Simulator Products & Services Overview

SimGenics

Company

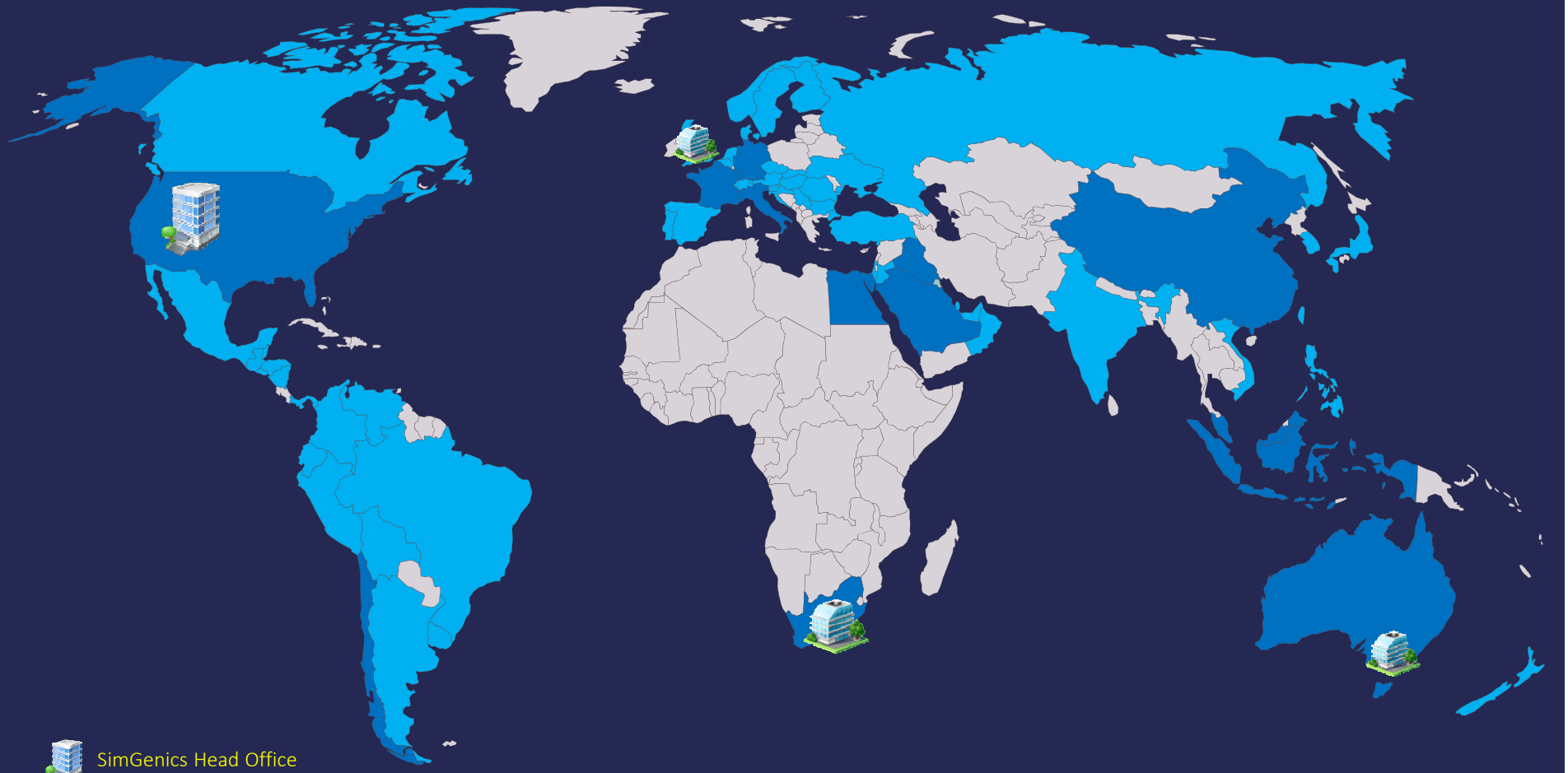
SimGenics' founding members have worked in the Simulator Industry since the 1980's

In 2006, Professional Simulation Services (Pty) Ltd. a company that was dedicated to developing full-scope Training Simulators in the Power Industry merged with M-Tech Industrial's Simulator Division to form Samahnzi (Pty) Ltd.

Since its founding, Samahnzi accelerated the delivery of high-fidelity, full-scope Training and Engineering Simulators and also established offices in the United States (Samahnzi US LLC) and Australia (Samahnzi Australia Ltd.)

In 2015, Samahnzi US merged with SimGenics LLC, a US corporation, creating a Simulation and Training company that does not only offer customers the full spectrum of Plant Simulation (Control Room and 3D/Virtual Outside Plant), but also unrivalled Training Services.

