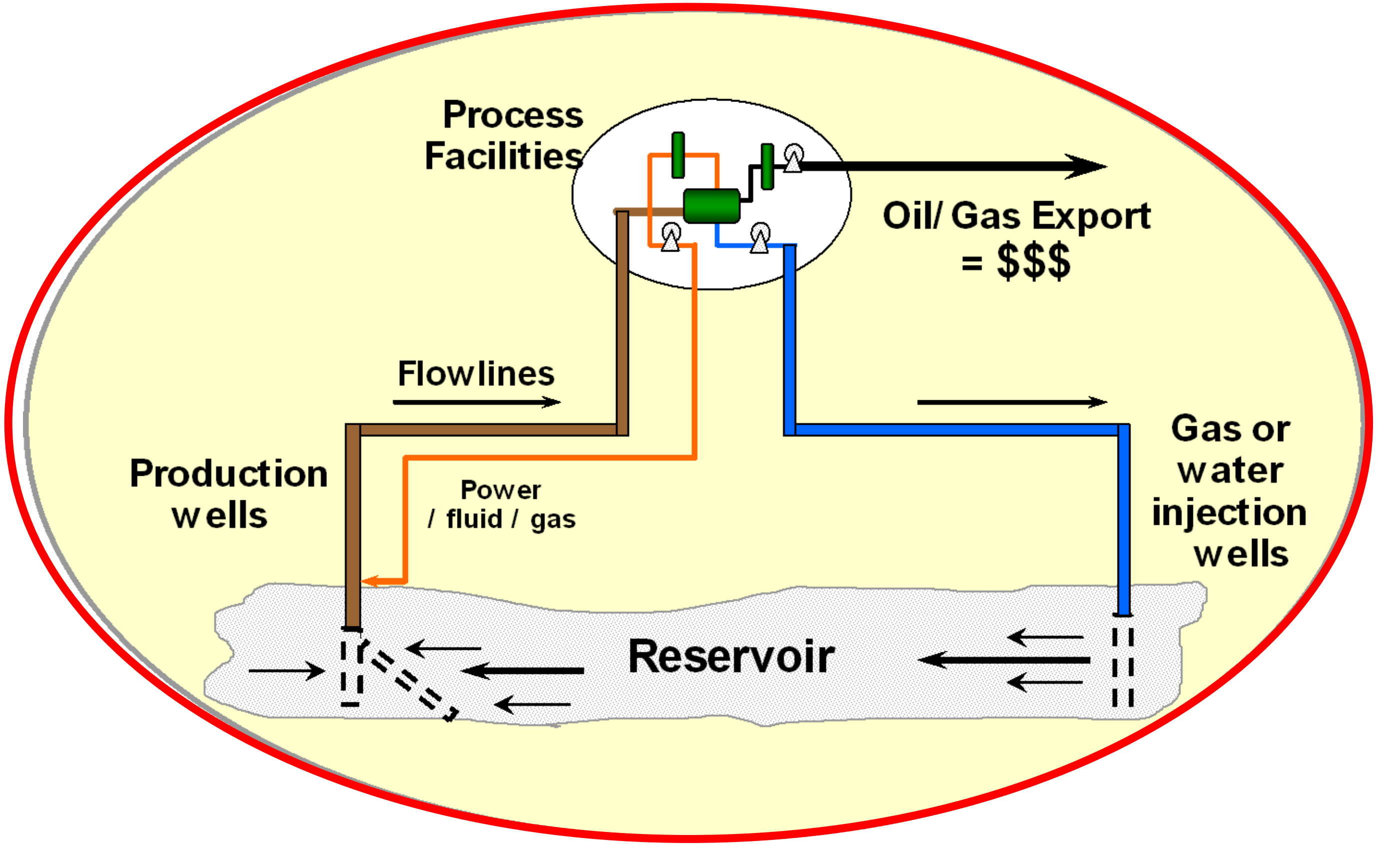


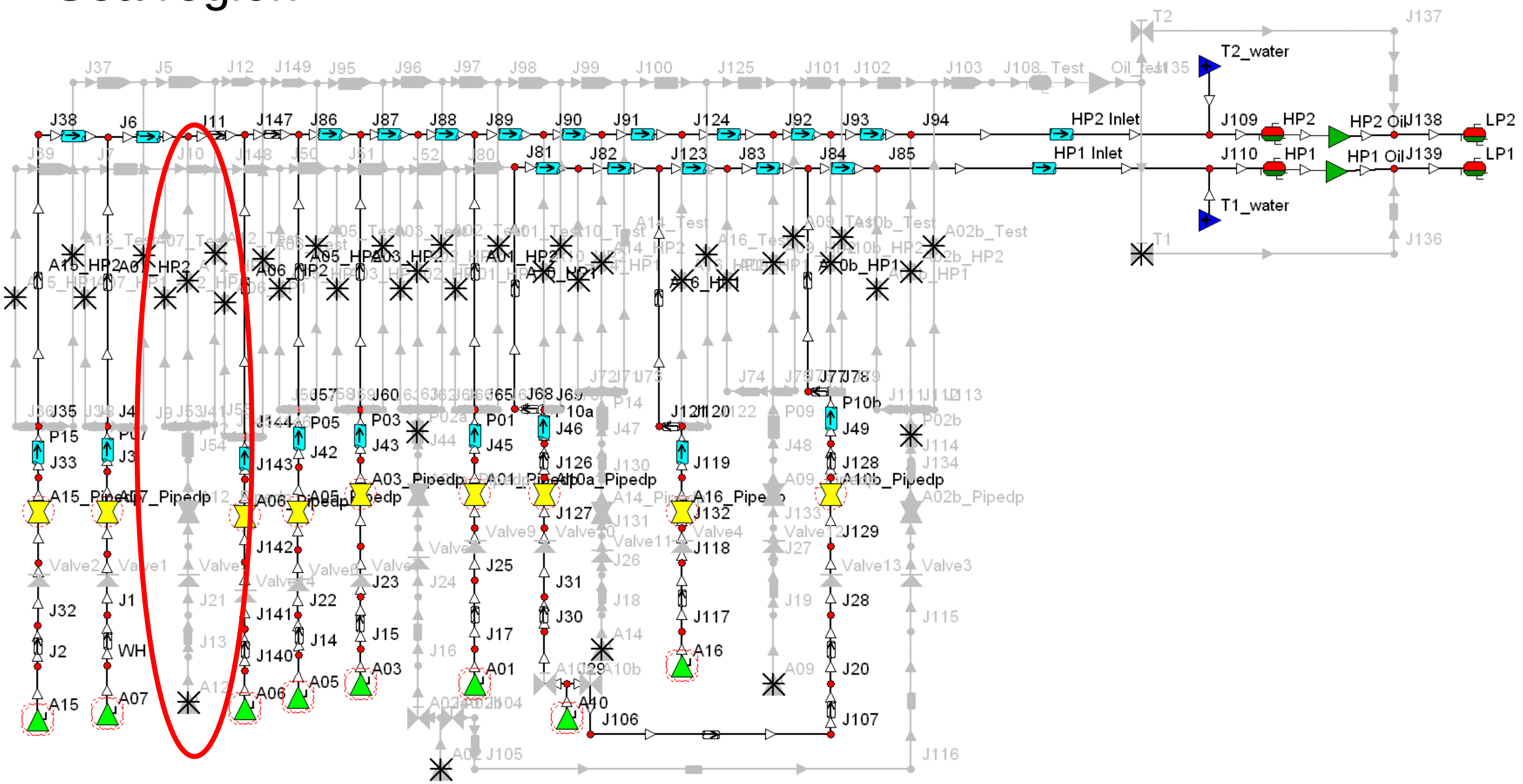
- Integration will enhance business benefit
- Addressed within the BP Upstream System Optimisation programme (a fieldofthefuture® capability)
- Current focus is on operational support

Current Wells & Flowline Modelling

- For steady-state, BP uses Prosper (wells) / GAP (wells & flowlines)
  - From Petroleum Experts
- Scope
  - Sand face to Separator
  - Pressure driven
  - Specified separator pressure
- Business uses in operations include:
  - Understanding of well performance
  - Managing well and flowline interactions
  - Well to riser routings
  - Artificial lift optimisation

GAP model for a typical asset (Clair)

