



DCS CHECK-OUT AND OPERATOR TRAINING WITH HYSYS DYNAMICS

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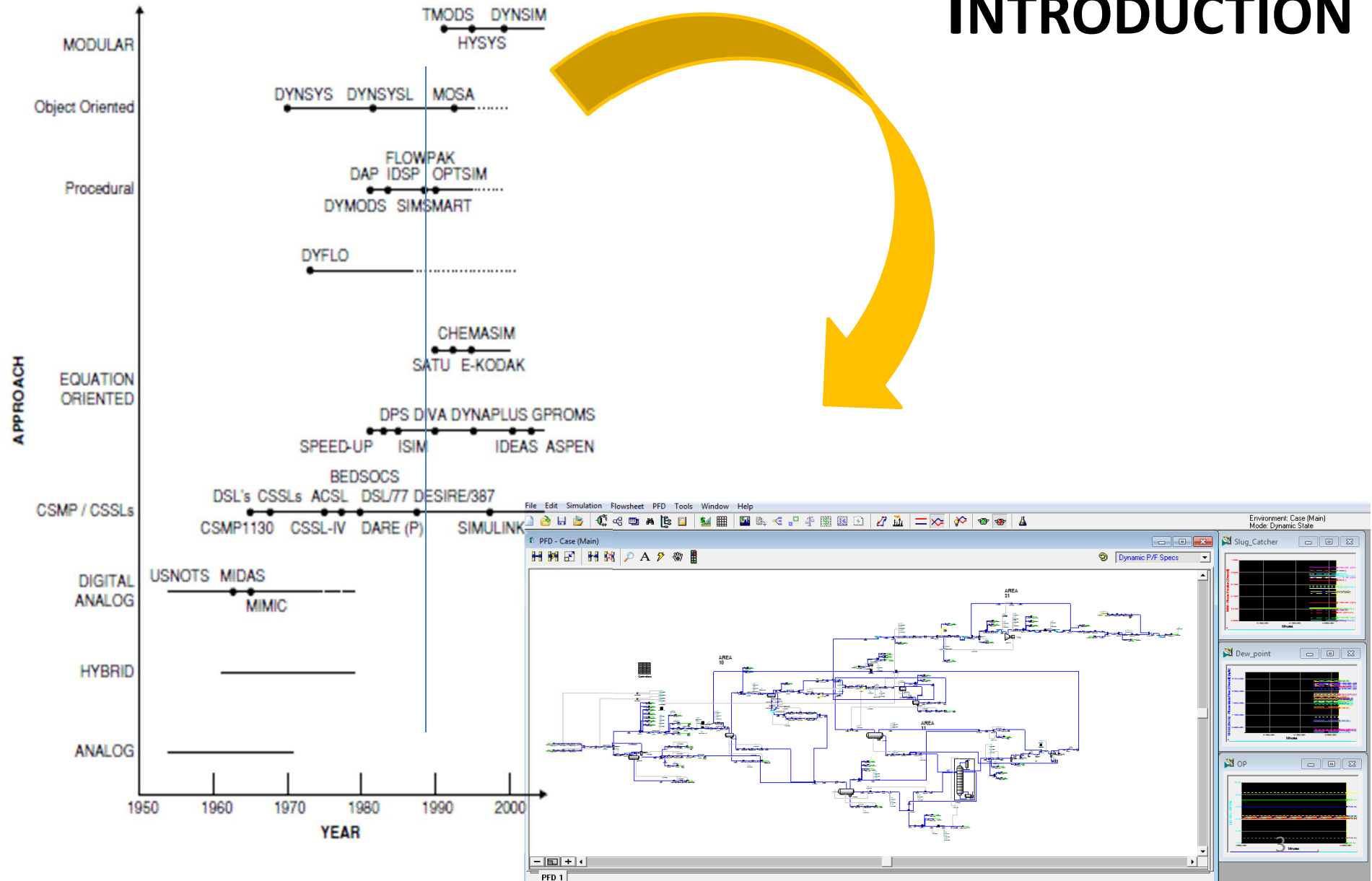


AGENDA

- Introduction
 - Dynamic Simulation
 - Operator Training Systems
 - DCS Check-Out
- Case of Study
 - Modelling of an E&P facility
 - DCS Integration and checkout
 - Training scenarios
- Key findings & Conclusions

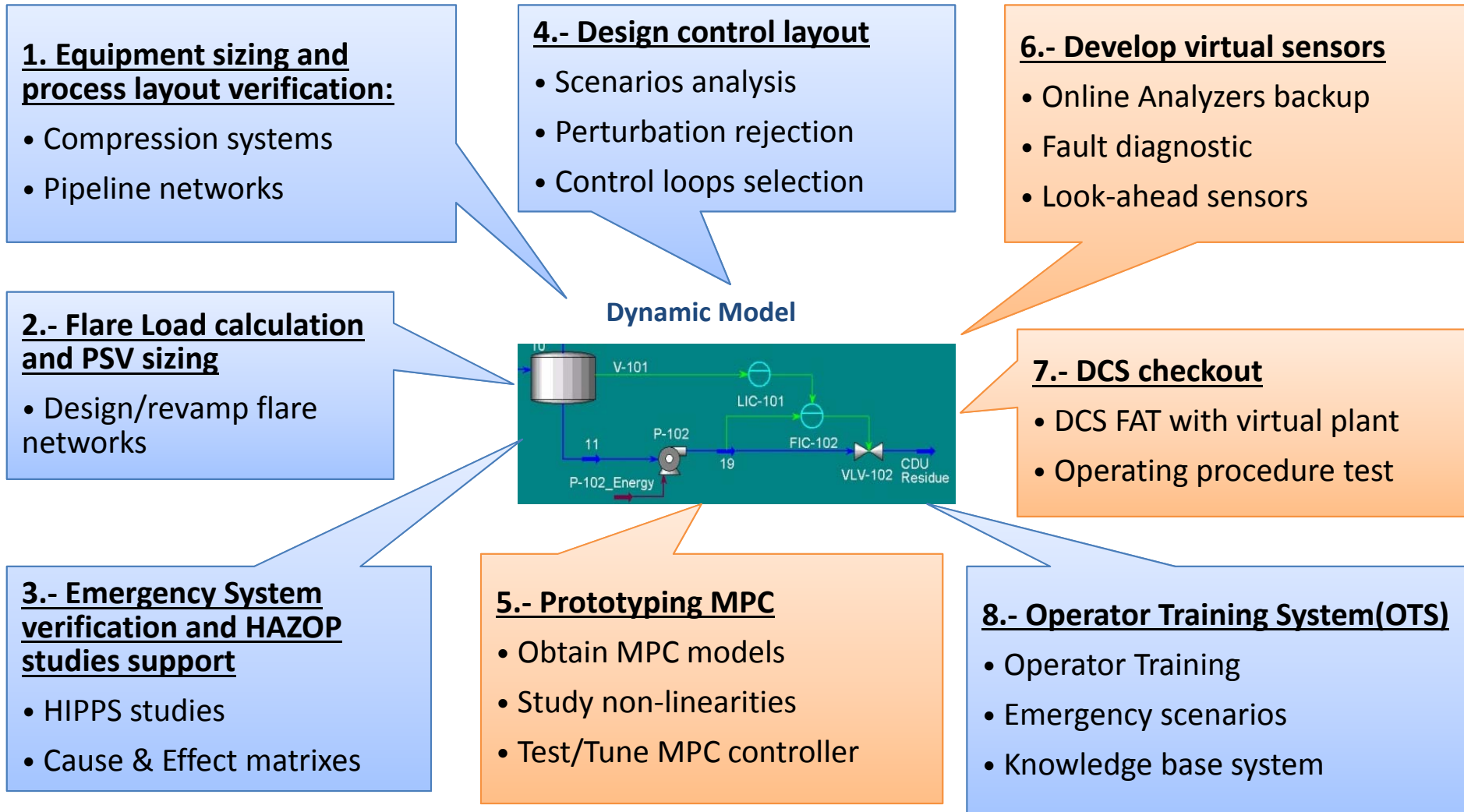
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INTRODUCTION

