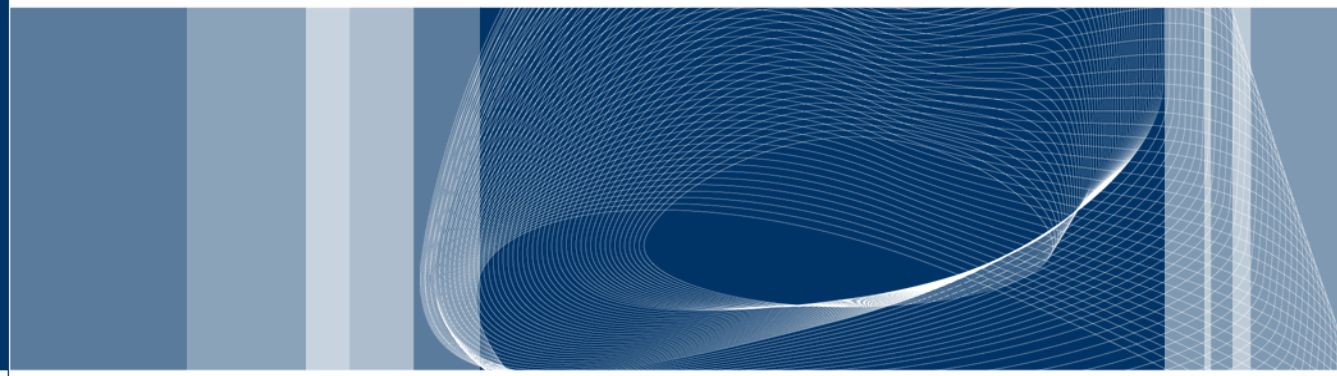
PSAM 9 International Probabilistic Safety Assessment and Management Conference
An IAPSAM Conference

18-23 May 2008 – Hong Kong, CHINA

POLITECNICO DI MILANO



Safe Process Start-up Procedures Based on an Operator Training Simulator: a Case Study

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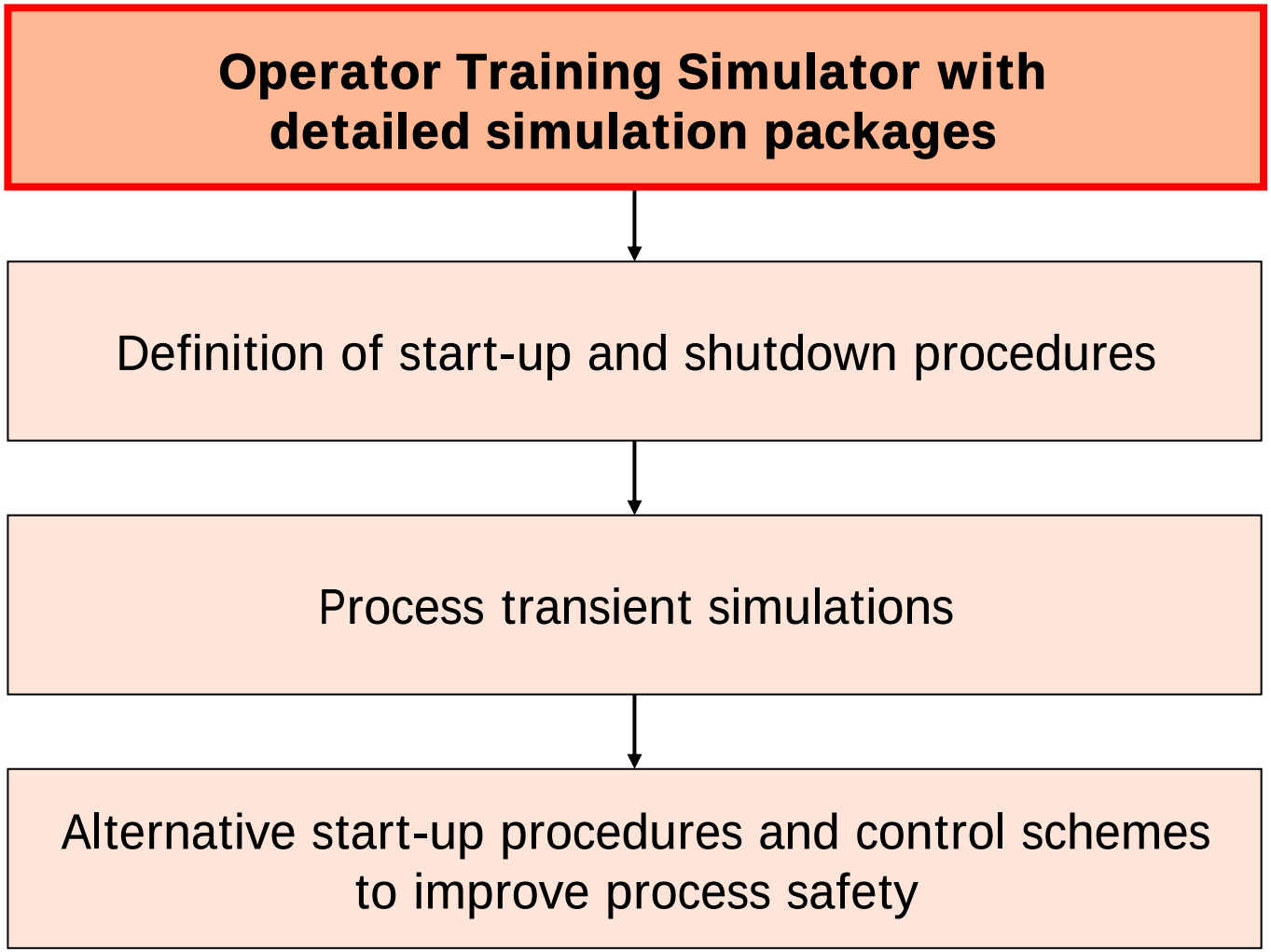
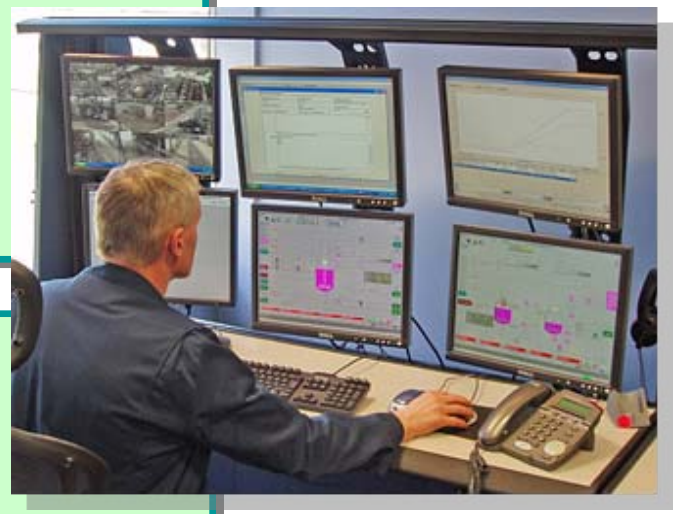
Dipartimento di Chimica Materiali e Ingegneria Chimica
Politecnico di Milano – ITALY