- An offshore oil and gas production facility in the UK North Sea region

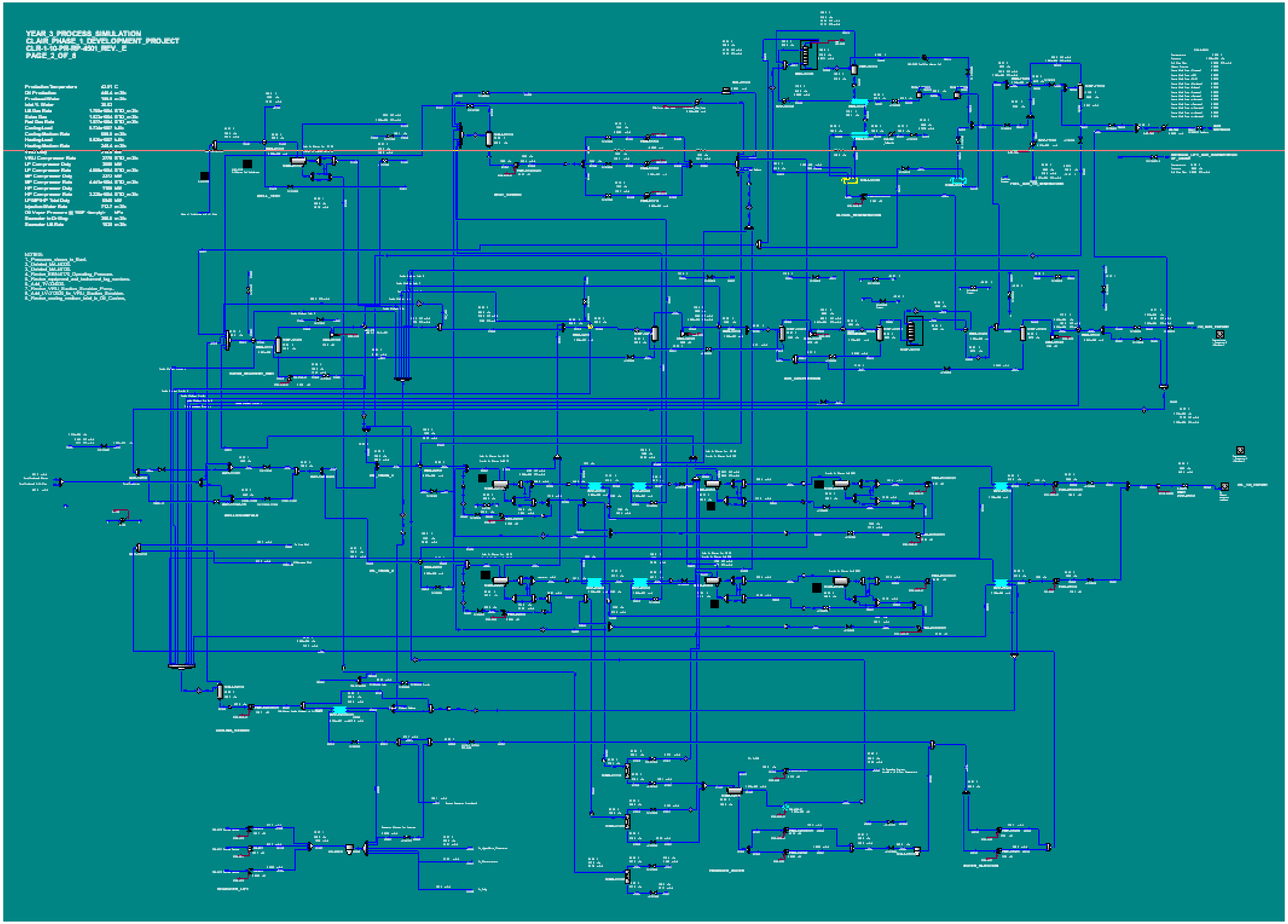


- Offline well and alternative flowline routings are greyed-out

Current Facilities Modelling

- BP Upstream uses HYSYS
- Scope
  - Separator to Export
  - Flow driven
- Business uses of steady-state modelling in operations include:
  - Managing commercial constraints on export pipeline
  - Understanding interactions between multiple trains
  - Identifying equipment constraints
  - Assessing equipment performance against design

HYSYS model for Clair Asset



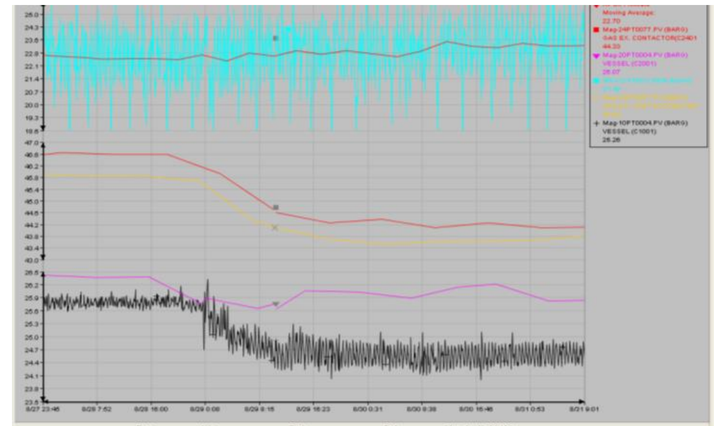
Business Benefits of Integrated Modelling

- Maximising production whilst ensuring the asset remains within the safe operating envelope
- Wells / Flowlines with facilities
  - Typically giving additional production increases of 1 – 4%
  - Lift Gas optimisation when facility is gas constrained
  - Separator pressures constrained by compression train and export pressure
  - NGL optimisation with variable well flowrates
    - Proven BP case-study gave significant commercial benefit, $1 million+
  - Consistent fluid representation from reservoir to export
- Underpin a common understanding of the asset across disciplines

Integrated Modelling Case Study

Opportunity

- Steady state simulations of the well and gas processing facilities revealed an opportunity to raise production by dropping the pressure set point of the glycol contactor.

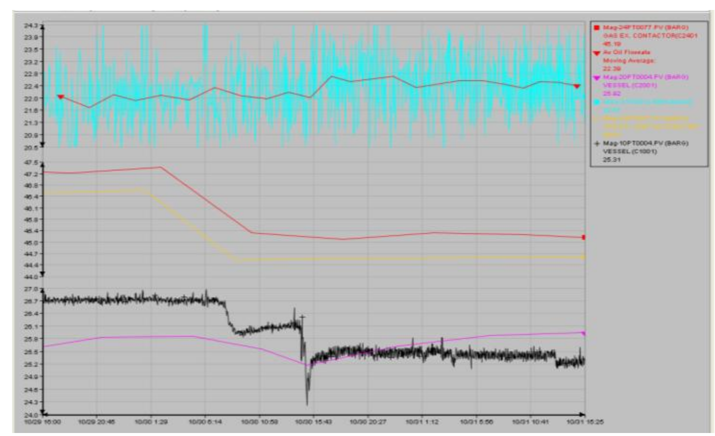


Action

- The set point of the glycol contactor was lowered by 2.5 barg, leading to a 1.5 barg reduction in the pressure of the HP separator.
- The discharge pressure was dropped by 2 barg.