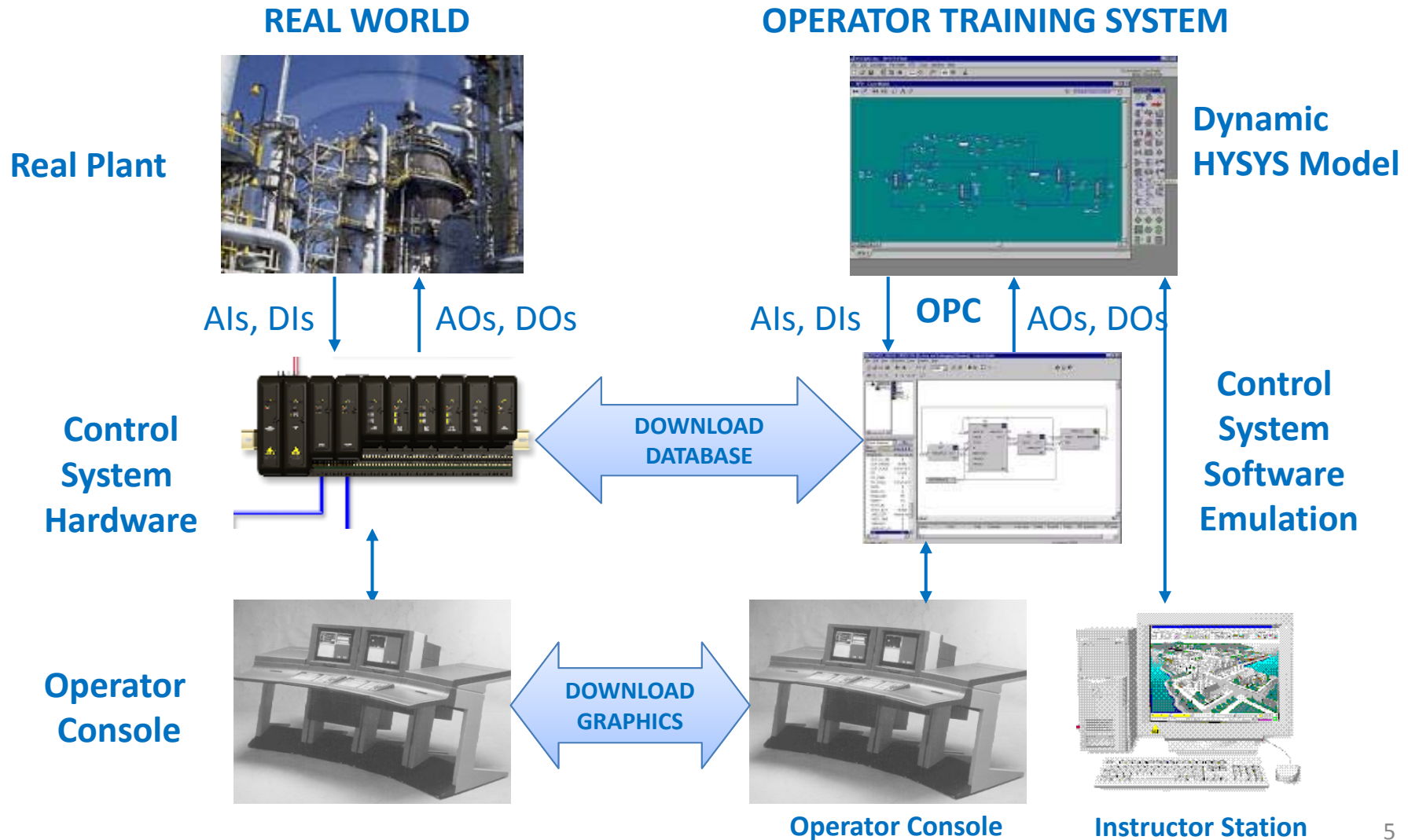


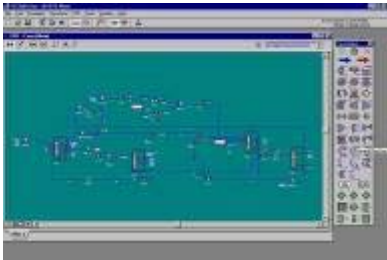
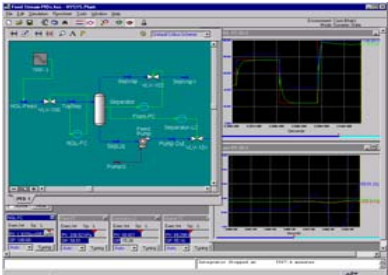
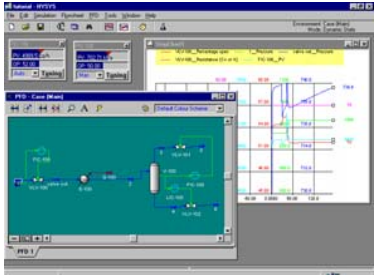
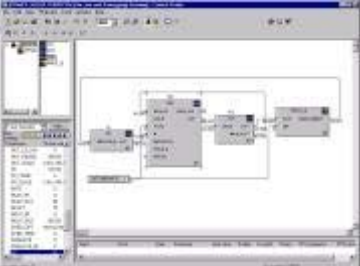
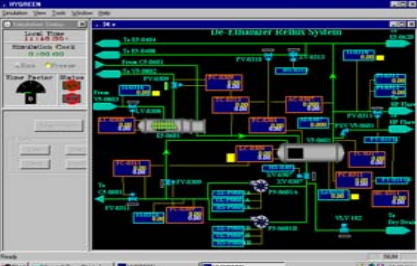

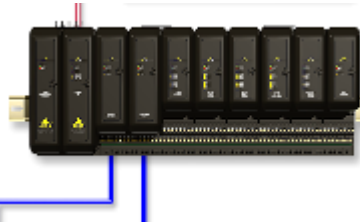

- Consolidated
- Exploring

WHY DYNAMIC SIMULATION?