Presentation outline



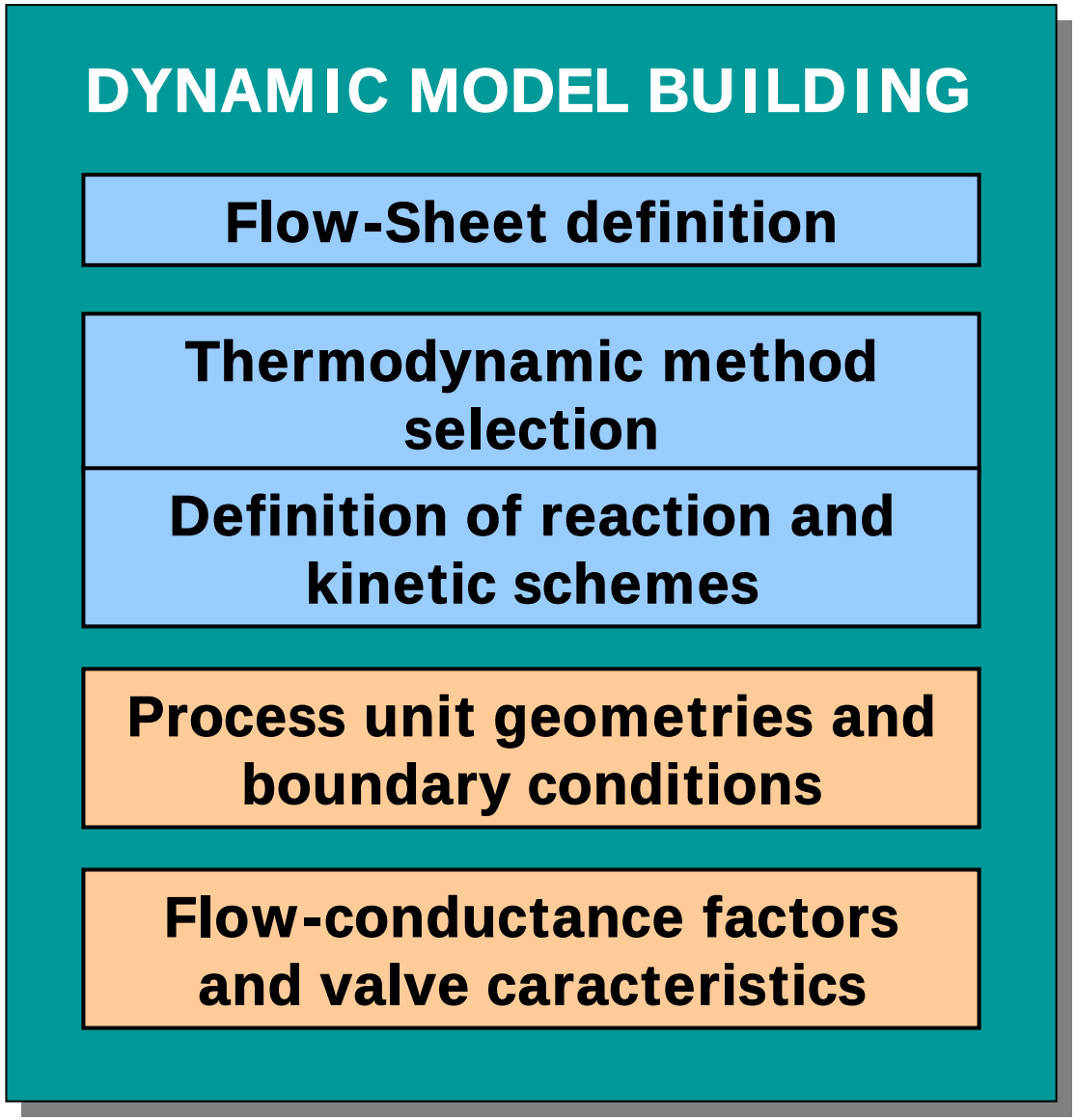
Widespread Simulation Toolkits

- Dynamic simulation features
  - Batch dynamic simulations
  - Control strategies
  - Start-up and shutdown
  - *Distributed Control Systems*
  - Operator Training Simulators
- Control-room and field operator training

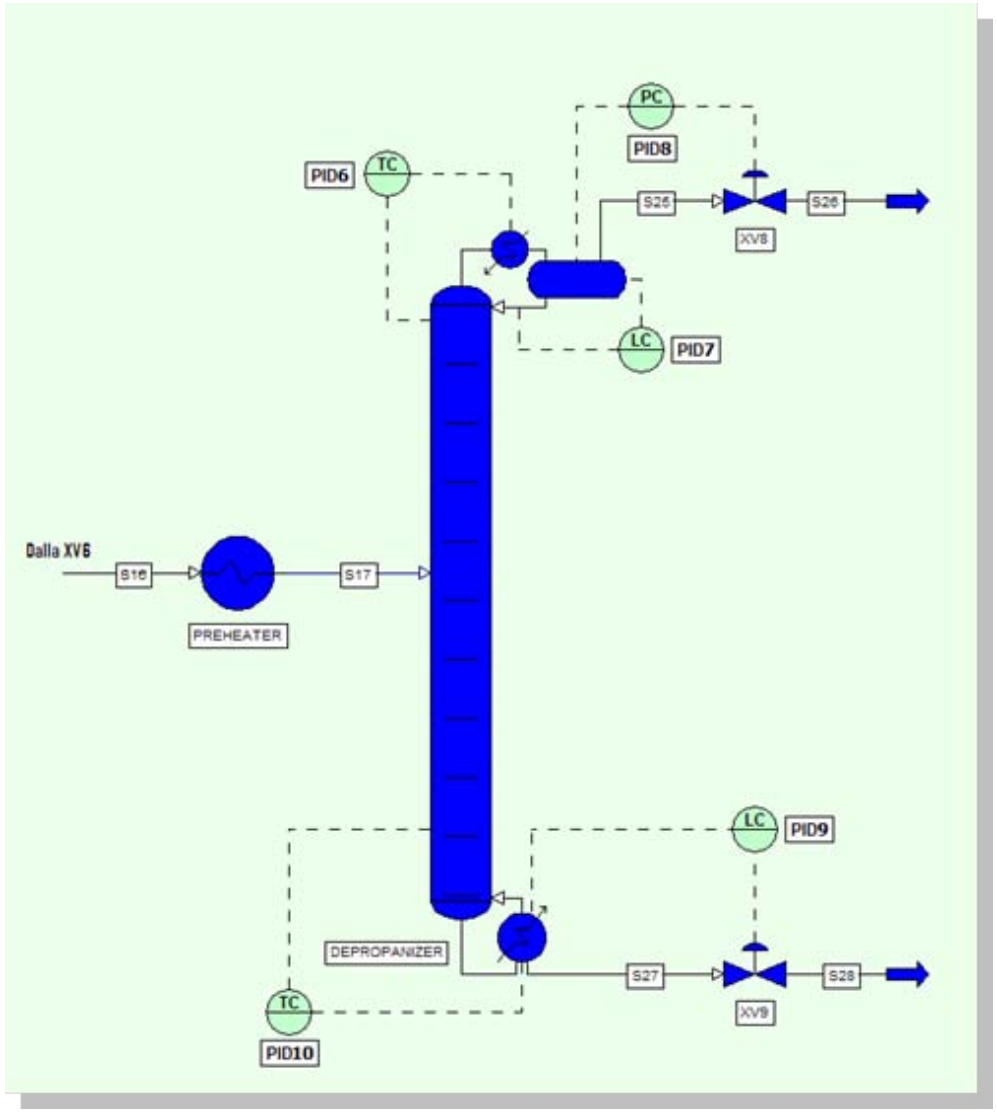


- SimSci-Esscor (**Dynsim**)
- Honeywell (**HYSYS**)
- Aspentech (**Aspen HYSYS**)
- PSE (**gPROMS**)
- CreateaSoft (**Simcad**)
- Simulation Solutions (**Virtual Refinery**)
- ...