SimGenics Locations



SimGenics Head Office

SimGenics Branch/Engineering Office

SimGenics

Recent Projects (Fossil and Other)

Coal/Oil/Gas -	Camden, Tutuka, Kusile, Hendrina, Lethabo, Arnot, Matla, Duvha, Medupi (Contracted by RDE) – SA Spurlock, Wygen, Hunter, Prairie State, Neal - USA Manjung – Malaysia, El Ain El Sokhna – Egypt Le Havre, Cordemais – France, Cedar Bayou – USA
Combined Cycle	Attala (MS), Greater Des Moines Energy Center (IA)- USA Az Zour/Sabiya, Kuwait, Red Bud – USA, Rio Bravo – Mexico, Lichterfelde - Germany
Desalination	Marafiq – Saudi Arabia
Petro-Chemical	Several clients in Middle East, Asia, and North America

PSS/Samahnzi/SimGenics established ties with many major global simulation companies and developed SimuPACT to incorporate the best elements of existing vendors, including GSE, RDE, WSC, Invensys Simsci-Esscor, Thomson-CSF (CORYS)

SimGenics

Experience (Nuclear)

1. Pebble Bed Modular Reactor

- Basic Simulator: (1998)
- Full Scope Training Simulator (2005-2009).
  This project included the complete Verification and Validation (V&V) process according to IEEE standards.
- Helium Test Facility (2006)

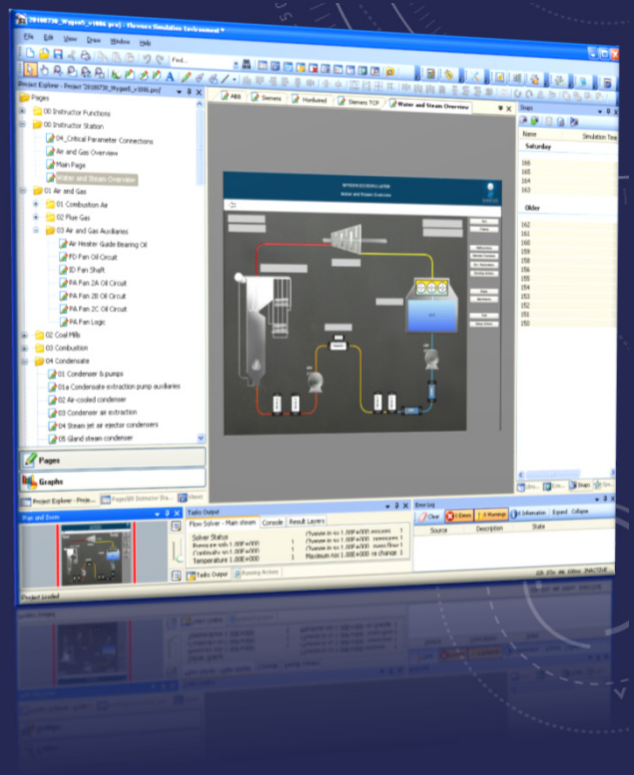
2. Pressurized Water Reactors

- Koeberg Power Station (1990-92):
  - Simulation Software: Thomson-CSF
  - 2 of our current employees worked on this project
- Necherwestheim Power Station (1994-1996):
  - Simulation Software: Thomson – CSF
  - 1 of our current employees worked on this project
- Japan: (2010-2011):
  - Sub-contract with GSE (Sweden)
  - 1 of our employees is currently part of the simulator team.

SimGenics

Why Choose SimuPACT?

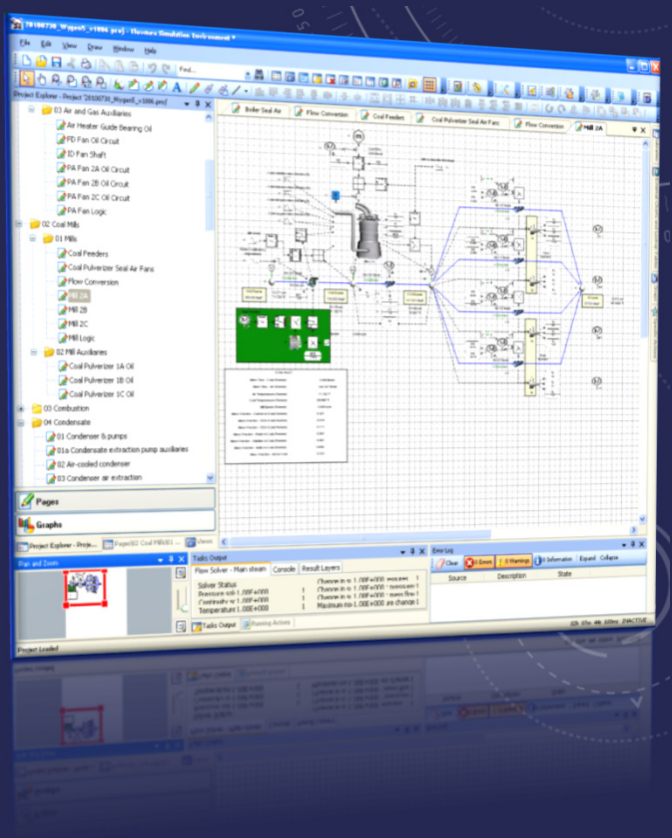
- Includes all essential capabilities to build full-scope high-fidelity Training Simulators:
  - Process modeling
  - Control modeling and linking to 3rd party systems
  - Operator interface
  - Instructor functionality
- User interface built on newest technology is extremely easy to use and substantially decreases time needed to complete simulators.
- SimuPACT use the proven Flow Solver, Flownex that is used for engineering design and analysis in industry.
- First principles Flow Solver allows re-use of design models in simulators and significant cost and time savings