Result

- Modifications to the set point of the glycol contactor led to a production improvement of 400 bd. The lowering of the discharge pressure increased the gas handling capacity by 2 – 3 mmscfd.



Key to Delivery

- Integrated well and process modelling helped to quantify the value prior to implementation.

Possible Methods for Model Integration

- Extending model scope within a single modelling tool
  - Conceptually very simple
  - But extends model scope beyond core capability of tool
- Commercially available Model Integration environments
- CAPE-OPEN

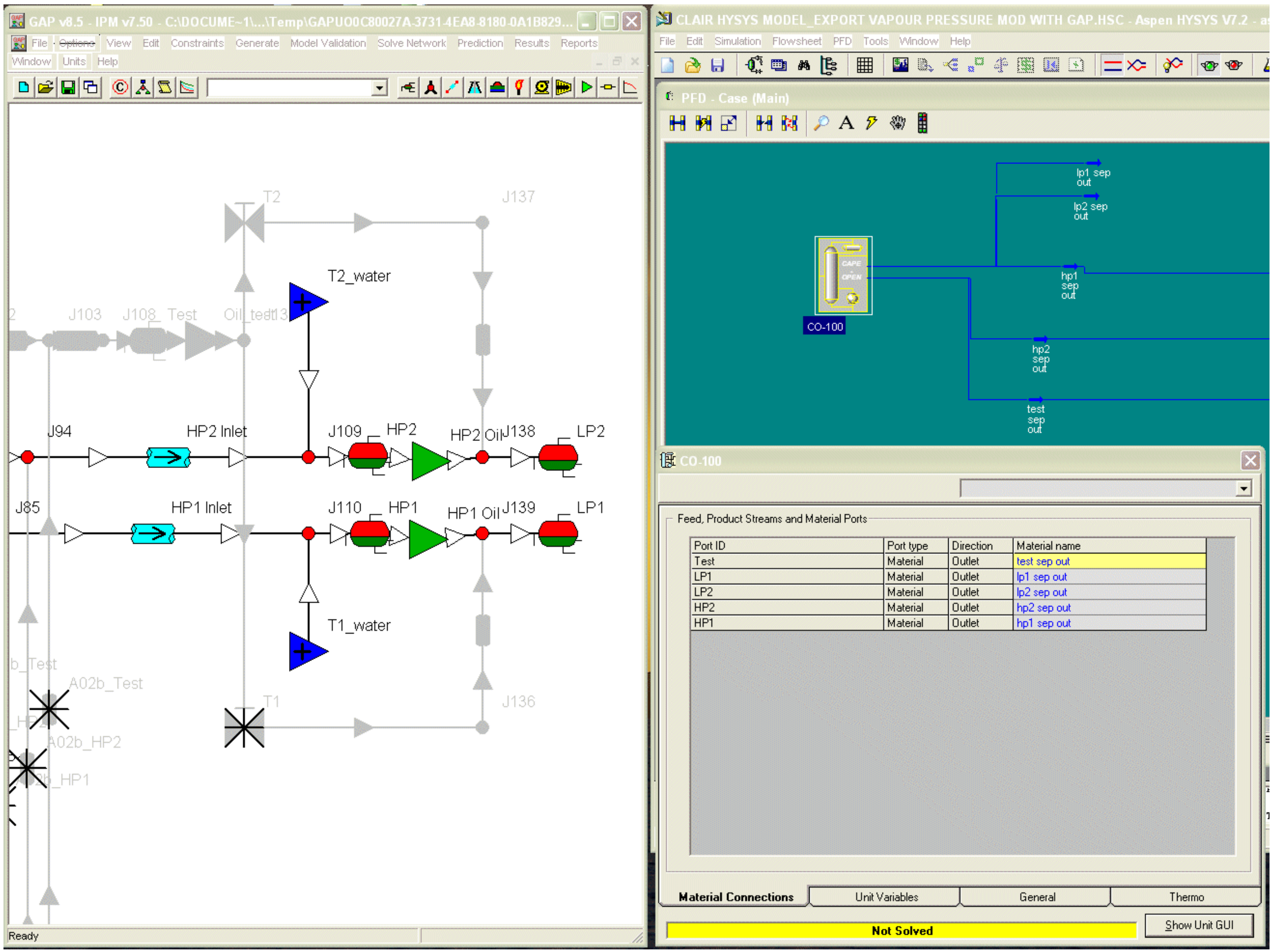
Commercially Available Integration Environments