Dynamic Simulation Implementation



Dynamic Simulation and Control



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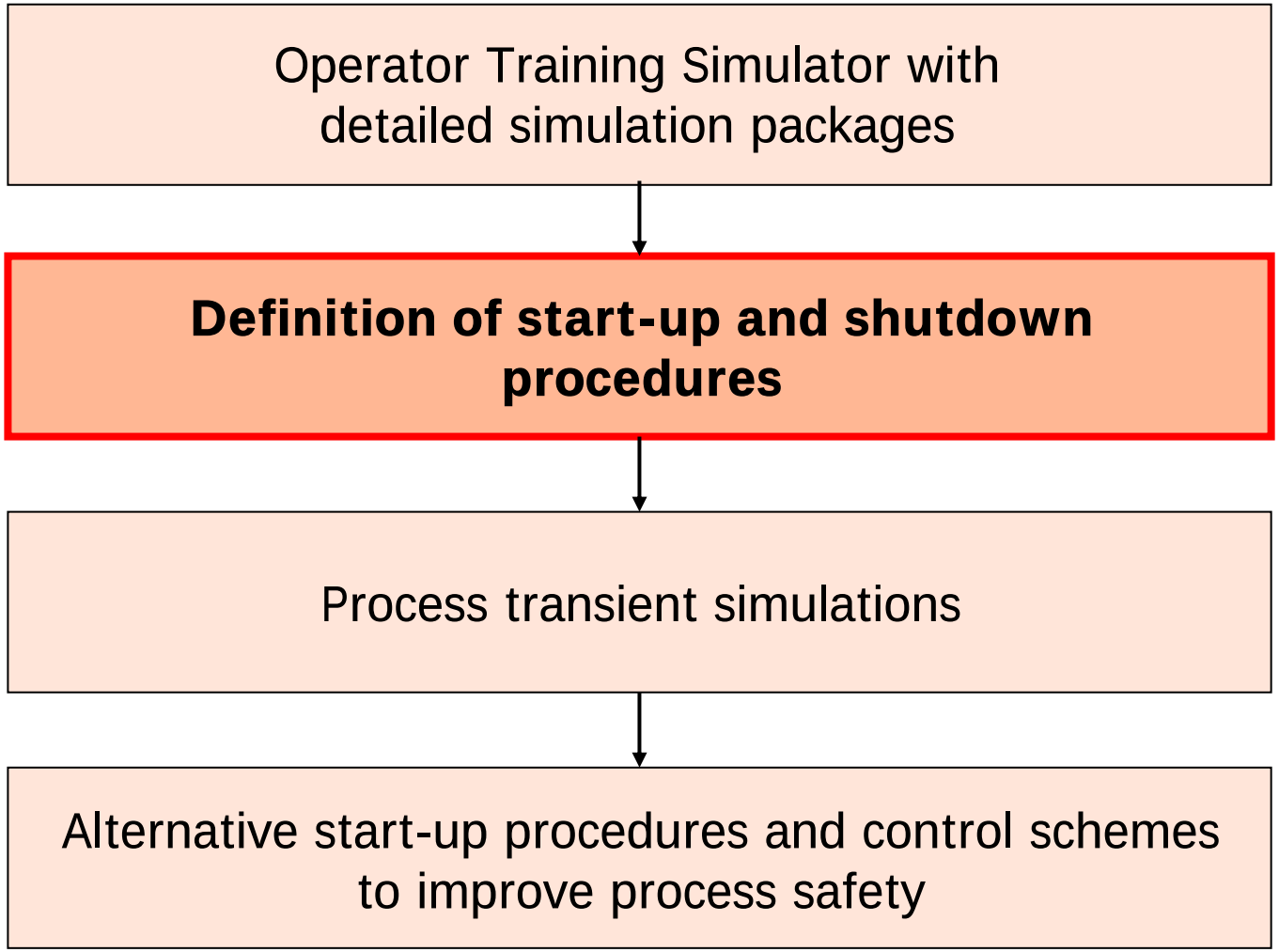
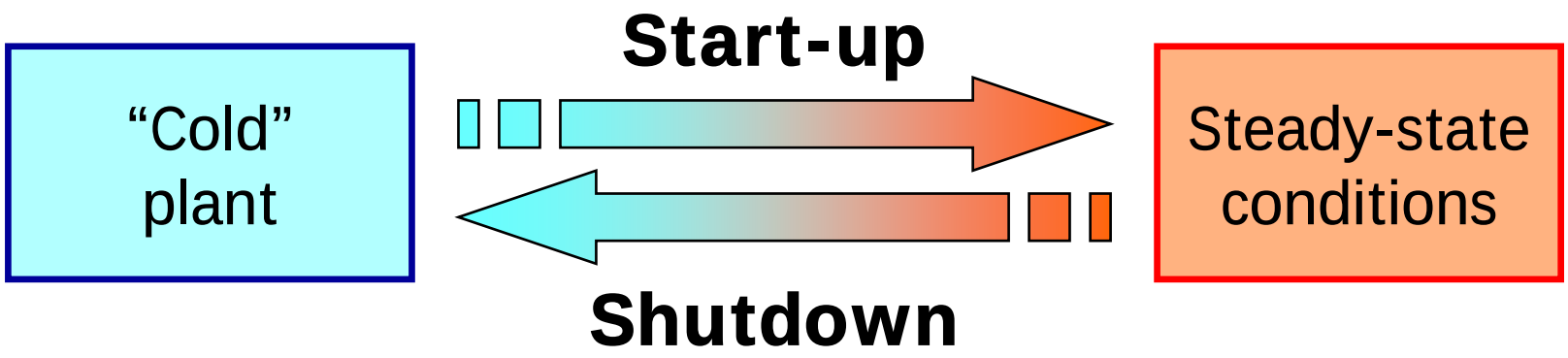