WHAT IS AN OPERATOR TRAINING SYSTEM?



	Plant	Controls	Operator Console
Simulated	<p>HYSYS Model</p> 	<p>HYSYS Controls</p> 	<p>HYSYS Environment</p> 
Emulated		<p>Software emulation</p> 	<p>Graphic Interface</p> 
Stimulated	<p>Real Plant</p> 	<p>DCS Hardware</p> 	<p>DCS Console</p> 

BENEFITS FROM OTS PROJECTS

3 STAGE BENEFITS FROM OTS



1. PROCESS VALIDATION

- Verify sizing/layout
- Verify Relief
- Validate control design
- Confirm operability

2. DCS VALIDATION

- DCS logic config. checkout
- ESD trip checkout
- Pre-tune loops
- Displays checks & operability
- Alarms setting
- Automatic procedures check

3. OPERATOR TRAINING

- Process & displays familiarization
- Start-up training
- Emergency training
- Procedures optimization
- Refreshing training

WHAT IS A STANDARD DCS FAT?

Factory Acceptance Test (FAT) involves of:

1. **Hardware**, such as controllers, I/O modules, power supplies, terminations, etc.
2. **Logic**, forcing analog and discrete inputs, then watching the logic to be sure it responds as expected.
3. **Operator displays and alarms**, which are tested in conjunction with the forced logic and signals step above.

MOTIVATION FOR BETTER TESTING

- **Increasing complexity of DCS** → Tightens the requirements for functional testing before commissioning.
- **Client/Suppliers try to minimize involved risks**: This includes software testing, as well as early detecting specification errors.
- **At the real installation**: The available time does not suffice to achieve the required depth of testing.

Testing environments with a simulated installation are a worthwhile alternative.

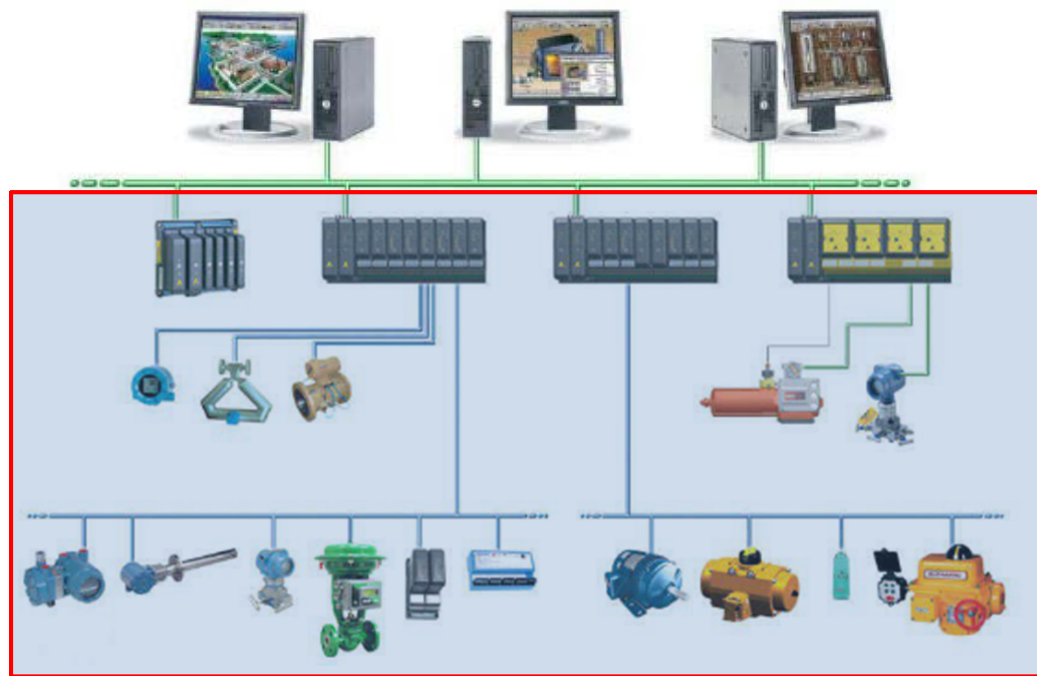
WHY USING SIMULATION IN DCS FAT?

Control system checkout allows the Simulator to be used to:

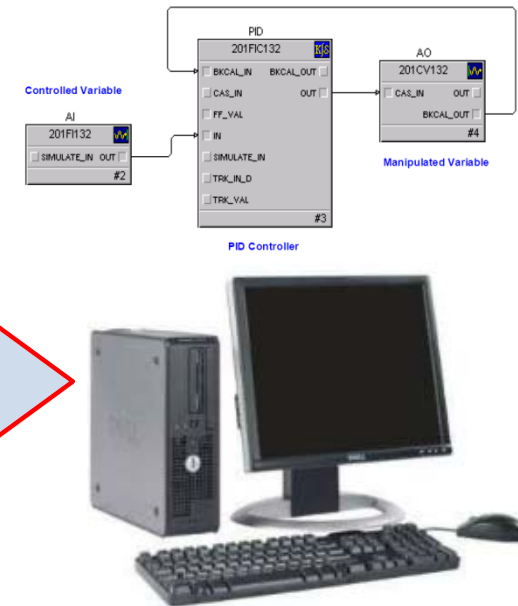
1. Pre-tune control loops
2. Test motor start/stop logic
3. Validate permissive logic for start-up/shutdown sequences
4. Evaluate controls stability/interactions against perturbations
5. Check graphics displays and operability with procedures
6. Re-setting for certain alarms limits
7. Test ESD systems and logic sequences
8. Evaluate procedures for abnormal operation

DCS FAT WITH ONLY EMULATED DCS&SIS

Control design and configuration is independent of the hardware, DeltaV Simulate allows all configuration to run in virtual control with identical functionality



