ADVANCED PROCESS MODELLING FORUM

22–23 APRIL 2015

gPROMS ProcessBuilder

Advanced Process Simulation

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gPROMS ProcessBuilder

Why did we create it? *

* Does the world need another process simulator?

Motivation 1

"We model the reactor in gPROMS then put a simplified version in Aspen Plus so we can design the separation system"

"I've got a guy starting on building a set of distillation models so we can build a whole plant model"

"We can provide the model to engineers via the CAPE-OPEN interface"

"We've created comprehensive libraries of all the basic unit operations – valves, compressors, pumps, etc."

Situation until now

Traditional process simulators

- Easy to learn and use
- Rapid production of process-wide heat & material balances

BUT

- Limited by Sequential Modular architecture
  - e.g. converging complex recycles
- Limited process model libraries
  - difficult to add own operations
- Limited or no optimisation capability

gPROMS ModelBuilder

- Very powerful modelling and solution
- Custom modelling for complete flexibility
- Powerful optimisation capability (including MIO)

BUT

- Limited by usability
- Need to write own models
- Difficult to learn – preserve of 'expert modellers'

Motivation 2

Need to …

Provide all the power of the gPROMS platform and first-principles modelling …

… without the need to write models

… but with a custom modelling capability where necessary

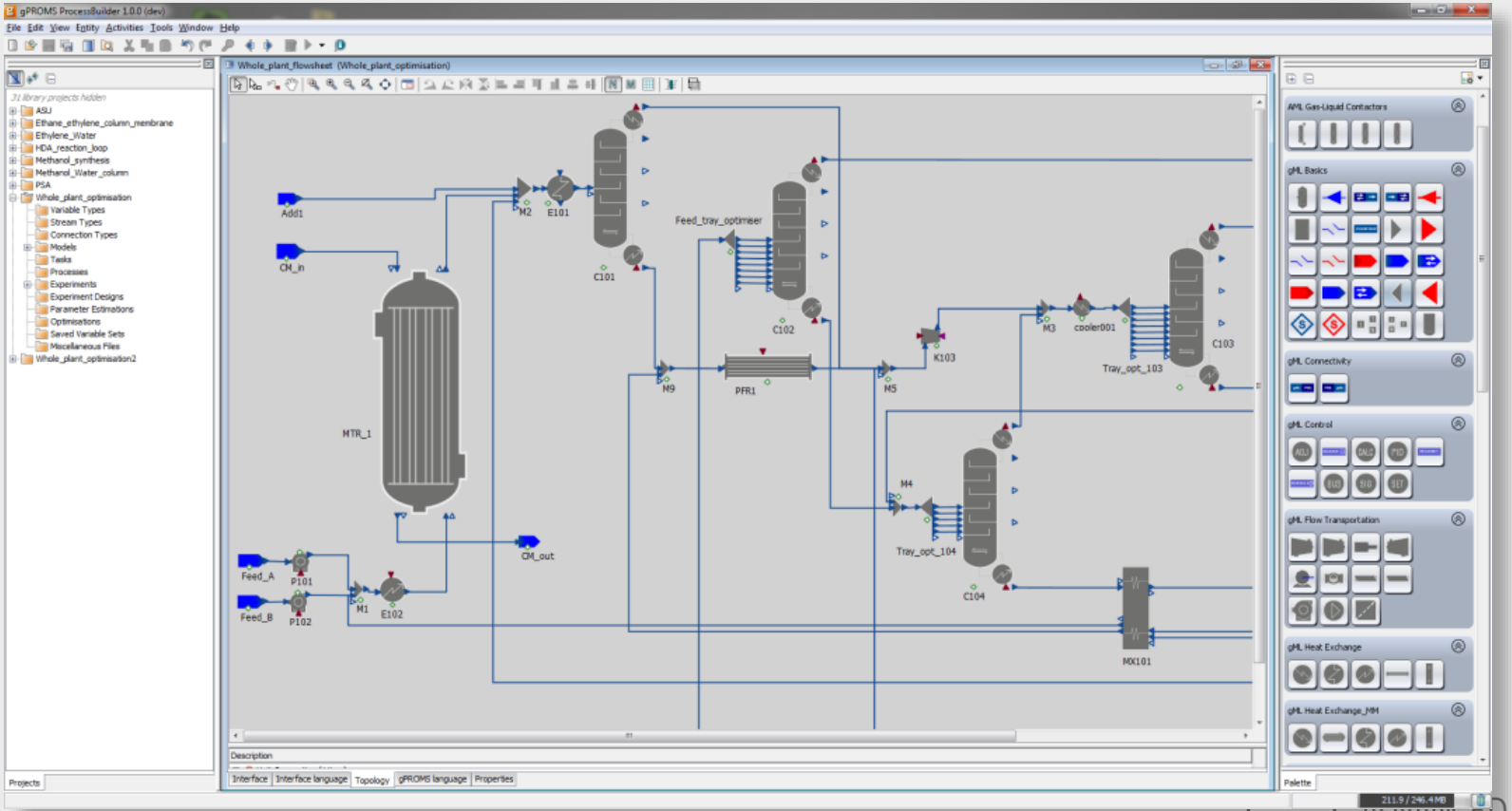
➔ maximise competitive advantage

And make it easy to use!

gPROMS ProcessBuilder

gPROMS ProcessBuilder
“Advanced Process Simulation”