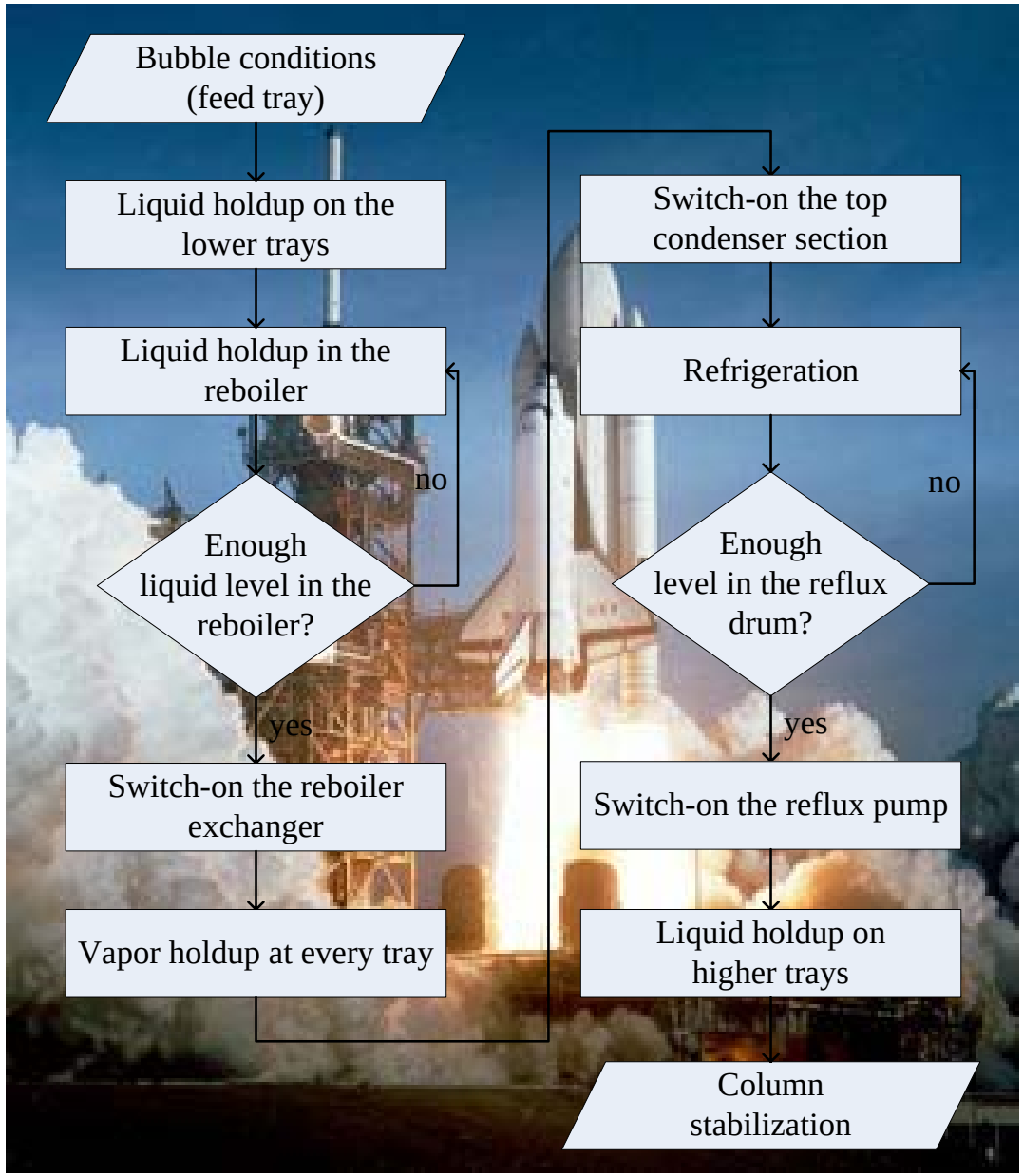
Start-up and Shutdown Procedures



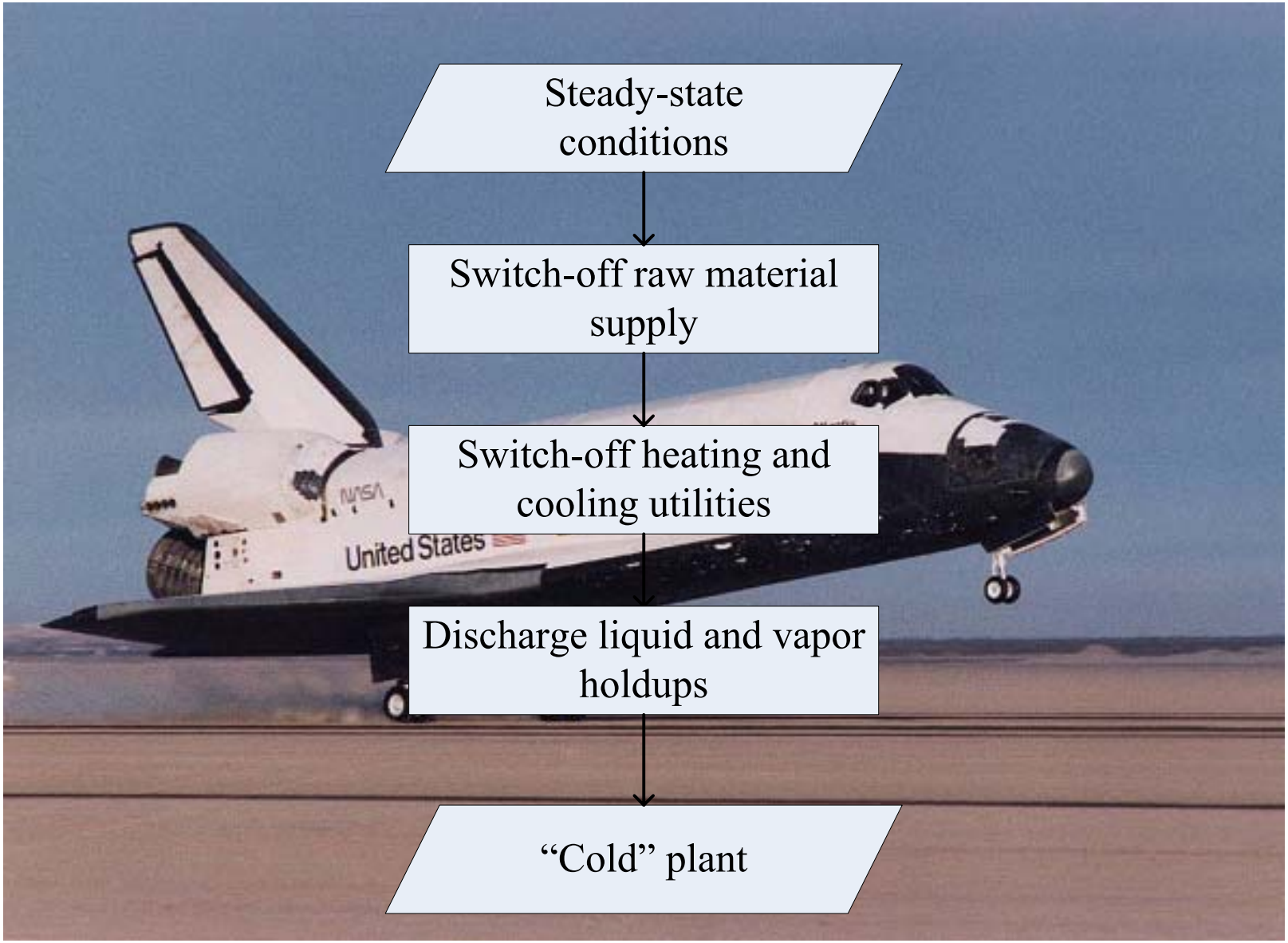
Importance of the analysis of unsteady conditions

- Decrease of off-spec periods
- Increase of plant productivity
- Start-up and shutdown operating conditions are significantly different from the steady-state conditions
- Relevant safety and operability problems