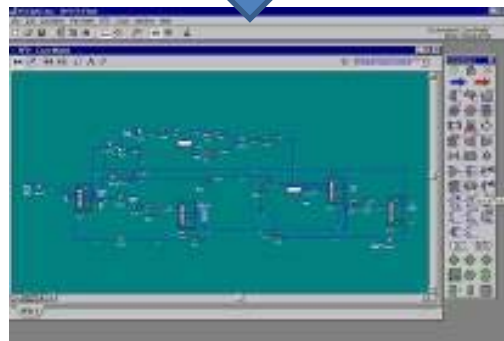
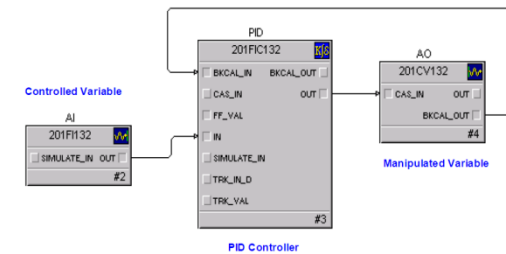
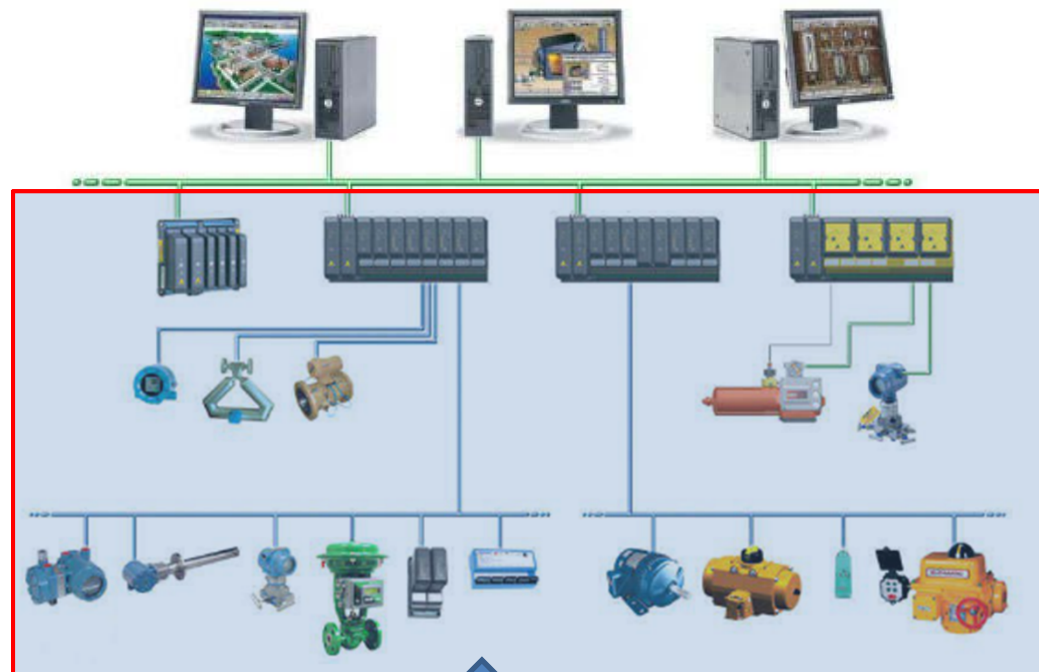
Virtual Control with DeltaV Simulate Pro



Discrete I/Os are stimulated by engineer, Analog I/Os use tie-backs

DCS FAT WITH FULL VIRTUAL PLANT

Virtual Control with
DeltaV Simulate Pro



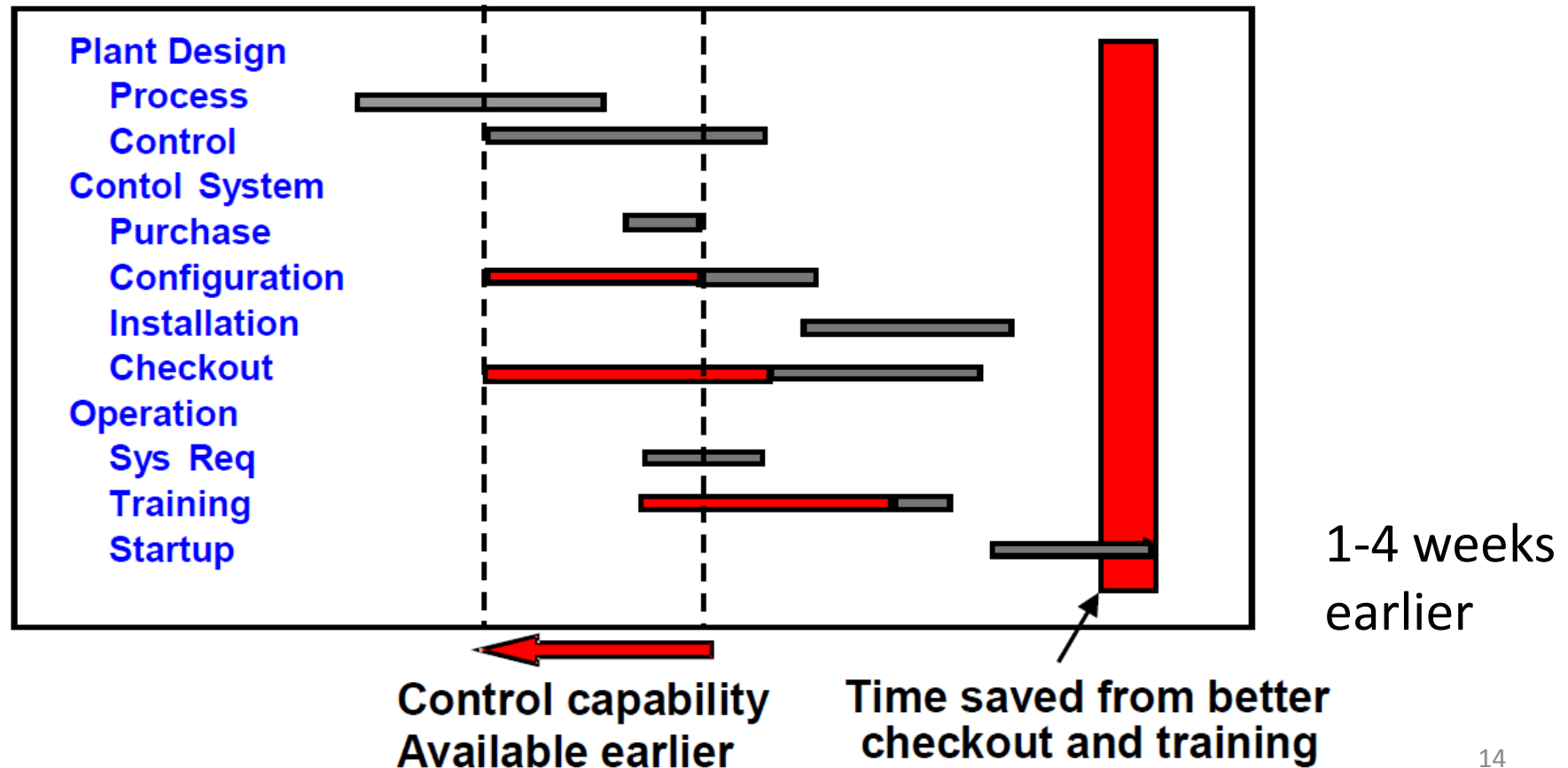
The I/Os (discrete & analog) are fully simulated by a process dynamic simulator of the entire plant

STANDARD FAT VS. VIRTUAL PLANT FAT?