A process modelling tool for chemicals & petrochemicals



Support for the basics … and more

Support for the basics

- "Core" flowsheeting functionality
  - **drag & drop flowsheeting** based on **model libraries**
  - accurate and comprehensive physical properties
  - process analysis via **steady-state & dynamic simulation**

➔ Heat & material balance information

➔ Stream properties

… and more

- More comprehensive **model libraries**
  - higher fidelity
  - many more unit operations
- **Steady state** AND **dynamic** in same environment
- State-of-the-art **custom modelling**
- Powerful **optimisation**
- Equation-oriented **solution power**
  - complex integrated flowsheets
  - faster, more robust solution

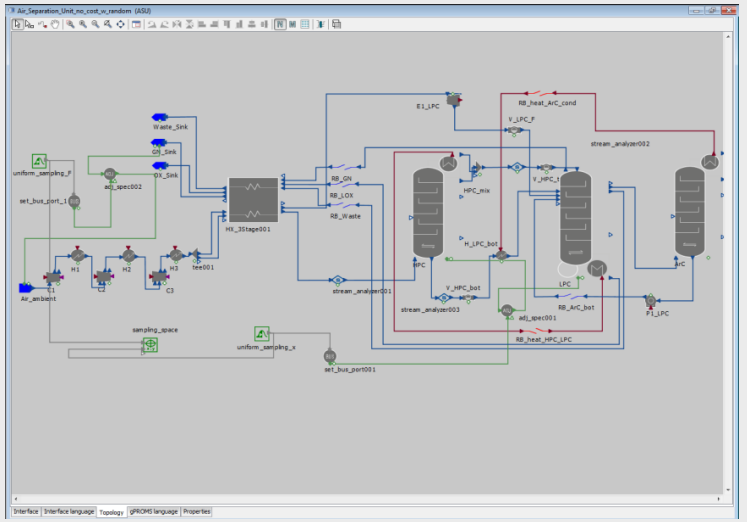
Support for the basics … and much more

- BUT ProcessBuilder goes **well beyond current practice**
- *Advanced applications* that
  - add NEW value
  - create **sustainable competitive advantage**
- … by enabling
  - rapid innovation
  - rigorous optimisation of process and equipment design
  - better management of technology risk
  - application across the process lifecycle

Advanced applications

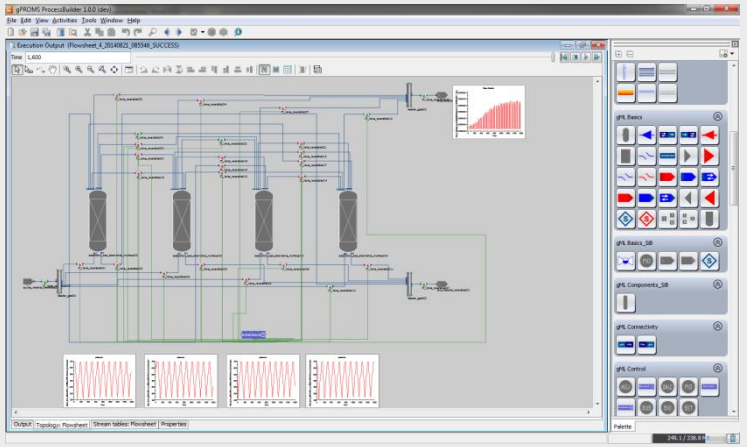
Advanced applications – 1

- Solve **new classes of problems**
  - Flowsheets with **complex unit operations**
  - Flowsheets with **complex recycles**
  - **Large-scale optimisation** – complex reaction and separation section
  - **Mixed-integer optimisation** problems – process synthesis, equipment configuration
  - Rigorous **sensitivity analysis**
  - **Online model-based applications** with **rigorous** models
  - Complex **operating policies**