Start-up Procedure



Shutdown Procedure



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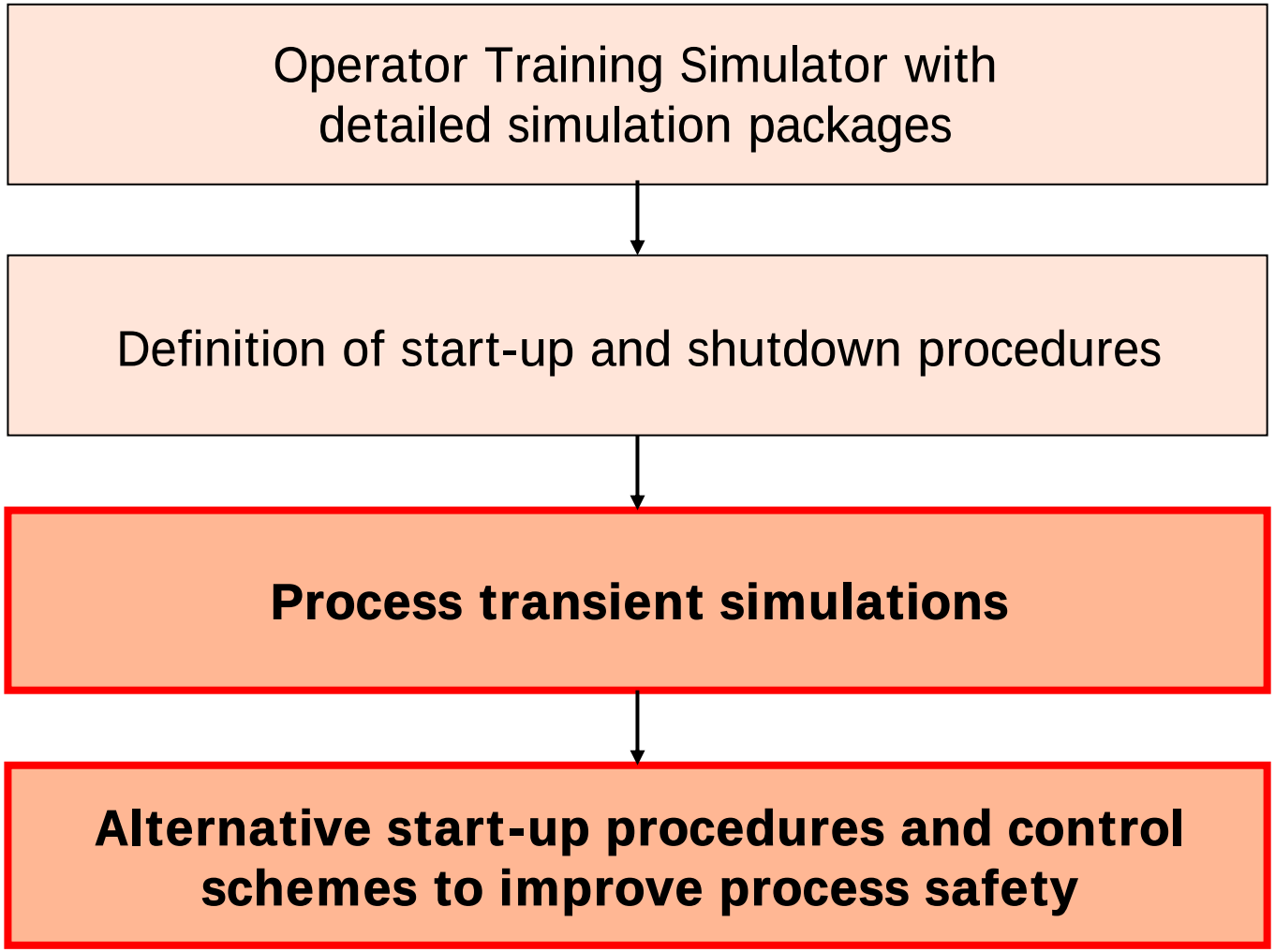
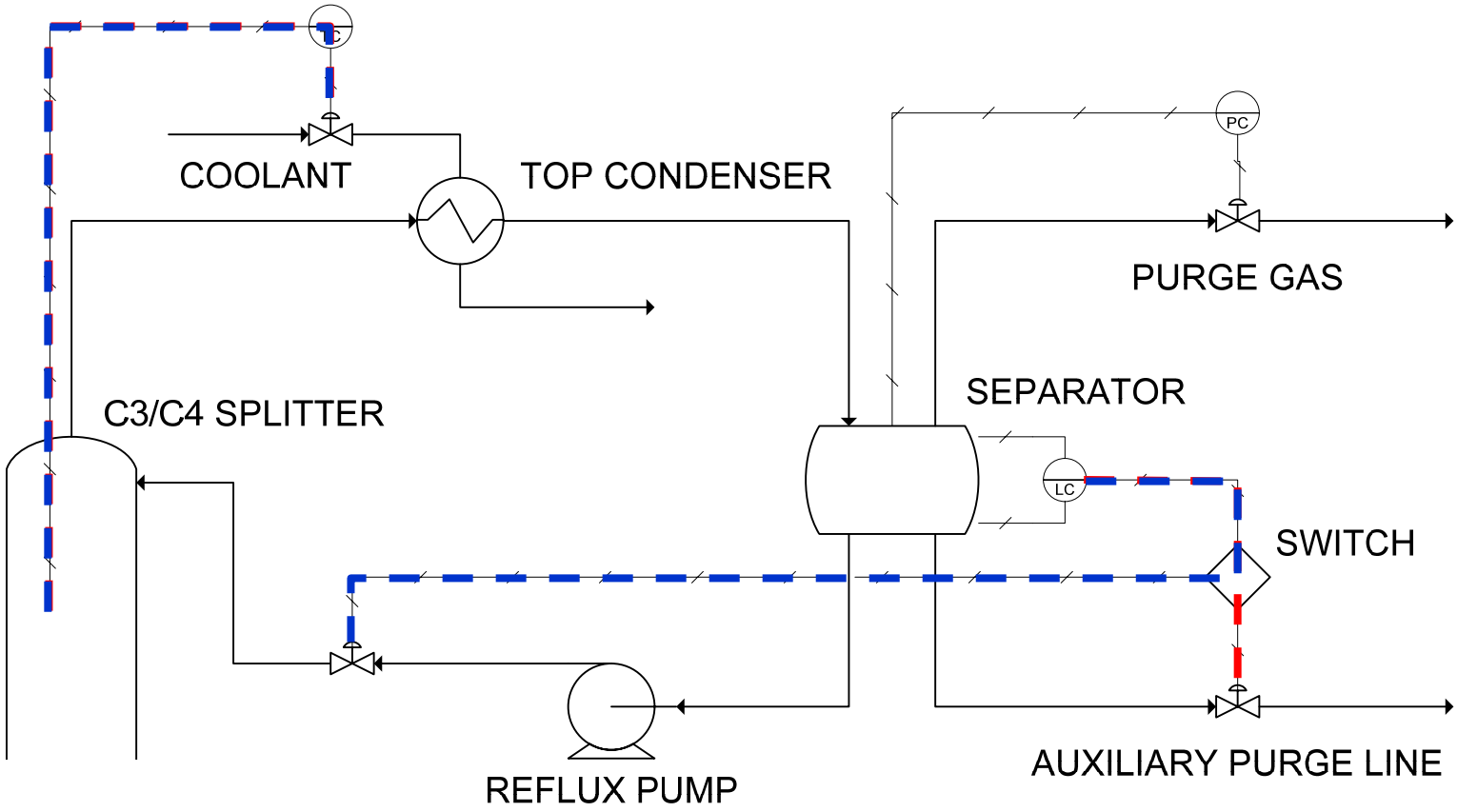
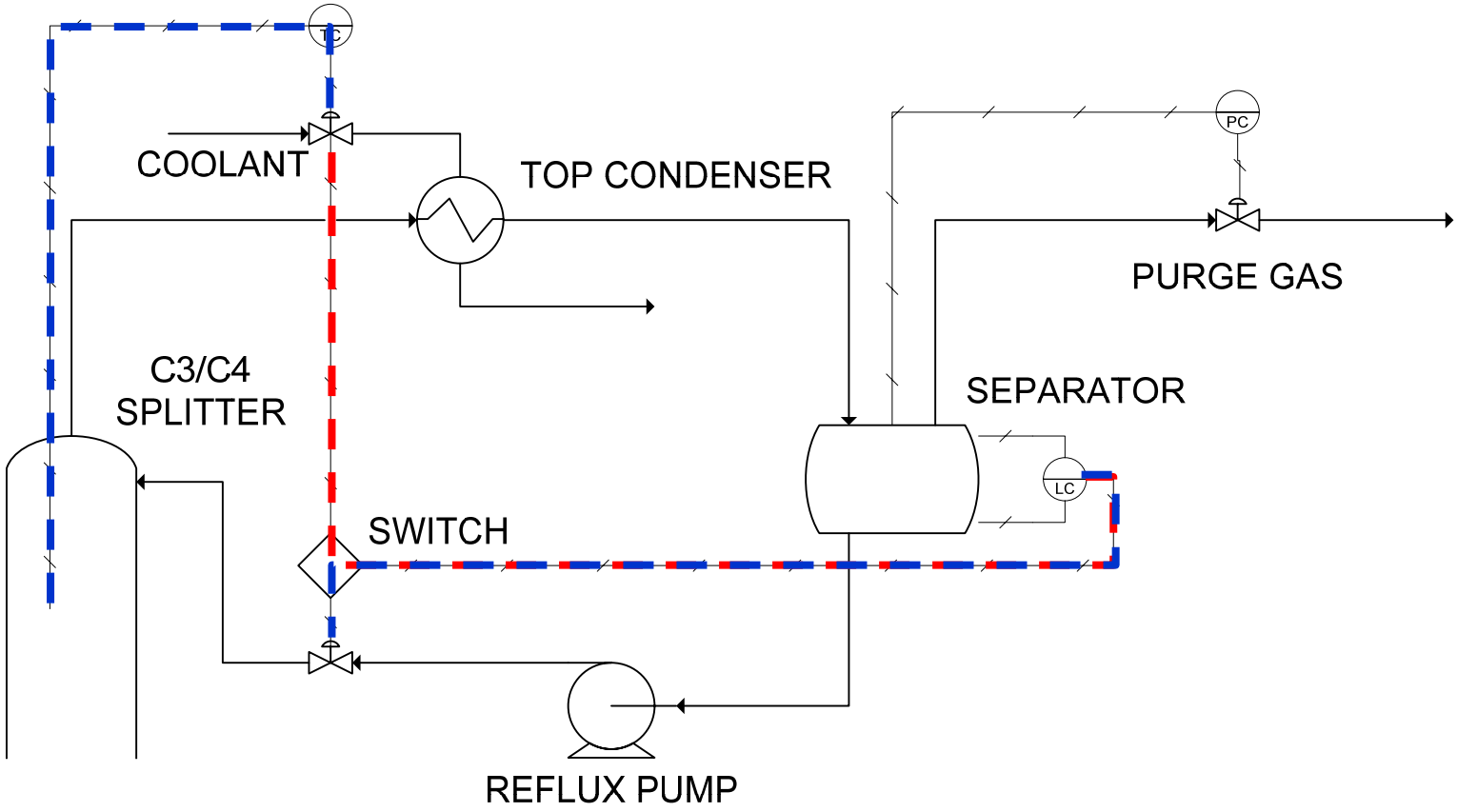