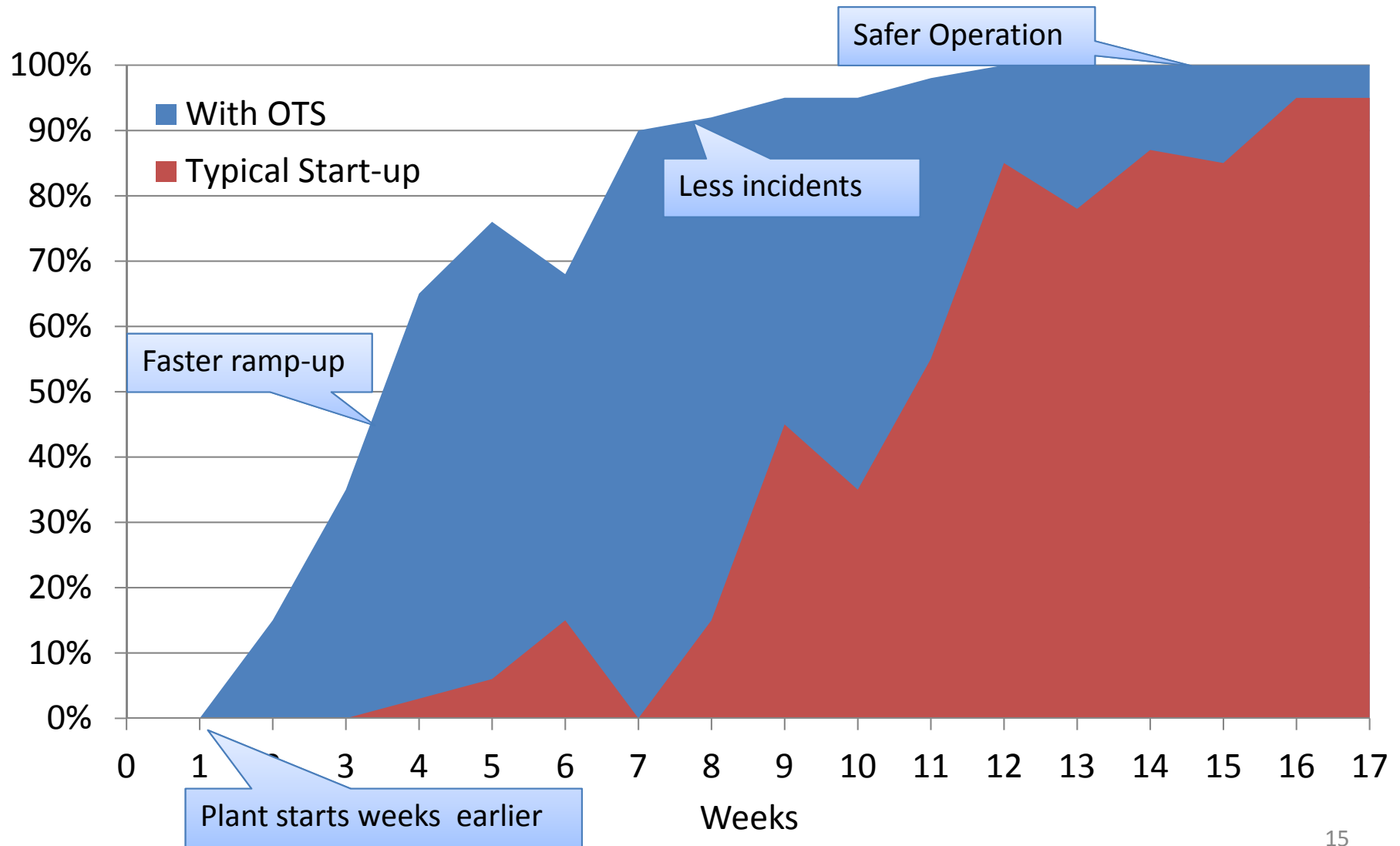
	STANDARD DCS FAT	DCS FAT with VIRTUAL PLANT
Hardware	Actual DCS/SIS modules	Standard PCs or laptops
Software	Actual DCS /SIS software	DeltaV Simulate Pro, HYSYS Dynamics
Location	At DCS vendor Facilities	At any location (Customer, EPC, etc)
Timing	When DCS hardware and I/Os modules are available	As soon as DCS logic and configuration is available
Testing proceeding	Limited to the I/O signal introduced by hand	Same as during commissioning & start-up with real plant
Procedures testing	Limited verification	All procedures and start-up/shutdown sequences
Loop testing	No possible	Full, as in real plant
Alarm verification	Only non-time dependent	Full, as in real plant
SIS verification	Limited, no plant interaction	Full, as in real plant

PROJECT ANTICIPATION

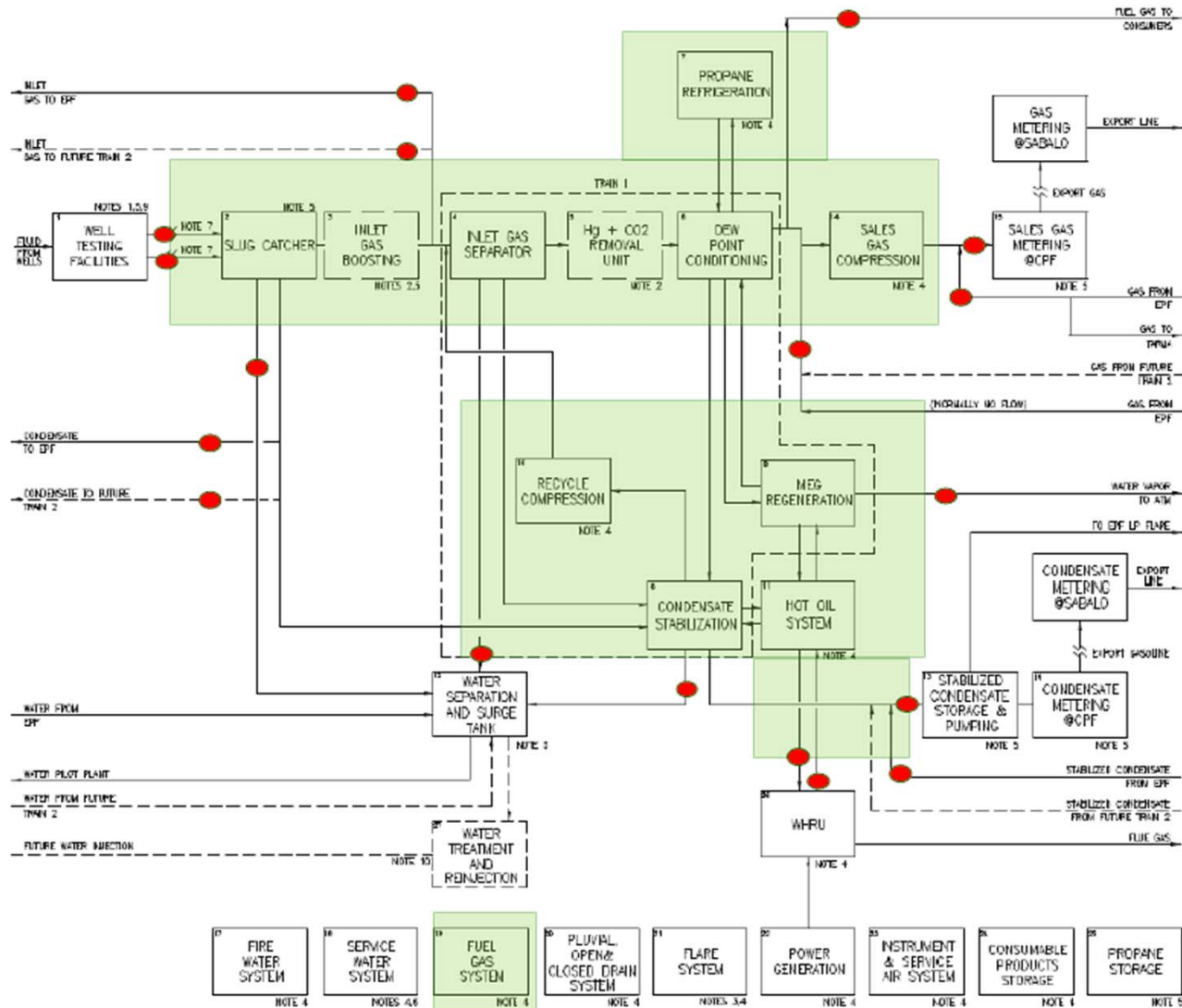
Certain tasks don't need to wait for the physical good to exist, they can start as soon as the dynamic simulation is available