Complex recycles

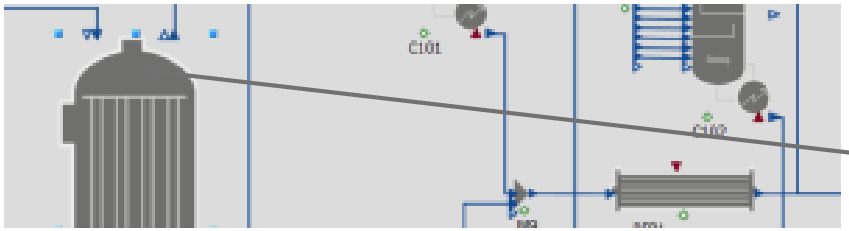
Air Separation Unit (ASU)



Complex dynamics

Pressure-Swing Adsorption (PSA)

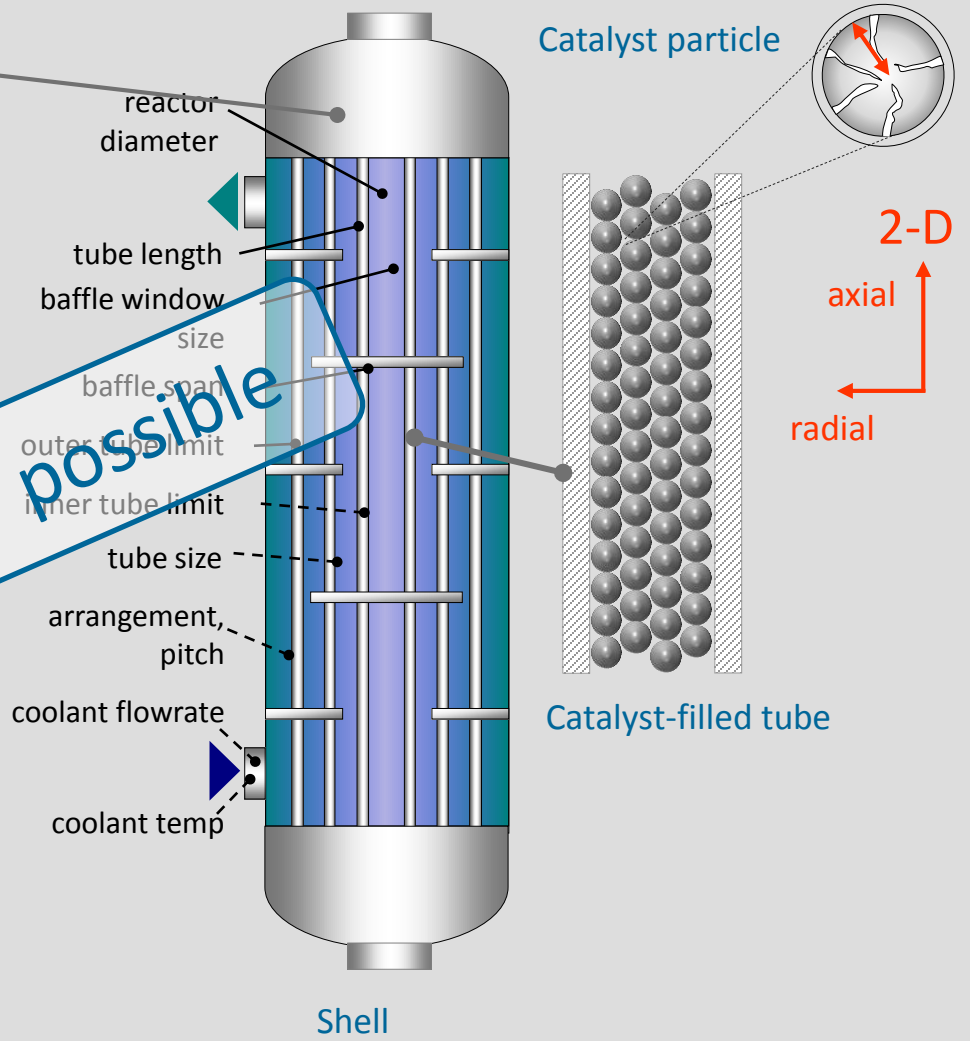
Advanced applications – 2



Detailed reactor design

- Full reactor modelling
  - standalone or within flowsheet
- Any level of complexity
- Start-up, shutdown, transition analysis
- Take ownership of reactor, catalyst design

➔ **Potential $mm benefit**



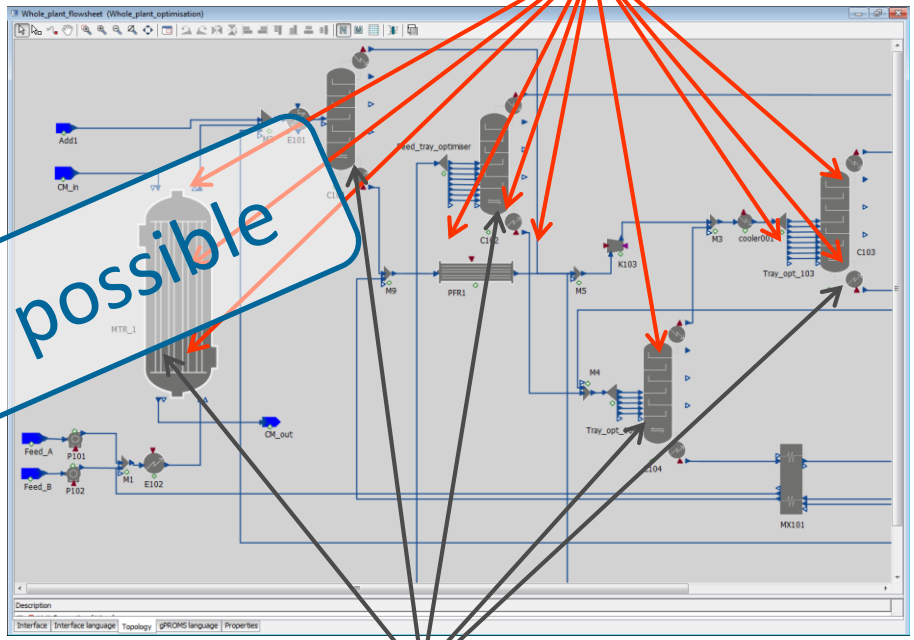
Advanced applications – 3

Whole-plant optimisation

- Consider entire plant simultaneously