Conventional control scheme



Modified Control Scheme

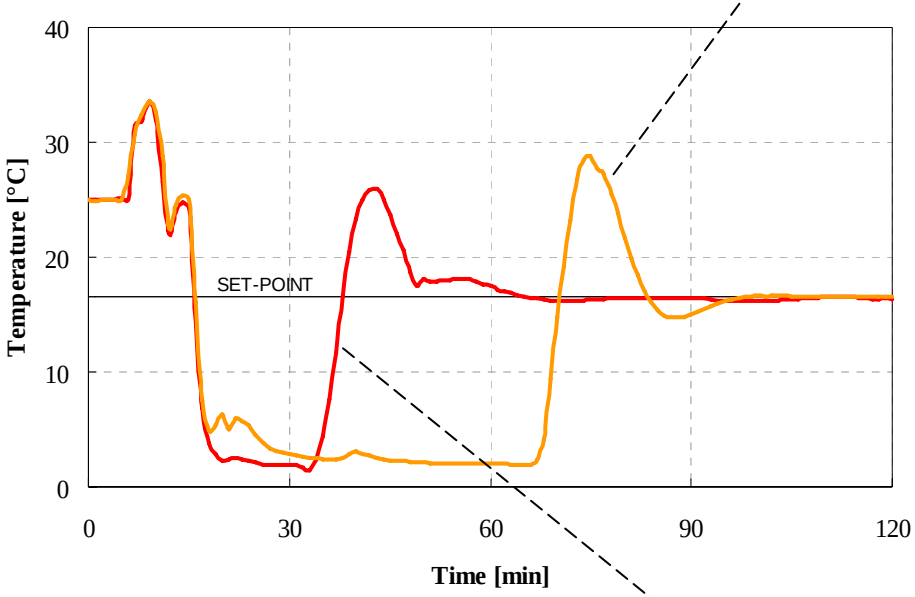


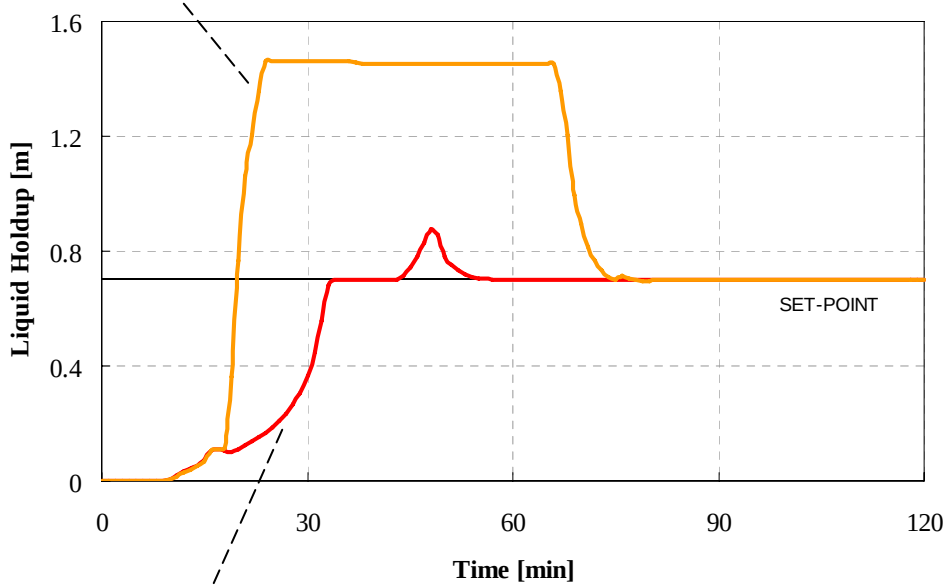
Safety and Reliability Issues

- Loading
- Flooding
- Weeping
- Pressure shots
- Entrainment
- Wet Bundles
- Smooth dynamics
- ...