SimGenics

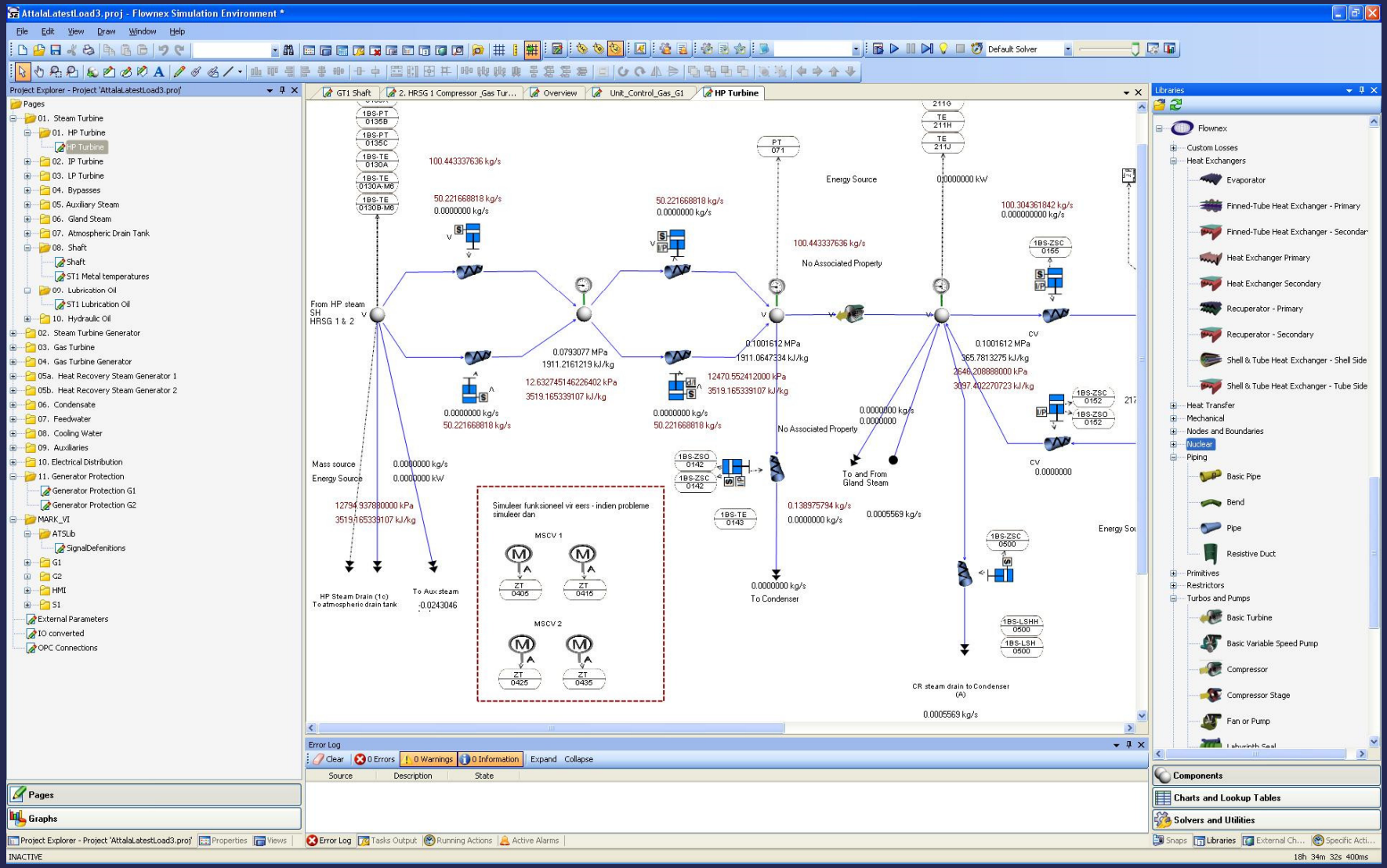
Why Choose SimuPACT?

- Used not only for training simulators but also for Engineering Simulators
- Extremely open and flexible architecture allows limitless user solvers, models and tools
- Open architecture allows users to customize and extend all aspects of the software and user interface
- Complete API allows SimuPACT to be integrated seamless in existing systems
- Most user coding is written using a very friendly user interface – very short learning curve
- Multiple levels of parallelization and leveraging of multi core processor technology



SimGenics

SimuPACT User Interface



Full-Scope Simulator Building Blocks

- Process Models running on Real-Time First Principle Mathematical Solvers
  - High-Fidelity Water/Steam/Air/Gas System Models (SimuPACT)
  - Electrical Reticulation Model (SimuPACT)
  - Sensor and Actuator Models (SimuPACT)