- Detailed reactor and separation
- Multiple optimisation variables
- Economic objective function

➔ **Potential $mm benefit**

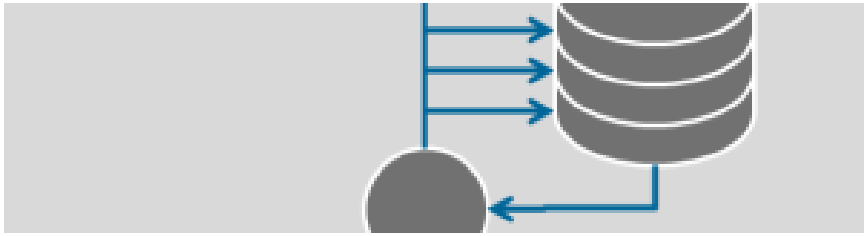
Optimisation (including mixed-integer) with multiple integer & continuous decisions

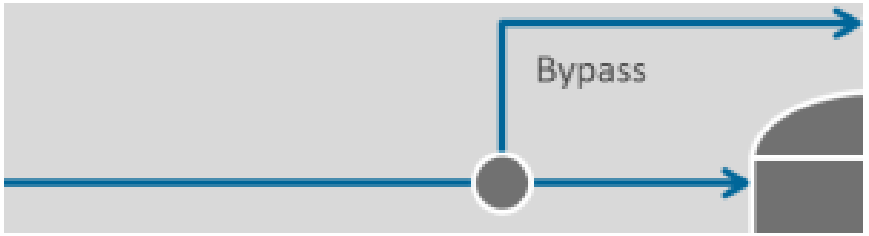


Not previously possible

Detailed reactor & separation

Advanced applications – 4





Optimal equipment configuration

- Rigorously optimise configuration aspects
  - distillation stages & draw locati…
  - batch equi… sizes
  - Number of trains …
- Reduce CAPEX & OPEX