Condenser

Conventional control structure

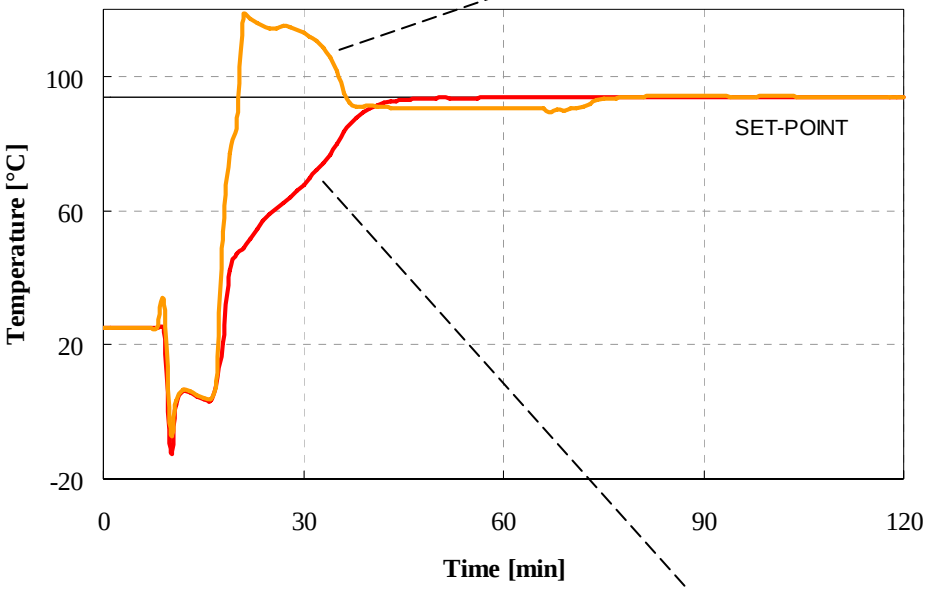


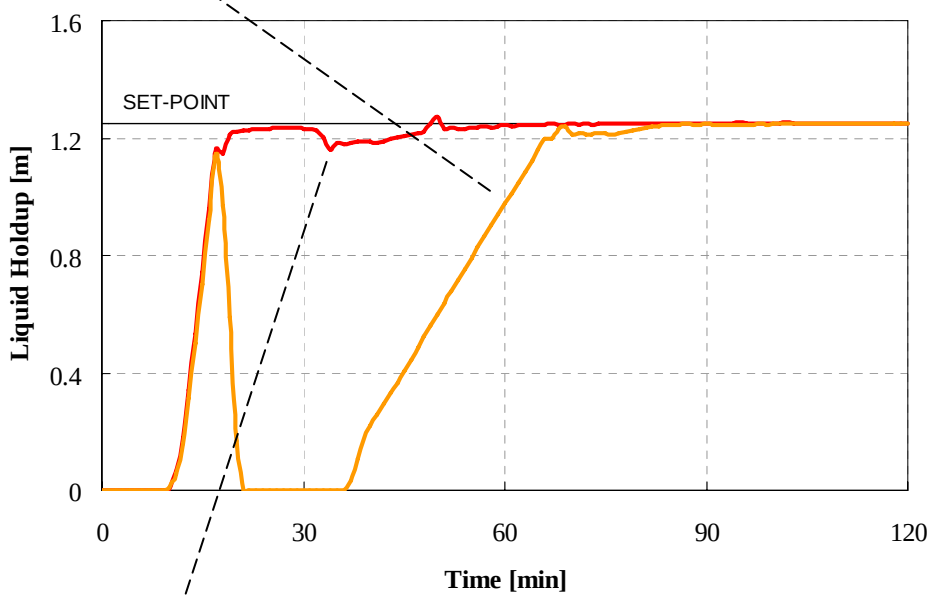


Modified control structure

Reboiler

Conventional control structure

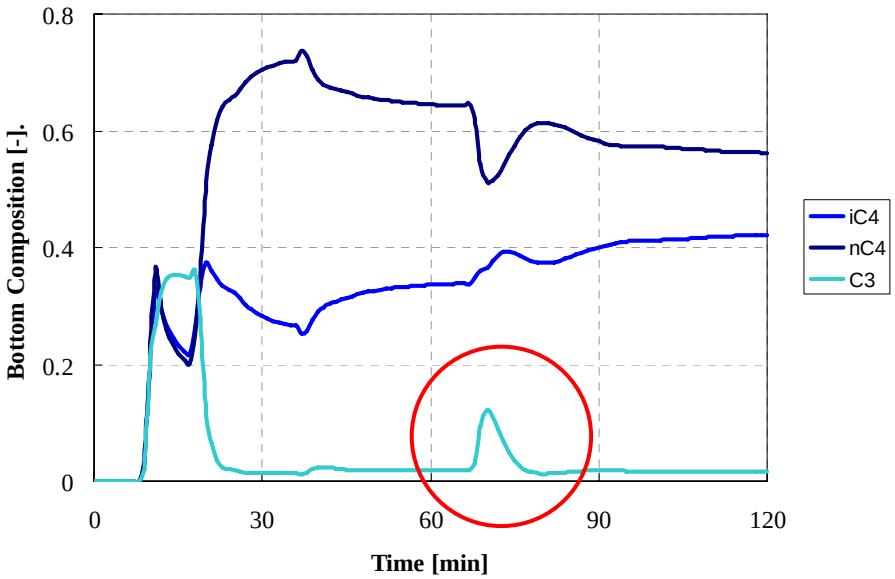




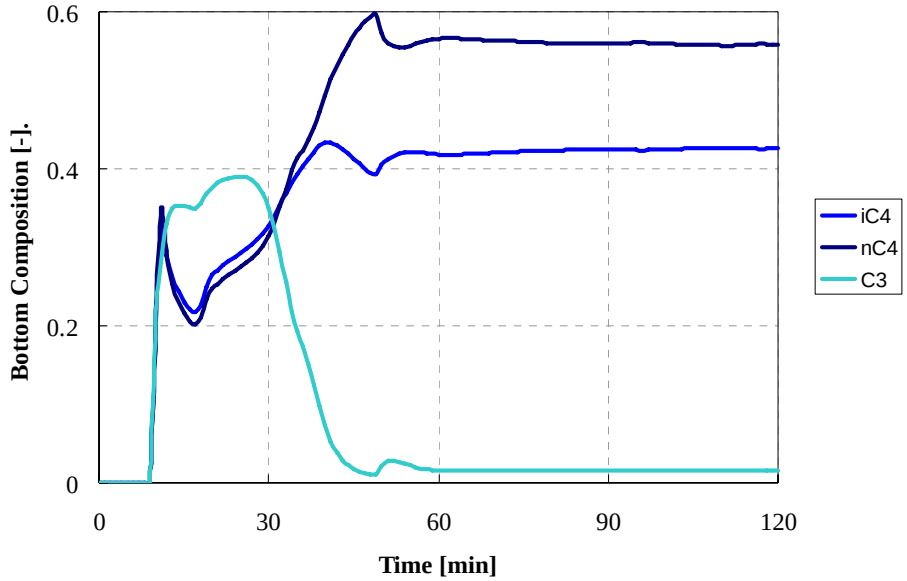
Modified control structure

Bottom composition

Conventional control structure



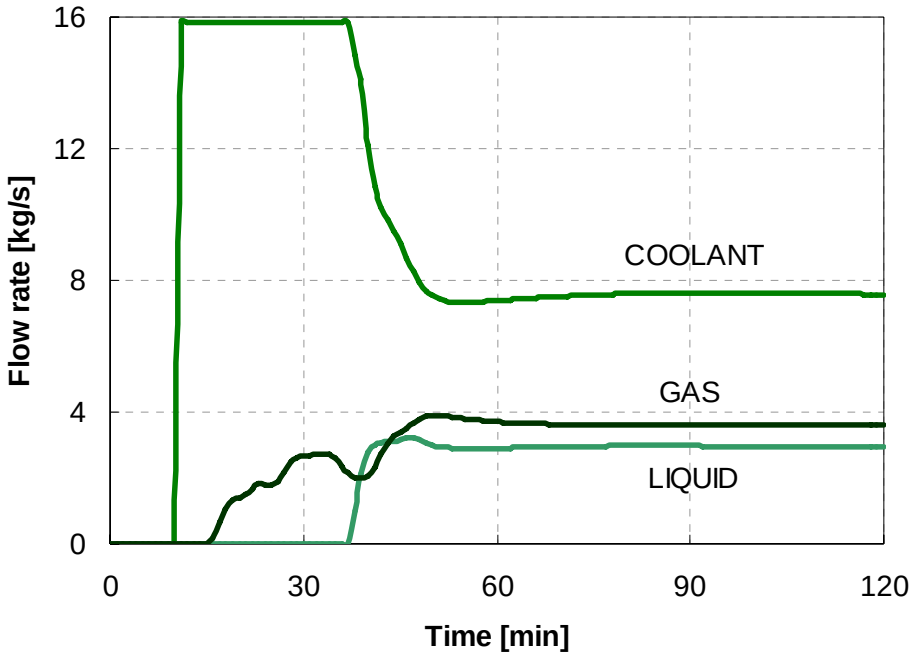
Modified control structure



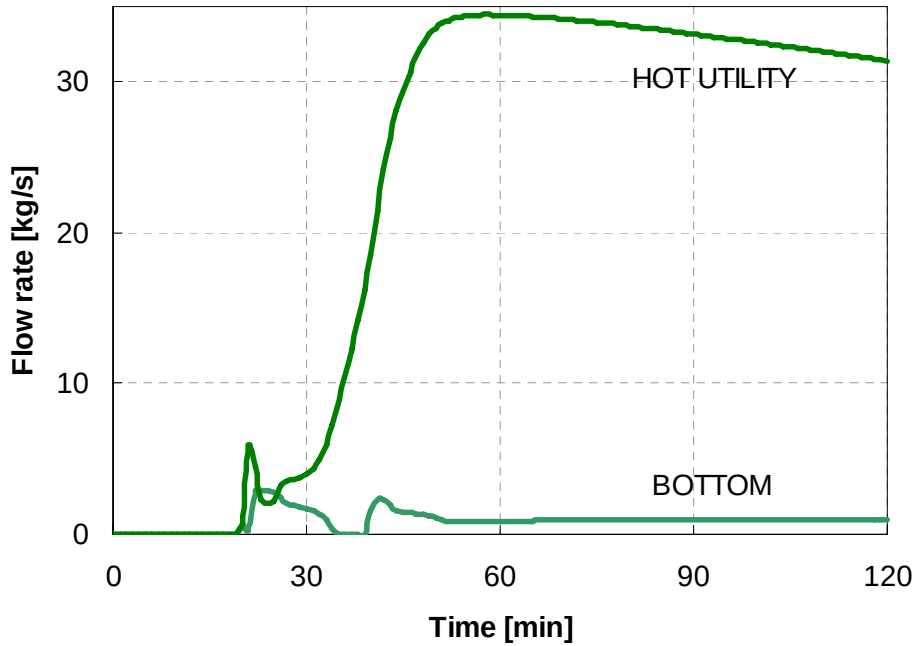
Manipulated variables of the modified control structure