- Control System and Operator Interface
  - Unit Control System (SimuPACT or 3rd party)
  - Turbine Control System (SimuPACT or 3rd party)
  - Turbine, Boiler and Generator Protection Systems (SimuPACT or 3rd party)
  - Human Machine Interface (HMI), including Alarm Handling
    - Computer-based (SimuPACT or 3rd party)
    - 'Hard' Panels and Mimics (SimuPACT or 3rd party)

- Instructor Station
  - Control Simulator Execution (SimuPACT)
  - Initiate and Control Malfunctions and Scenarios (SimuPACT)
  - Trainee Performance Measurement (SimuPACT)

- Hardware
  - Process Model Server
  - Control System and Operator Interface Server
  - Instructor and Operator Workstations
  - Simulator Room

SimGenics

SimuPACT Process Modelling

- **Simulation Libraries in Samahnzi's SimuPACT process simulation package**
  - Multi-Phase Flow with Incondensable Gases and Trace Elements (Pipes, Tanks, Valves, Heat Exchangers, Pumps, Turbines, etc.)
    - Steady state and transient analyses
    - Fundamental approach, i.e. solves compressible flow with choking, Joule Thomson effect, thermal inertia etc.
    - Conjugate heat transfer (Primitives)
    - Turbo-machine power matching
  - DCS Libraries, Translators and Emulators (Details covered later in presentation)
  - Integration with 3D PACT (Input and Output)
  - Electrical Networks
  - Logic and Control Networks (Basic and Advanced)
  - OPC Client (Integration to 3rd Party Control and HMI Systems)
  - Mechanical (Shafts, Gearboxes, Bearings etc.)
  - Sensors and Actuators
  - Materials Handling (including Slurry Flow)

SimGenics

SimuPACT Process Modelling

- **Simulation Libraries in Samahnzi's SimuPACT process simulation package (Cont.)**
  - Fossil Power (Drum, Benson, Super-Critical, Fluidised Bed Boilers, HRSG's. Various types of Coal Mills, Oil/Gas/Coal Burners, etc.)
  - Gas (Combustion) Turbines (Siemens, GE, Alstom), Steam/Water Turbines (Siemens, GE, Alstom) with multiple leak-offs
  - Nuclear Power (3D Diffusion Model)
  - Chemical Reaction Builder (Empirical)
  - HMI and Local Control Panel Emulation
  - Integrated C# Scripting Engine
  - Integration library with Aspen Materials Database
  - Full Instructor Station Capability, including Virtual Instructor
  - Multi-core, Multi-PC deployment (i.e. can have various operator station and instructor station PCs connected to the process simulation server PC over a network)

SimGenics

Analysis of DCS Simulation Types

Fully Stimulated

Uses DCS hardware
Exact copy of control System
HMI's & controls
Stimulated by model

Hybrid

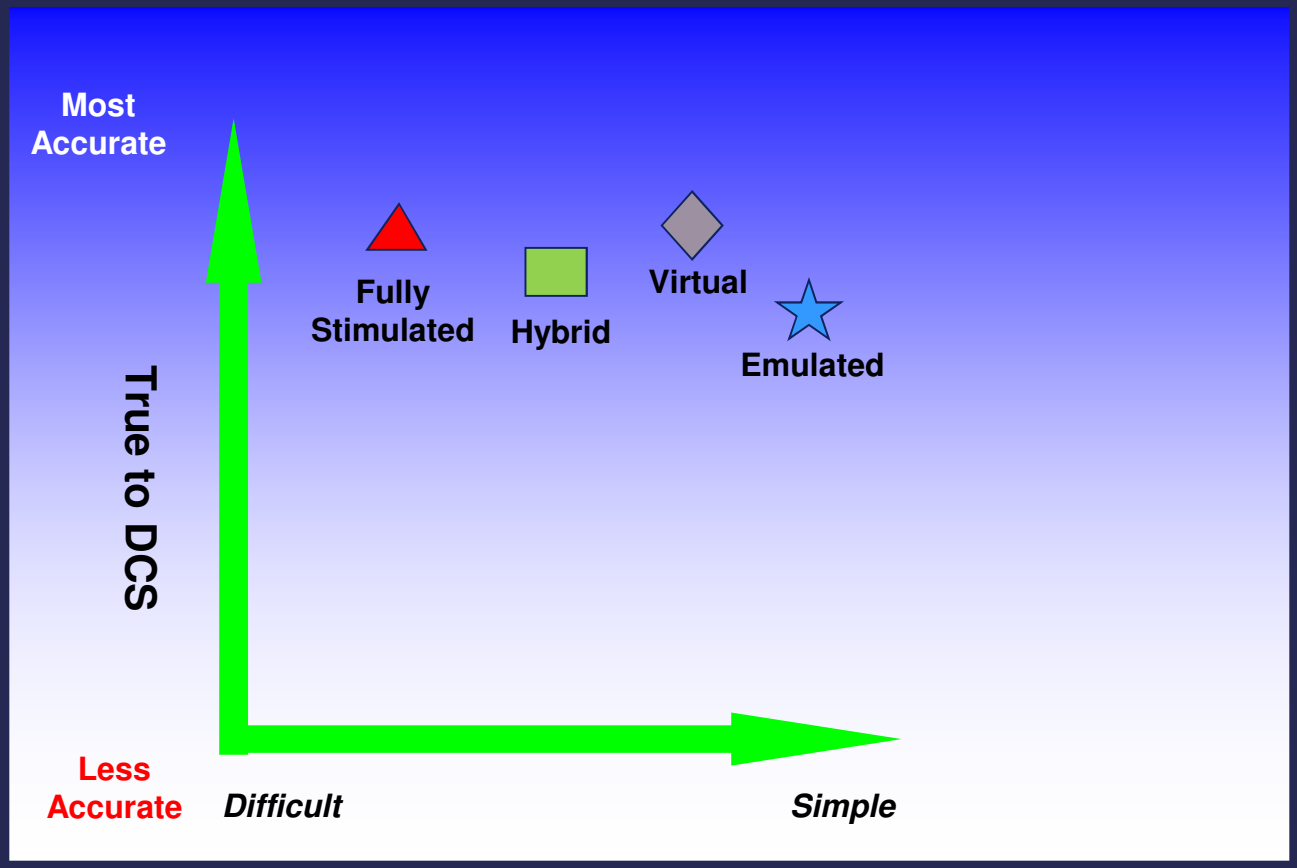
Control system translated
Uses same DCS HMI's