- Available from a number of suppliers
- Allow integration of modelling tools as “black boxes”
- Support optimisation of integrated models
- Need “drivers” for each modelling tool to be included
- Drawbacks
  - Need relevant drivers
  - User needs to be familiar with an extra tool
  - User may be required to develop the mapping(s) between the various fluid representations
    - E.g. black oil and compositional
  - Recycles (information and physical) often need to be converged as an optimisation problem

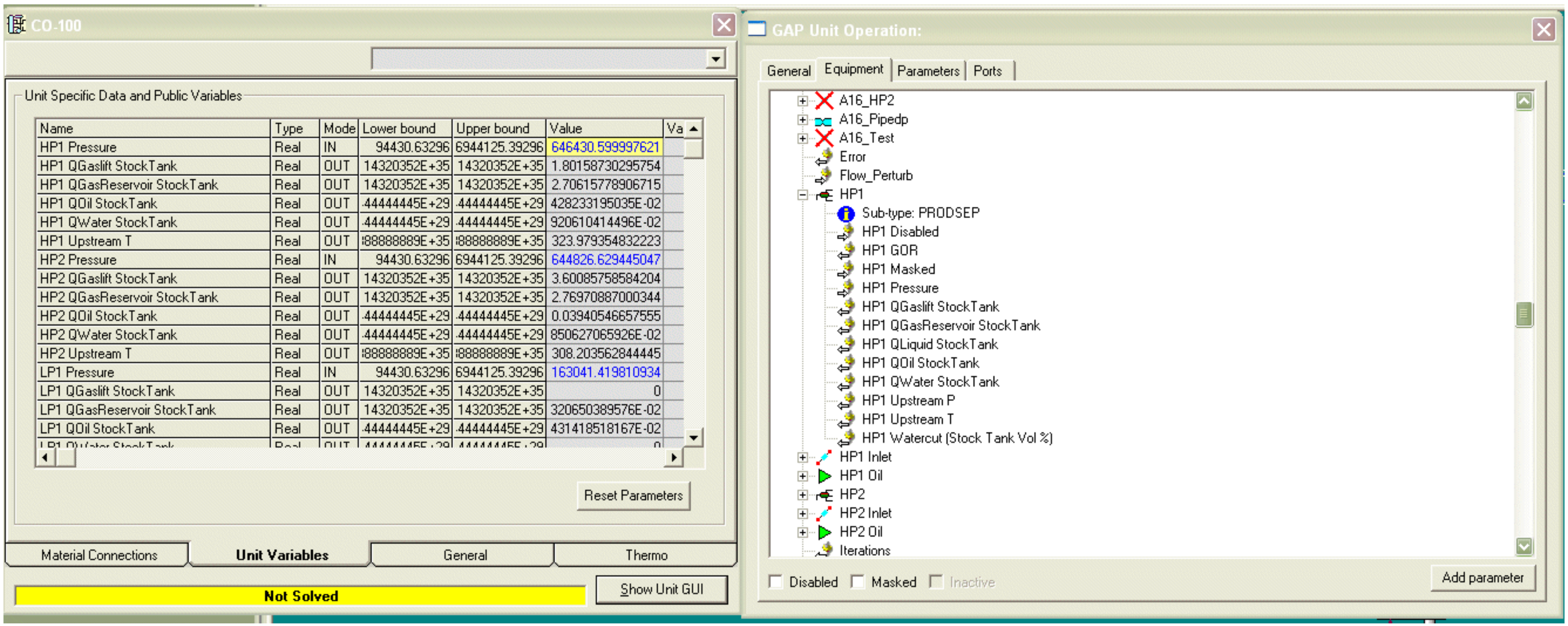
GAP as a CAPE-OPEN Unit Operation

- CAPE-OPEN defines rules and interfaces that allow CAPE (Computer-Aided Process Engineering) applications or components to interoperate
  - A freely available industry standard for interfaces
  - CAPE-OPEN is not software or a data model
  - CO-LaN is responsible for maintenance of the standards
- CAPE-OPEN wrapper for GAP
  - Using “OpenServer”
- Commissioned by CO-LaN
- Required no modifications to GAP
- Development took approximately 2 weeks
  - Plus subsequent debugging