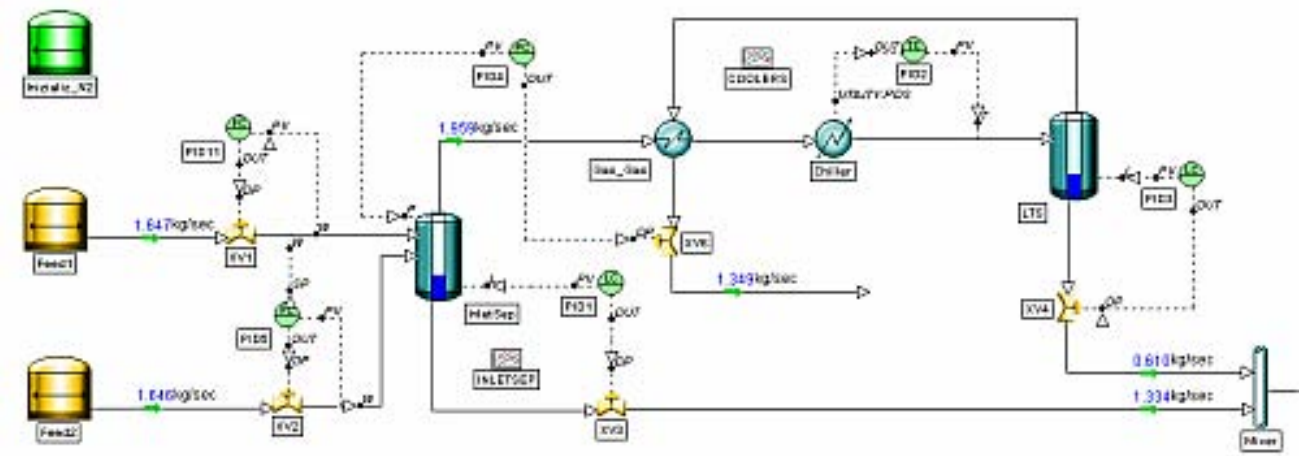
Modified control structure

Condenser



Reboiler



Conclusions

- A detailed simulation of process transients allows:
  - **designing** new control structures;
  - **quantifying** the **performance** of start-up and shutdown procedures;
  - **assessing** the **safety issues** and **risky conditions** of start-up and shutdown procedures;
  - **training** both control-room and field operators;
  - **improving** process safety and performance.