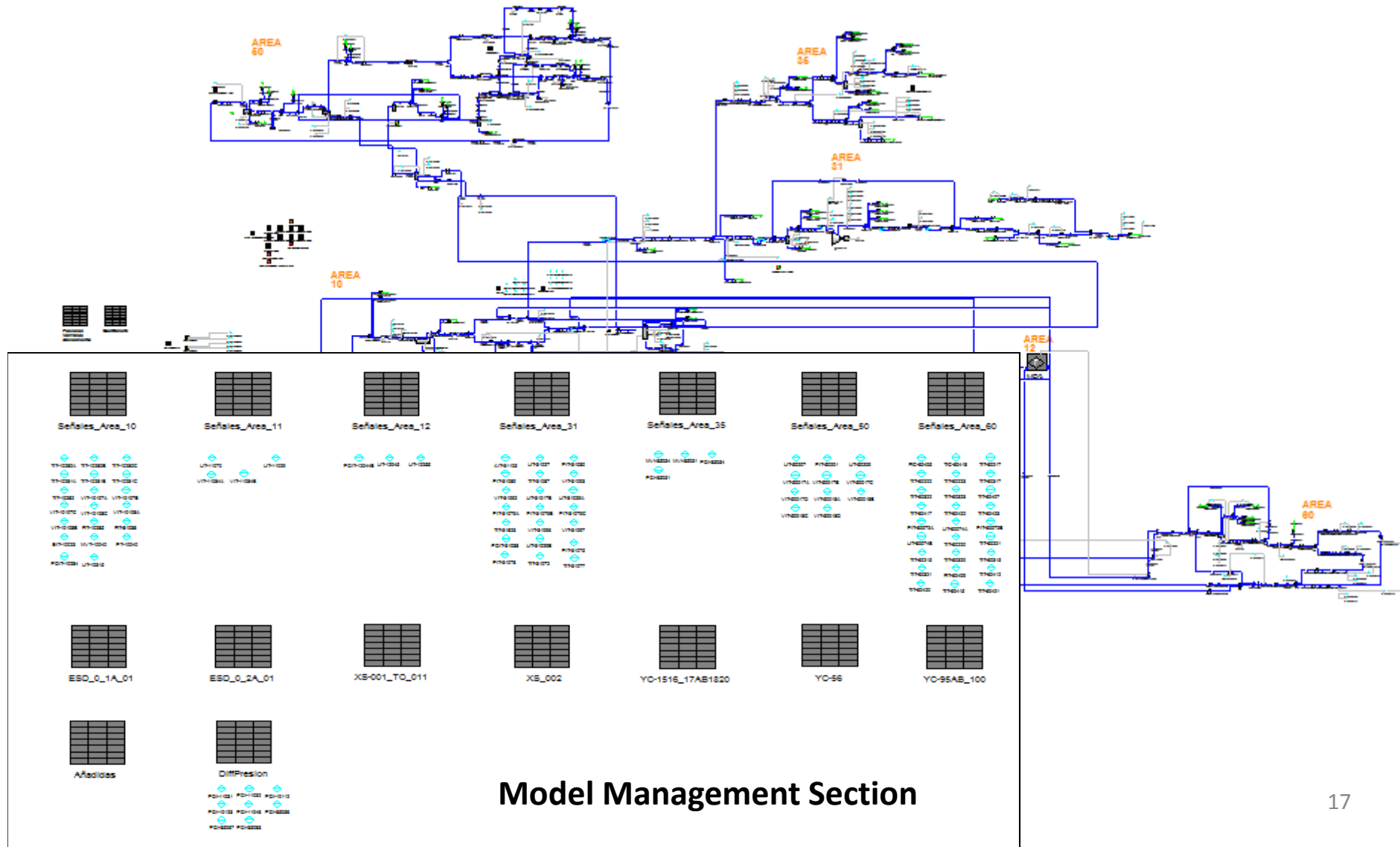
START-UP WITH OTS



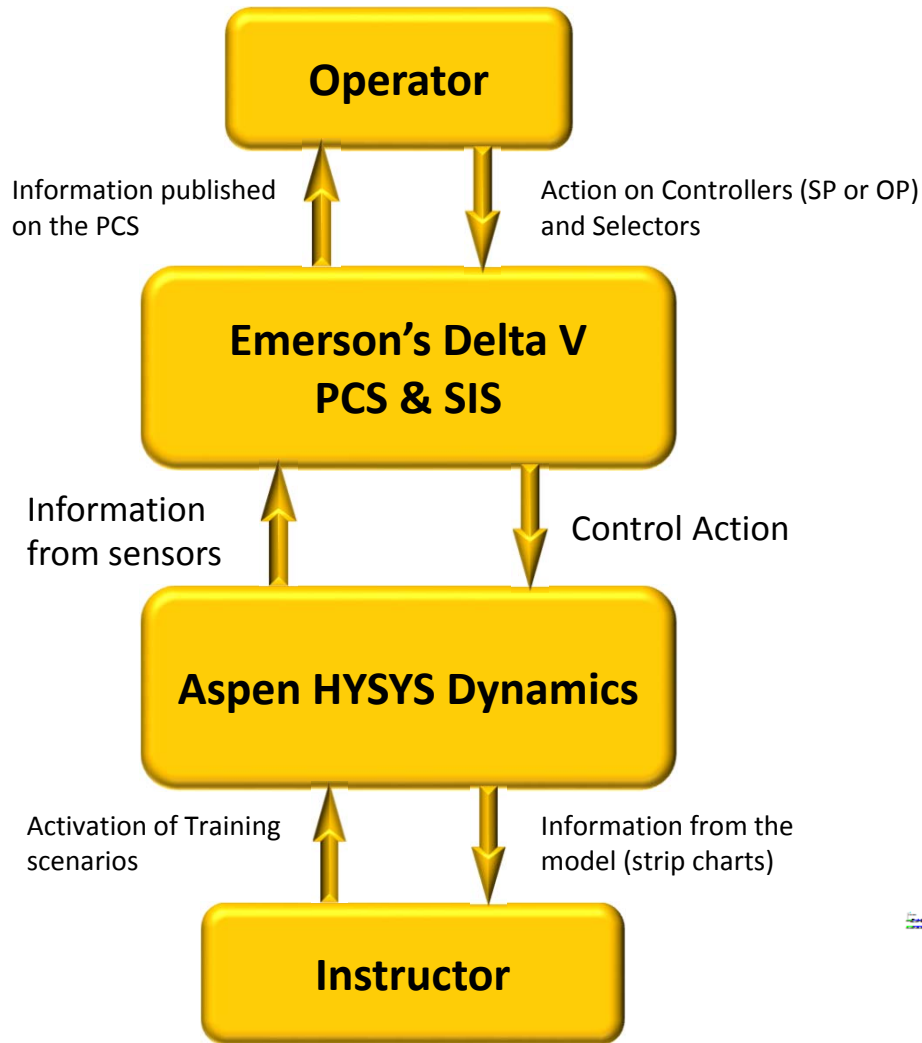
SCOPE OF THE DYNAMIC MODEL



DYNAMIC MODEL

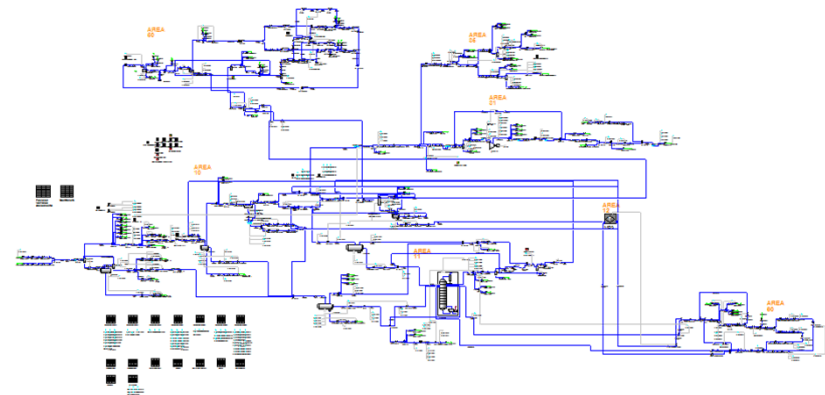