Virtual

Actual control system
Running on PC's
HMI's & controls
stimulated by models

Emulated

HMI's & controls translated
Requires custom DCS translation software

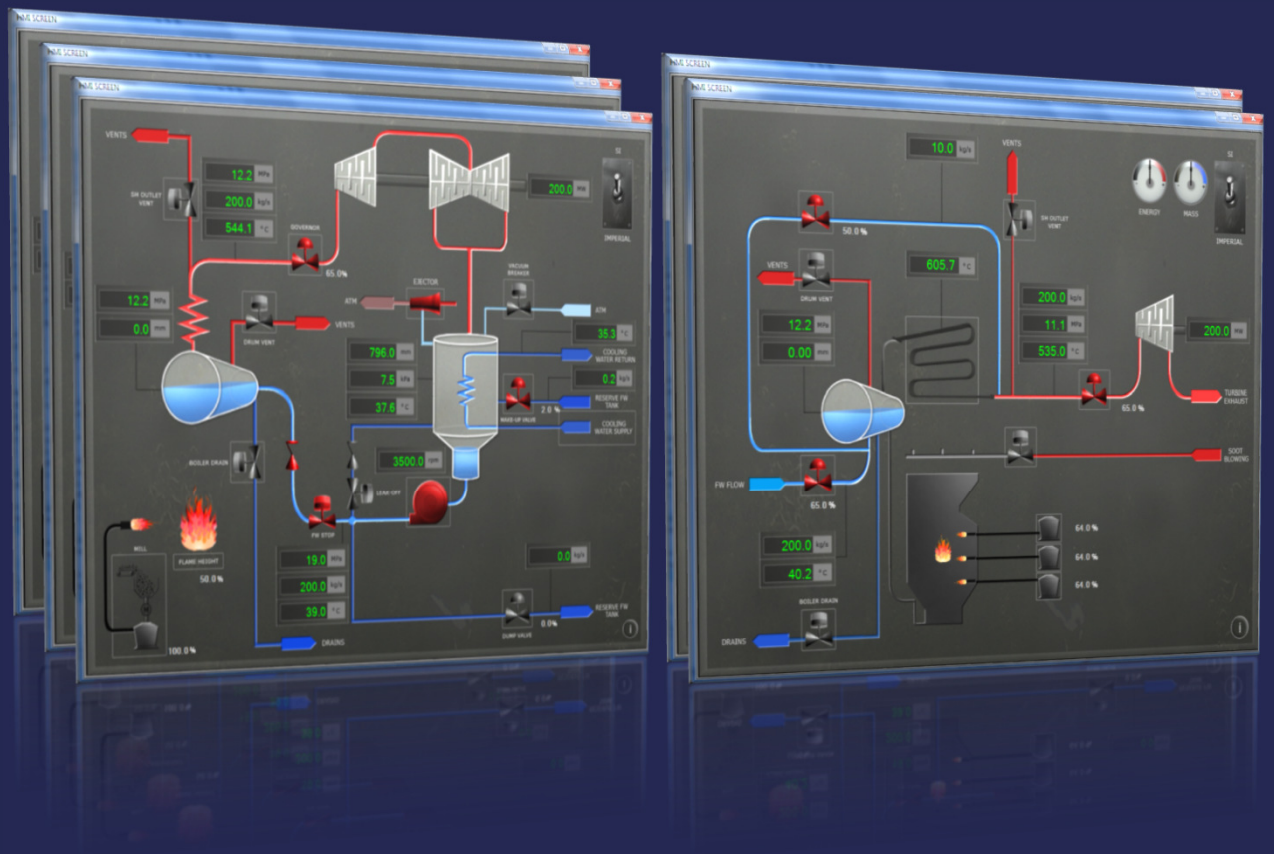


Simulation Functionality, Implementation & Maintainability

SimGenics

Diagram element definitions courtesy Emerson Process Management

Control System Integration

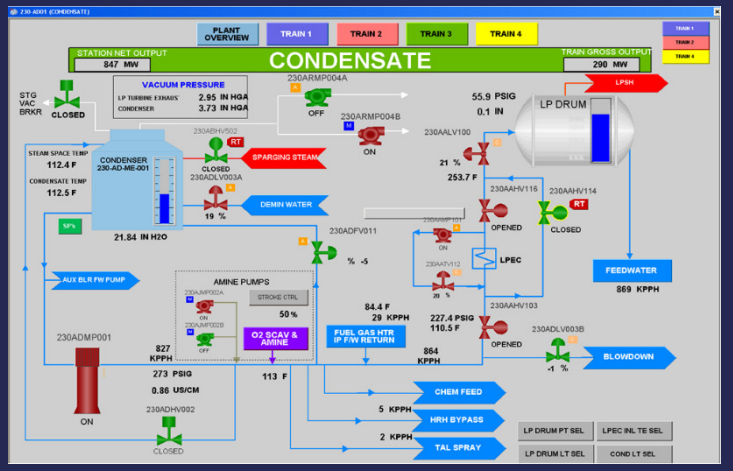


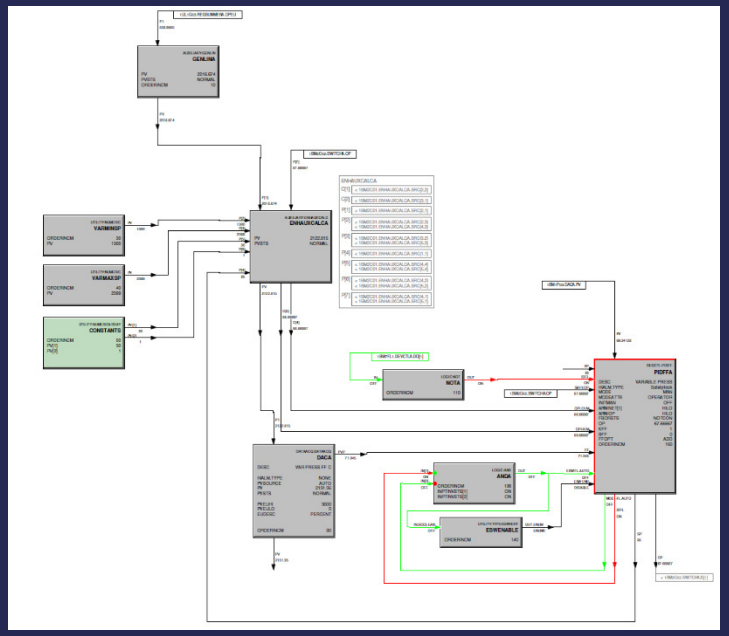
SimGenics

Control Systems Integration Options

Control Systems (DCS) and Operator Interface (HMI)

- Emulated in SimuPACT or linked to a 3rd party system
- Unit Control System (SimuPACT or 3rd party)
- Turbine Control System (SimuPACT or 3rd party)
- Turbine, Boiler and Generator Protection Systems (SimuPACT or 3rd party)