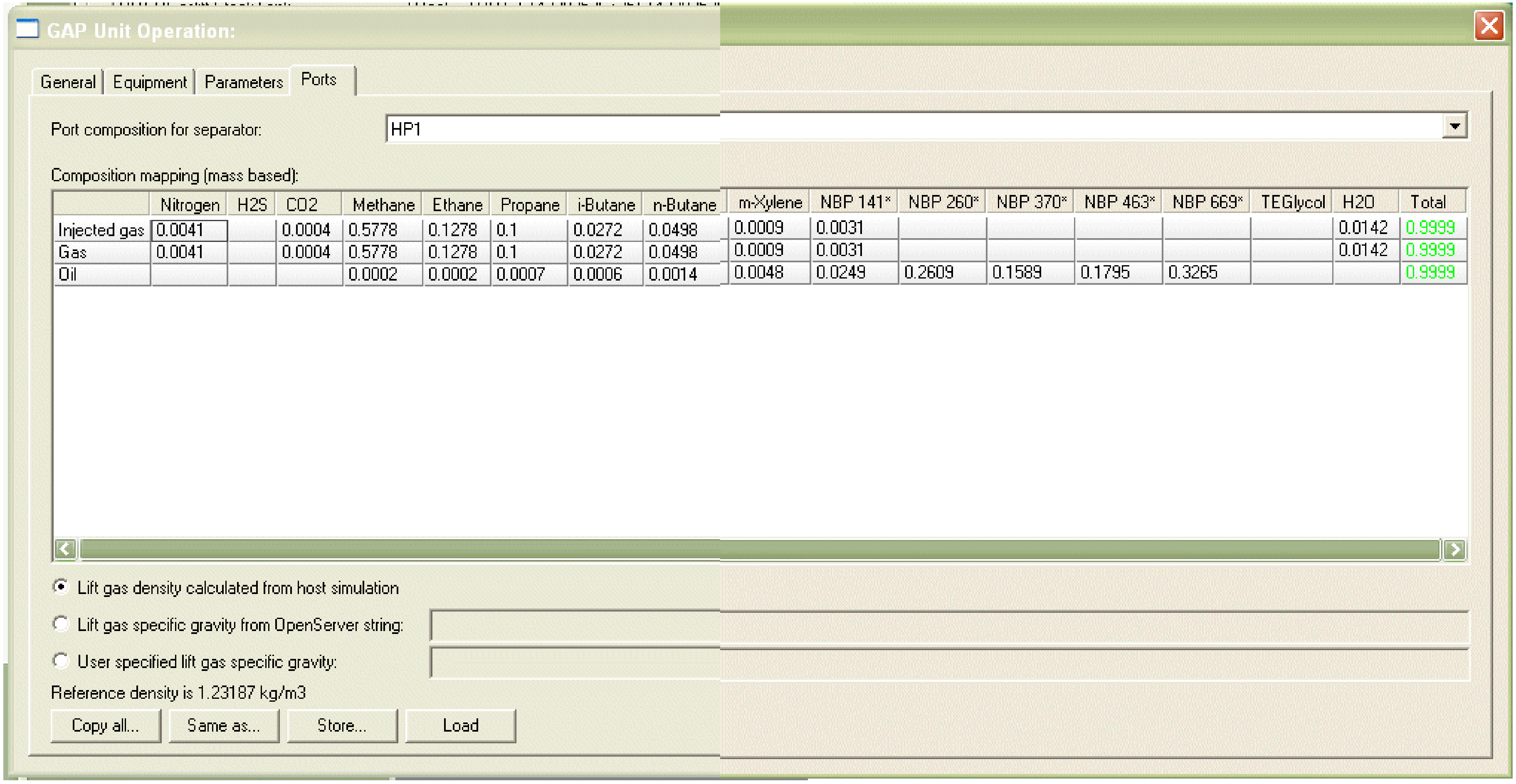
Steam connections in HYSYS



GAP Inputs and Outputs in HYSYS



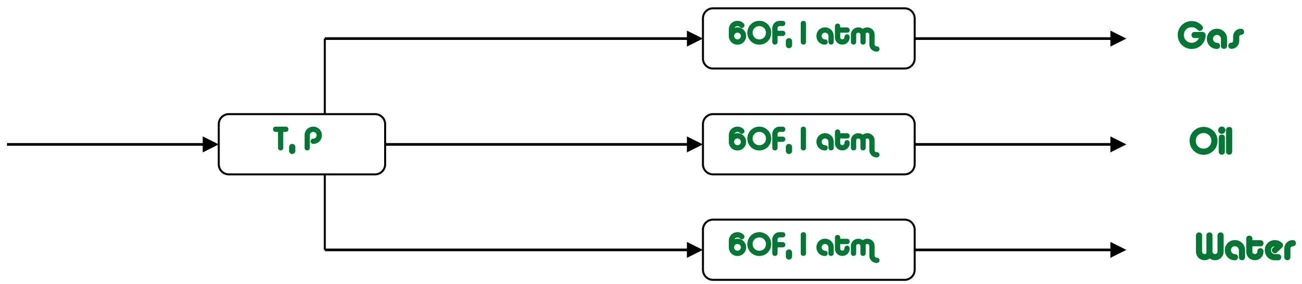
Black Oil to Compositional Mapping



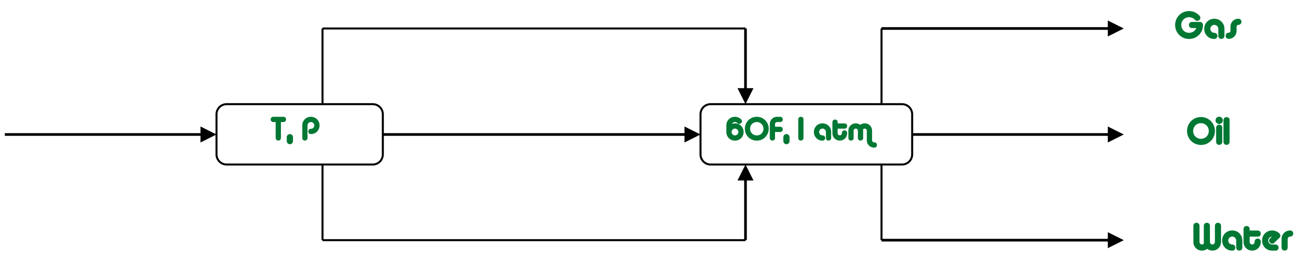
	Nitrogen	H2S	CO2	Methane	Ethane	Propane	i-Butane	n-Butane	m-Xylene	NBP 141*	NBP 260*	NBP 370*	NBP 463*	NBP 669*	TEGlycol	H2O	Total
Injected gas	0.0041		0.0004	0.5778	0.1278	0.1	0.0272	0.0498	0.0009	0.0031						0.0142	0.9999