OTS ARCHITECTURE

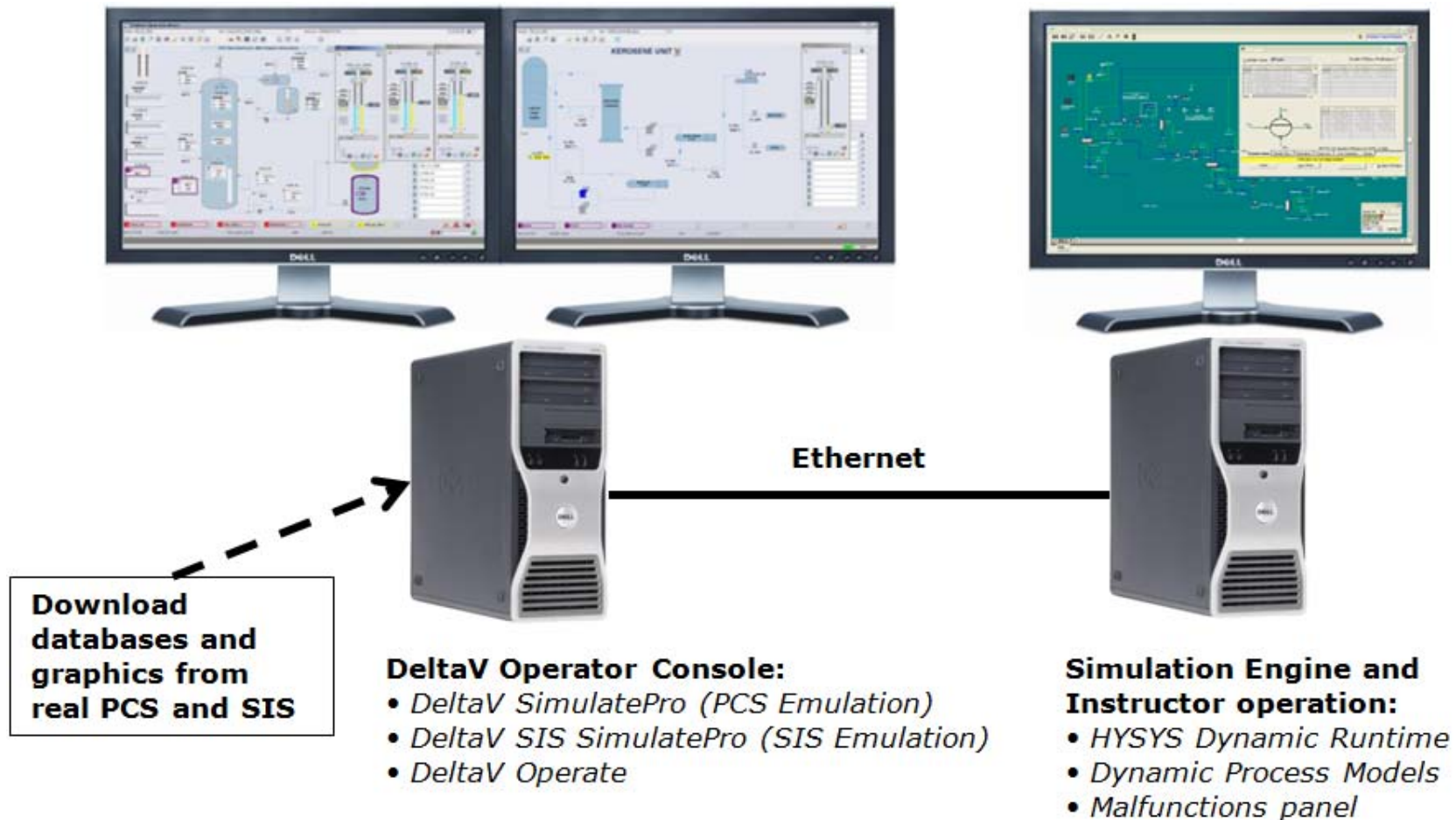


Simulation Scope Train I

- Equipments: 68
- Isolation valves: 55
- Control valves: 38
- Relief valves: 55
- PID loops: 56
- I/O Count: 800