➔ **Potential $m-$mm benefit**

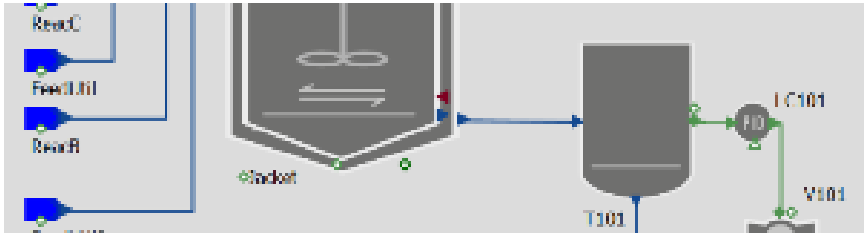
Process synthesis

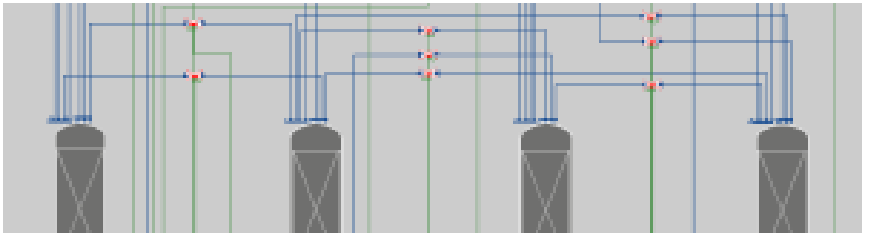
- Combi… n of reaction and …quipment
- …iser chooses between proposed process options
- Find optimal process configuration

➔ **Potential $m–$mm benefit over lifetime**

Not previously possible

Advanced applications – 5





Batch process optimisation

- Rigorously optimise batch schedule
- Based on rigorous modules, schedule
- Maintain or exceed quality constraints
- Increase throughput

➔ **Potential $m-$mm benefit**

Complex process design

- Dynamic processes eg. cyclic separation
- Very difficult to design!
- Runtimes reduced from days/weeks to hours
- Optimise, not just simulate

➔ **Potential $m-$mm savings in operating costs**

Not previously possible

In summary

We believe that these are very important new capabilities that will become a standard part of engineers' tools and engineering workflows in the future

All made possible by the gPROMS platform

gPROMS ProcessBuilder – Launch

- ProcessBuilder launch in EMEA/Americas
- ‘New product’, but we have some history
  - APAC launch mid-2014
  - Already have 10+ customers
  - Feedback, improvement

- Next up

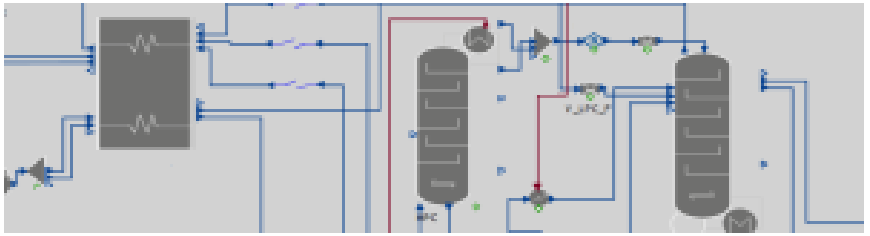
1. gPROMS ProcessBuilder: what’s in it? – Maarten Nauta
2. gPROMS ProcessBuilder: advanced applications – Bart de Groot

Thank you

gPROMS ProcessBuilder

A new product

Advanced applications – 2



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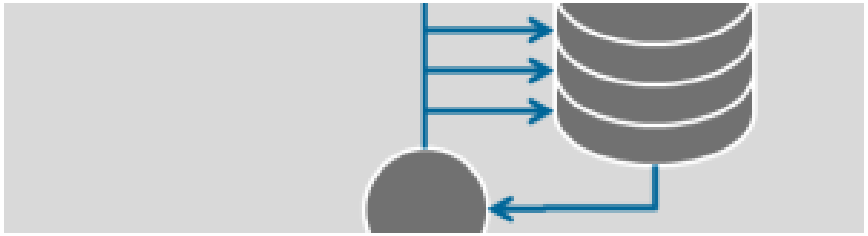