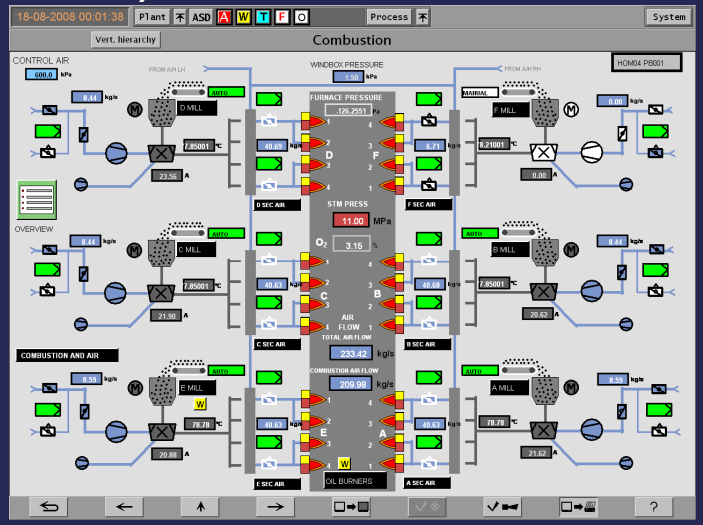
Executive Summary

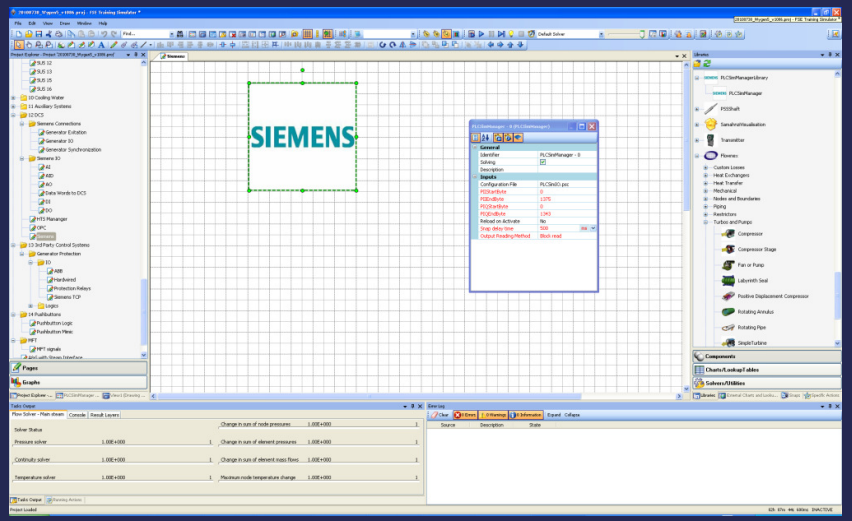
- SimuPACT provides the ability to:
  - Link to existing control systems or emulators via OPC
  - Link to existing control systems or emulators via vendor specific interfaces
  - Emulate entire control systems within SimuPACT
  - Allows users to write user code to link to their own proprietary control systems or emulators
  - SimuPACT development team can develop new links or emulators for users
- Wide array of control system options already available reduces project time
- The ability of SimuPACT to emulate entire control systems can save huge amounts in licensing costs
- Vendor specific control interfaces and emulation prices available on request

SimGenics

Siemens Control System Integration

- Siemens PCS7 - Interface to Full Emulator (Siemens PLCSim with WinCC)
- Siemens S7 Library – Lower cost solution to emulate PLC systems
- Siemens Teleperm ME Emulator via EON (Limited)
- Siemens Teleperm XP/T2000 - Full TXP Emulator via EON (AS and OS)
- Siemens AS620T - Emulation Library to reproduce AS620T Turbine Control and Protection System
- Siemens T3000 – Interface to Full T3000 Emulator (Siemens supplied) and also translator for full emulation of T3000 DCS and HMI inside SimuPACT environment (lower cost solution)