OTS HARDWARE ARCHITECTURE

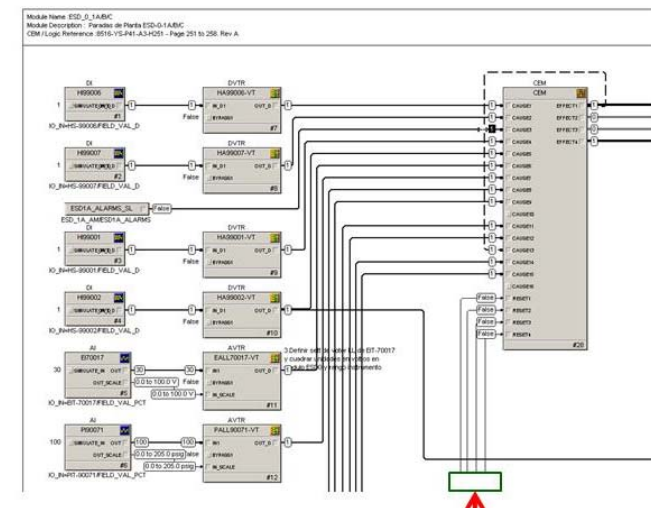


OTS ACTUAL SETUP



DCS DATABASE

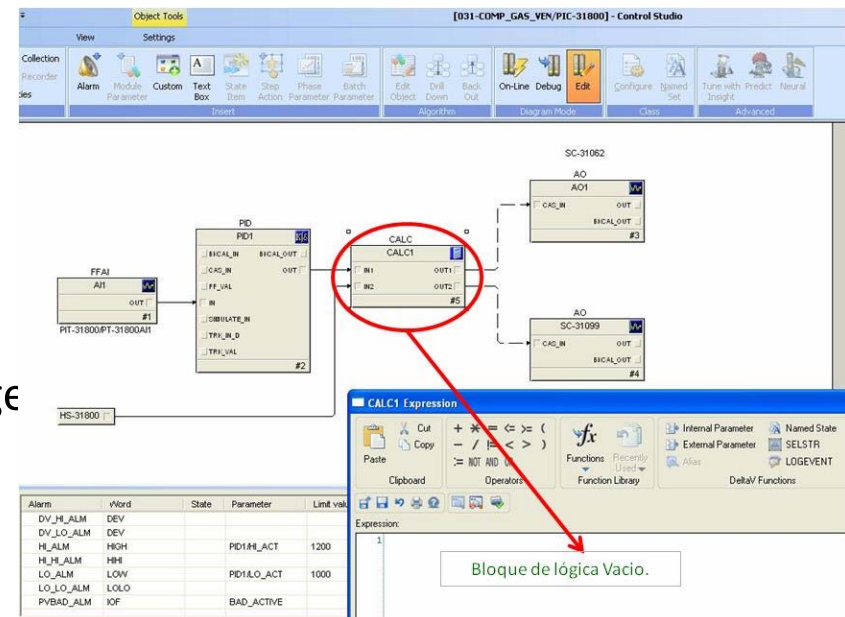
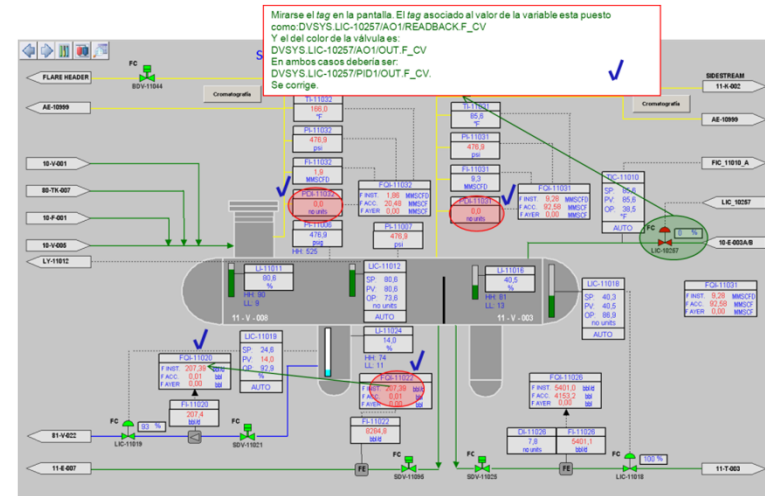
- Types of modules:
 - Control Modules. Associated to controllers and indicators inside the control logic of the plant areas under model scope
 - SIS Modules. Associated to the plant safety logic. Only the ones that affect the modelled areas.
 - Modules grouped by working areas



DCS DATABASE CHECKOUT

List of problems detected:

- Problems with the screens
- Problems with Controllers tuning
- Problems with alarms in controllers and indicators
 - Wrong limits trip spurious alarms together with signal noise that could trip ESD.
- Configuration of modules
 - Control modules configurations generated wrong signals affecting other modules that generate range deviations and could trip ESD.



KEY FINDINGS OF THE DCS CHECKOUT

- The OTS was configured with the post-FAT database and several items were revised:
 - 30% PID control action change, direct/reverse
 - Re-tuning of all Kp and Ti of all loops
 - Slug-catcher level control, control logic modified
 - Logic control verification of external DCS packages (Compressors)
 - Interlock in blowdown valves after identify issues in manual operation
 - Timing of SIS valves were verified
 - Redefine alarms limits (more than 50%)
 - Minor bugs of DCS operator screens

TRAINING SCENARIOS DESCRIPTION

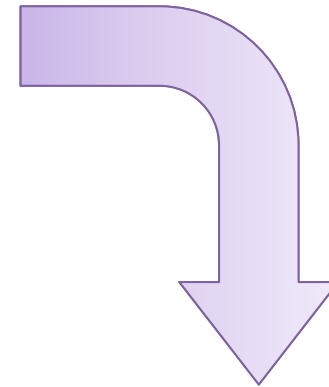
#	Scenario description
1	Trip of Sales Gas Compressor
2	Shutdown of Sales Gas Compressors due to a High Pressure Alarm in the export line
3	Fire in separator V-002-A/B, ESD activation and depressuring valve opening (according to Cause and Effect Matrix)
4	Sudden stop of EPF
5	Hot oil loss in stablizer reboiler
6	Trip of recycle gas compressor
7	Trip of one propane compressor
8	Plant adaptation to 50% throughput by only manipulating the load to the sales compressor, without affecting the operation of EPF

OTS IN PLACE AND IN OPERATION

- OTS currently in operation in the plant, being used by plant operators/engineers for operating procedures
- Operators were trained on safe and optimized procedures for all scenarios
- Incidents and equipment damages are being minimized
- Second phase of the project is currently being carried out in order to expand the scope of the first model with new Train II

OTS BENEFITS

1. Identify unit or process operating constraints at design phase
2. Identify errors in the automation system before commissioning and operation
3. Verify/Improve operating procedures
4. Train operators on safe and optimized procedures for all scenarios



1. Begin startup sooner
2. Complete startup in less time
3. Improved steady operating rate and product quality
4. Minimize incidents and equipment damages

RECAP

- Uses of Dynamic Simulation
- What are Operator Training Systems
- Additional value: DCS Check-Out
- Case Study: E&P facility
- Detected DCS problems
- OTS Benefits

QUESTIONS, CONTACT

Q&A

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