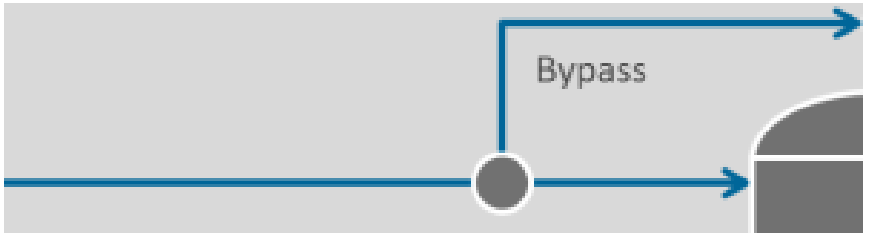

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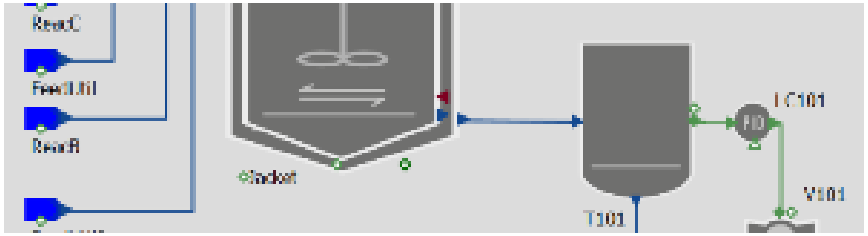

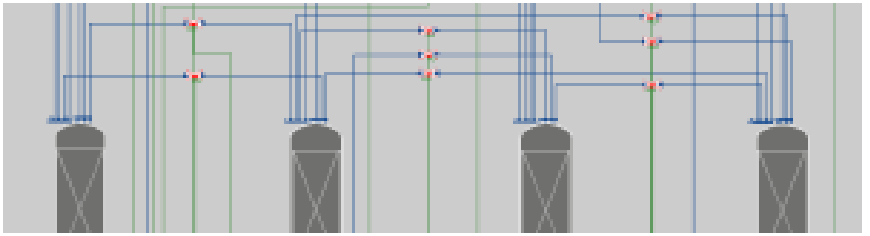

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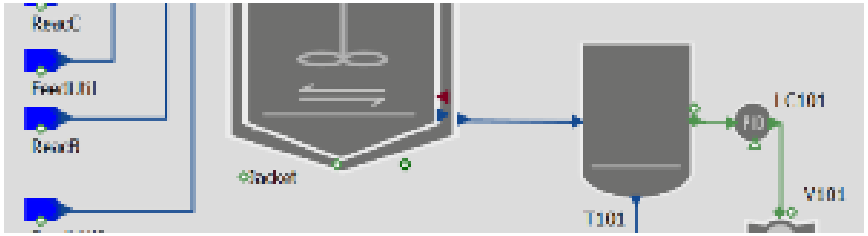

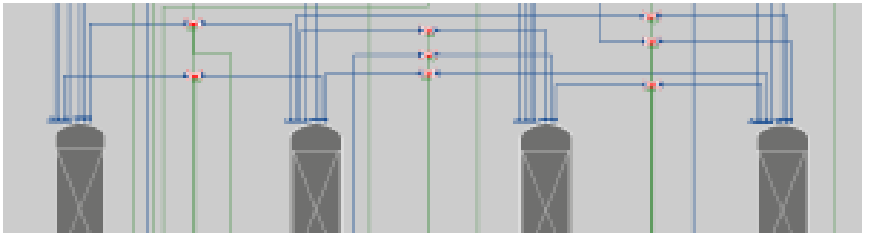

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Motivation 3 – exploring further

"We need to …"

"… simulate the whole process flowsheet including a detailed model of the reactor"

"… do an economic optimisation of the whole plant so we can decide which option to go for"

"… improve the reactor design to give better catalyst life"

"… perform hundreds of sensitivity studies over the next two weeks"

"… look at operability"

"We need a simulator that can answer all our questions"