

Computer-aided Hazard Identification



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HAZOP Studies

- an established and widely used technique in the process industry for hazard identification
- time consuming, labour intensive process
 - tedious
 - expensive



Computer-aided HAZOP

- different levels of support
 - electronic report form
 - electronic data
 - automated hazard identification
 - continuous operation
 - batch operation



Automated Hazard Identification

- continuous operation
 - from basic research to commercial product - HAZID
 - basic technology
 - signed directed graph representation
 - fault propagation
 - go through a list of deviations systematically and identify the faults that cause the deviations and the consequences that result from the faults and deviations



HAZID Overview

- Features

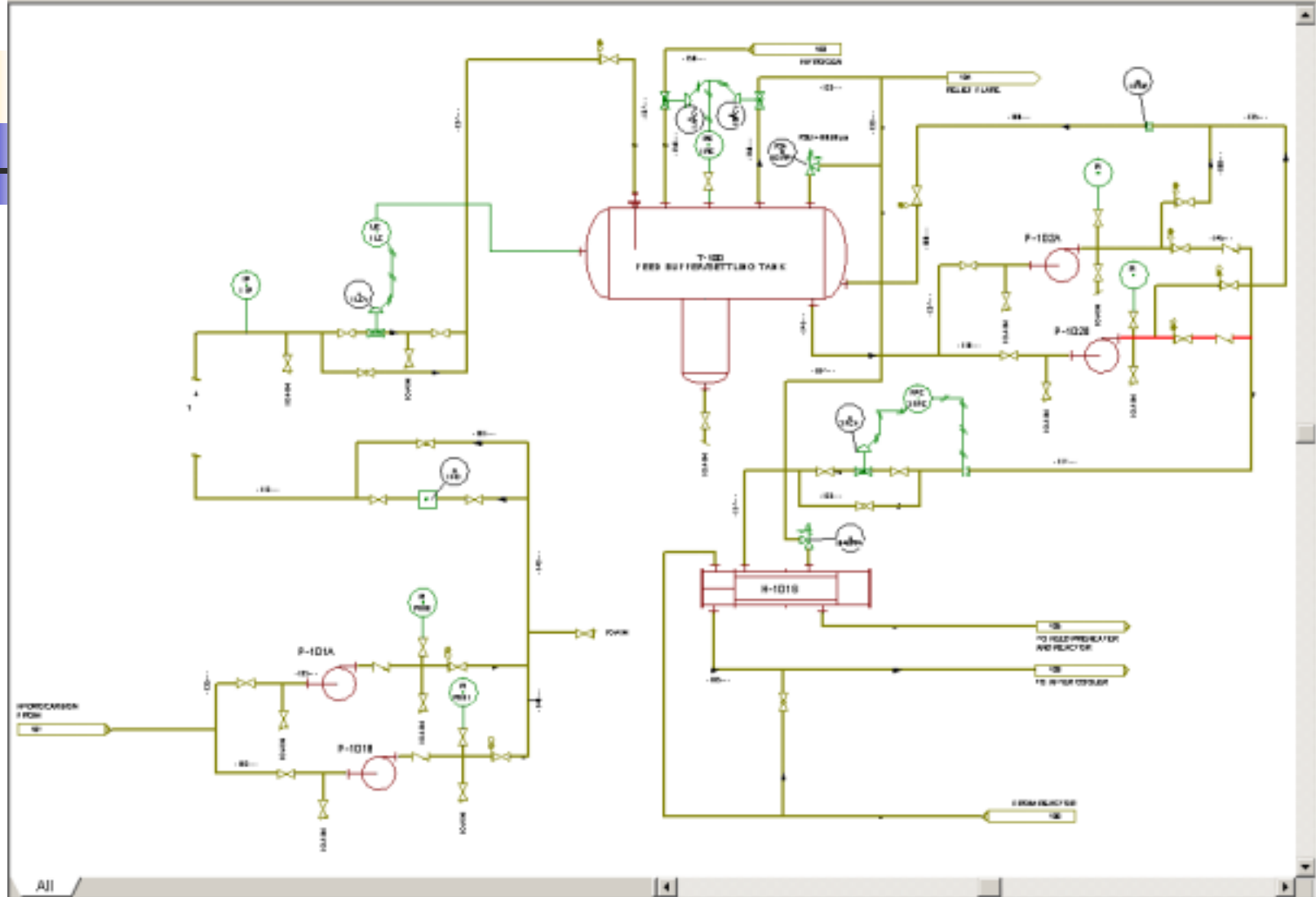
- automated extraction of plant design from a CAD system, e.g. Intergraph SmartPlant P&ID and Smart Sketch
- convenient forms for adding any missing process specific information
- tick boxes for selecting analysis options
 - deviations, e.g. more flow, less flow, etc.
 - items



HAZID Overview

- Features

- different output formats
 - XML web page
 - Excel spreadsheet
- query facility for viewing analysis results
 - e.g. viewing faults and consequences relating to a particular plant item
 - e.g. viewing the propagation path between a particular fault and consequence
- compare facility for viewing the difference between two HAZID runs
 - useful for after making a change to the design





HAZID Demo



Automated Hazard Identification

- batch operation
 - early research prototype (CHECKOP)
 - basic technology
 - action representation
 - state-based simulation
 - go through a set of operation instructions systematically and identify potential ambiguities, operating problems and hazards
 - applying guidewords such as before, after, no action, etc



CHECKOP Demonstration

([kettle] move-under [kitchen-tap])
([kettle] open-lid)
([kitchen-tap] turn-on)
([kettle] fill-from [kitchen-tap]
with water until volume 50 %)
([kitchen-tap] turn-off)
([kettle] close-lid)
([kettle] move-to [kettle-base])
([kettle-base] plug-to [power-
socket])
([power-socket] switch-on)
([kettle] switch-on)
([kettle] heat-content until temp
100 C)
([kettle] switch-off)
([power-socket] switch-off)

([tea-bag-tin] move-to [cup])
([tea-bag-tin] open-lid)
([tea-bag] move-into [cup])
([kettle] move-to [cup])
([cup] fill-from [kettle] with water until
volume 80 %)
([cup] react-content until elapsed-time 5
seconds)
([milk-bottle] move-to [cup])
([milk-bottle] open-lid)
([cup] fill-from [milk-bottle] with milk abs
amount 10 ml)
([bottle] close-lid)
([spoon] stir-content of [cup] until elapsed-
time 3 seconds)



Batch HAZOP

Guideword	Deviation	Cause	Consequence
No	Action		
Early	Action		
Early	Termination		
Late	Action		
Late	Termination		



Conclusions

- automated hazard identification
 - continuous operation
 - commercial tool that can reduce the time of HAZOP
 - batch operation
 - promising area of research and development for identifying problems associated with human errors and operating procedures