Gas	0.0041		0.0004	0.5778	0.1278	0.1	0.0272	0.0498	0.0009	0.0031						0.0142	0.9999
Oil				0.0002	0.0002	0.0007	0.0006	0.0014	0.0048	0.0249	0.2609	0.1589	0.1795	0.3265			0.9999

The Challenge: Reconciling Discipline Descriptions of Fluids

- Petroleum Engineers use concept of “Stock Tank” volumetric flows
- Process Engineer:

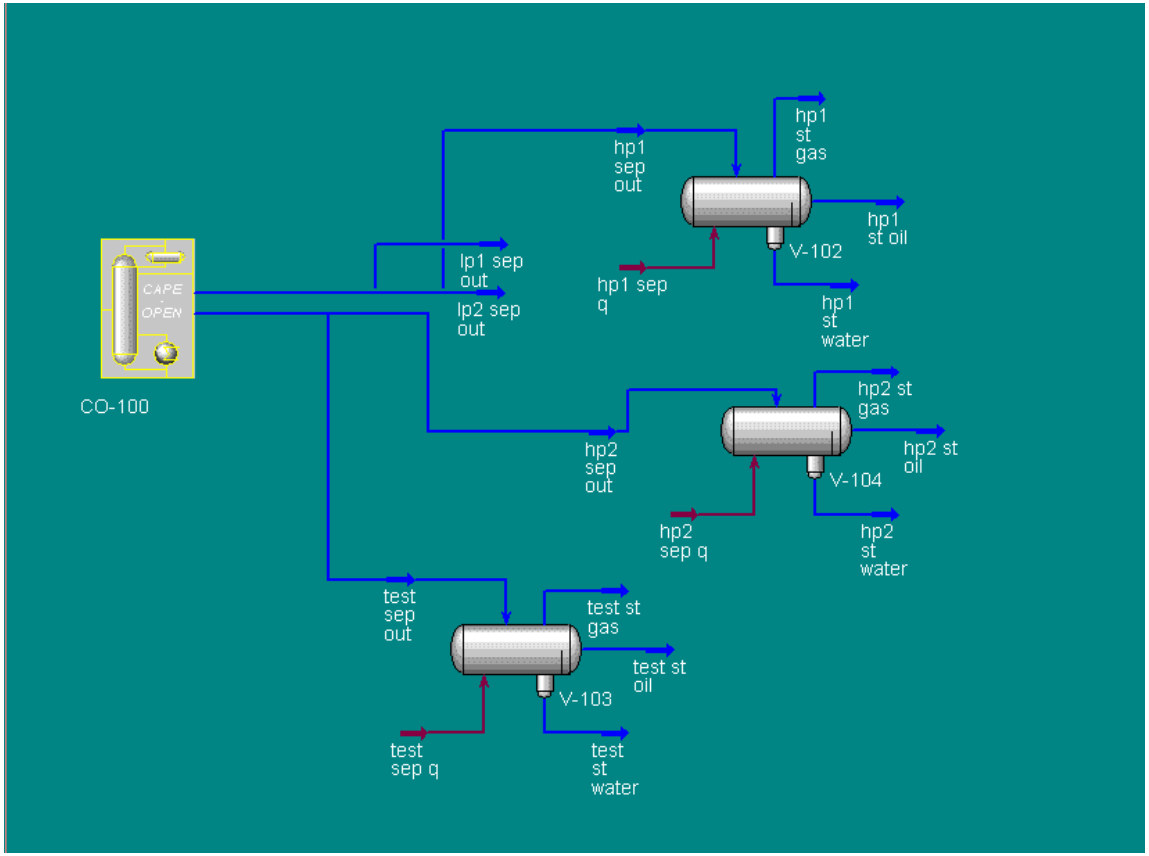


- Petroleum Engineer:



The Clair Asset example

- A work in progress

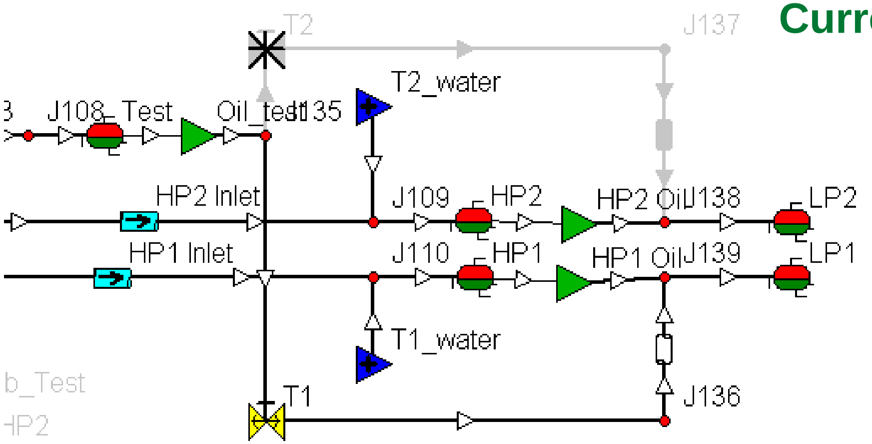


The Clair Asset example (2)

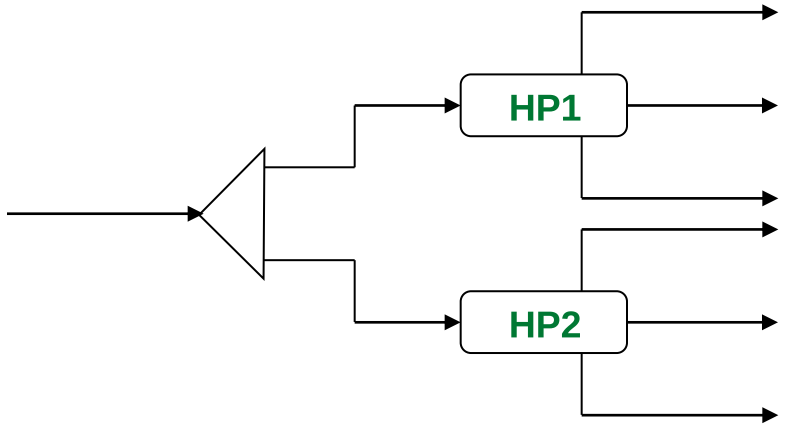
- Next steps:
  - Reconcile separator representation in GAP and HYSYS

GAP

Current



HYSYS



The Clair Asset example (2)

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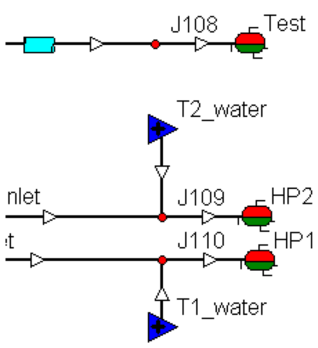
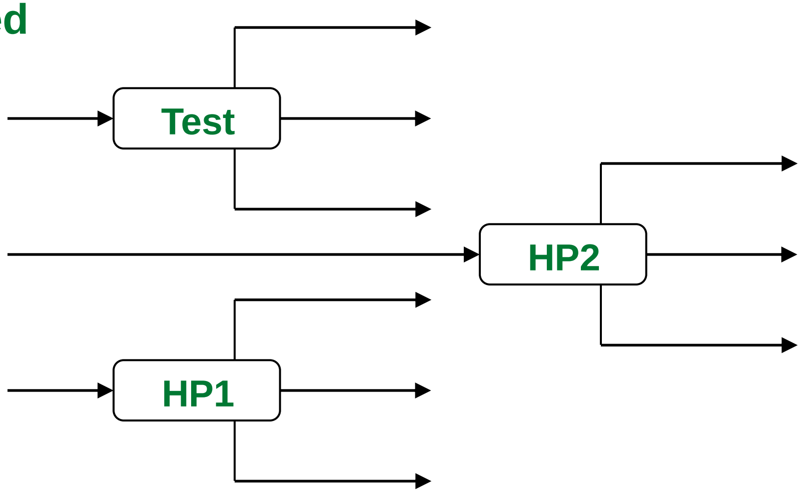
  - Reconcile separator representation in GAP and HYSYS

GAP



Required

HYSYS



  - Connect recycled gas lift from HYSYS to GAP gas lift input rates
    - Will require a HYSYS spreadsheet

Conclusions

- Benefits of integration include:
  - System optimisation within safe operating limits
  - Underpinning cross-discipline understanding
- CAPE-OPEN interface allows delivery of some of these benefits
  - Quick and easy to develop
  - Can be used in any CAPE-OPEN process simulator
  - Further work is required to prove that the interface will underpin the sustainable use of integrated models in Operations

Acknowledgements

- AspenTech for their support, especially Pradeep Polisetty
- CO-LaN for funding for interface development
- The Base Management and Operations teams at Clair