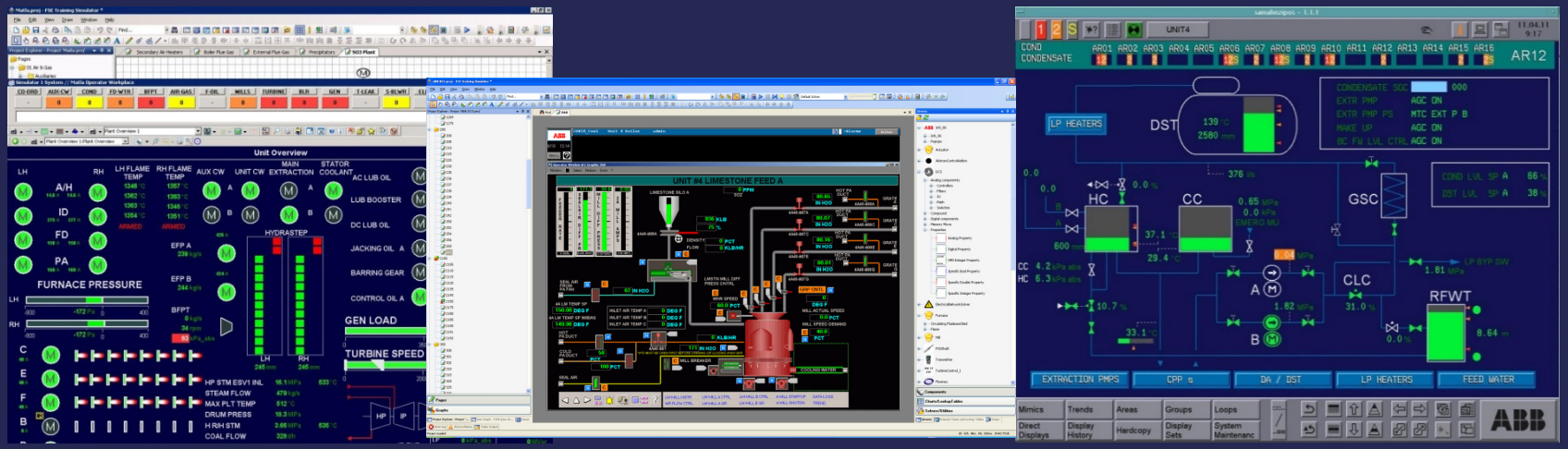




SimGenics

ABB Control System Integration

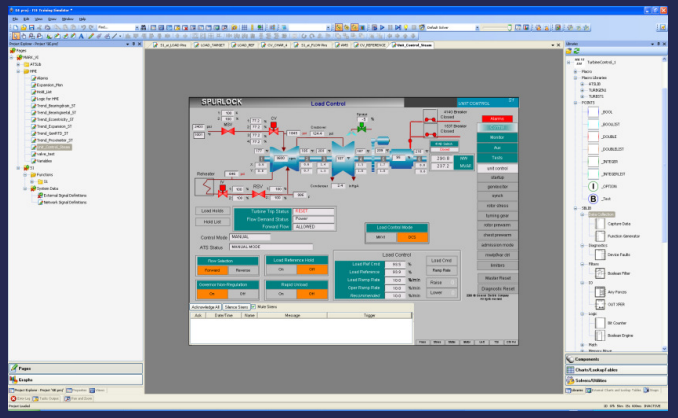
- ABB IndustrialIT 800xA (with or without the ITS add-on) - Interface to Full Emulator of AC800M and/or Melody AC870P Control System with 800xA HMI
- ABB Harmony Training System - HTS (Bailey Infi 90) - Interface to Full Emulator
- ABB Infi 90 - Translator to reproduce Control System from actual plant
- ABB Harmony HMI - HMI Emulation Library to reproduce ABB HMI
- ABB POS30 Translator and emulator allowing actual plant database to be used to automatically generate the HMI for the Simulator
- ABB P13/P14 – Translator to reproduce P13/P14 Control System from actual plant
- ABB AC450/AC160 – Translator to reproduce Control System from actual plant

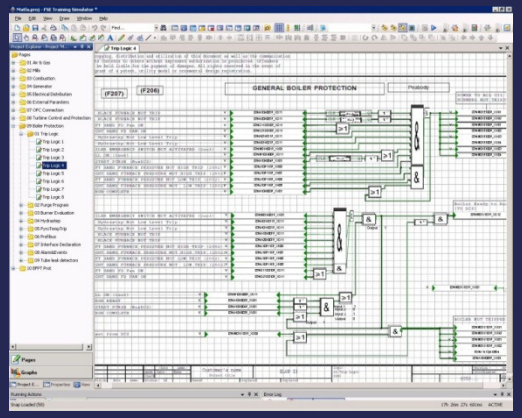


SimGenics

Other Control System Integration

- GE Mark VI and VIe with Cimplicity HMI- Full Emulator - Translator to reproduce control and HMI System in SP
- Foxboro I/A - Translator to reproduce control and HMI System in SP
- Alstom ALSPA P320 - Translator to reproduce control and HMI System in SP
- Honeywell Experion > PKS R400 – Translator to reproduce control and HMI System in SP
- Emerson Ovation – Translator to reproduce control and HMI System in SP
- Hitachi & Mauell TCS, Yokogawa BMS, HIMA Boiler Protection, Woodward 505 and Others

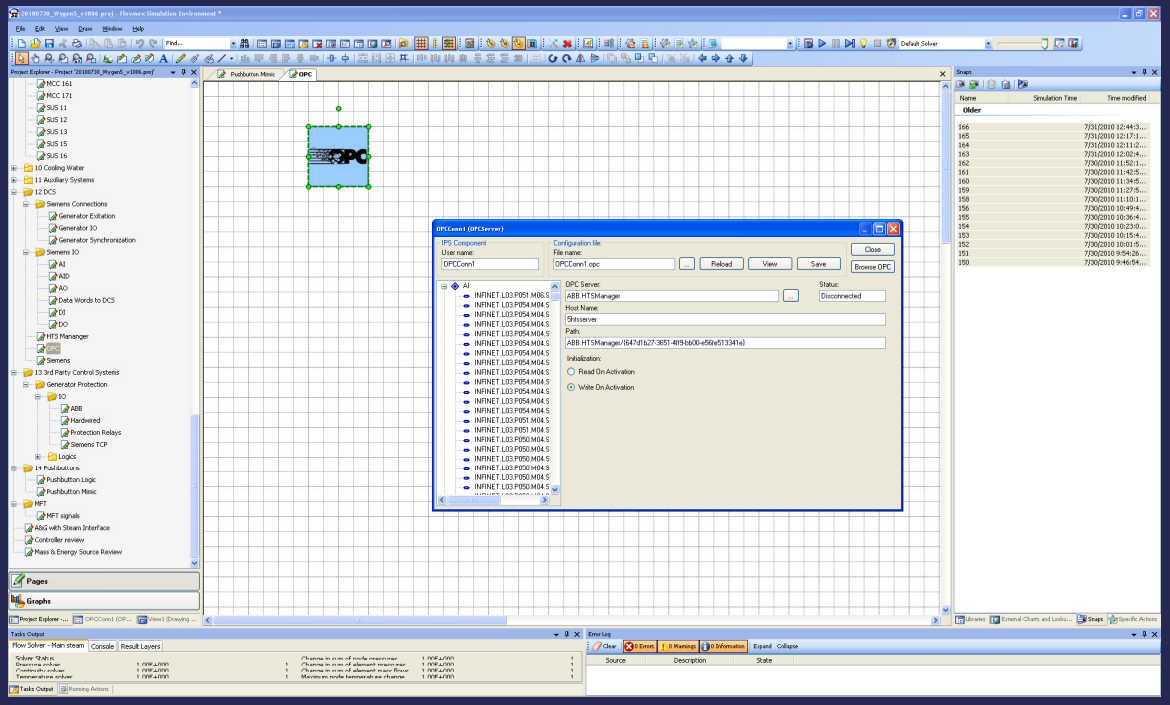




SimGenics

OPC Support

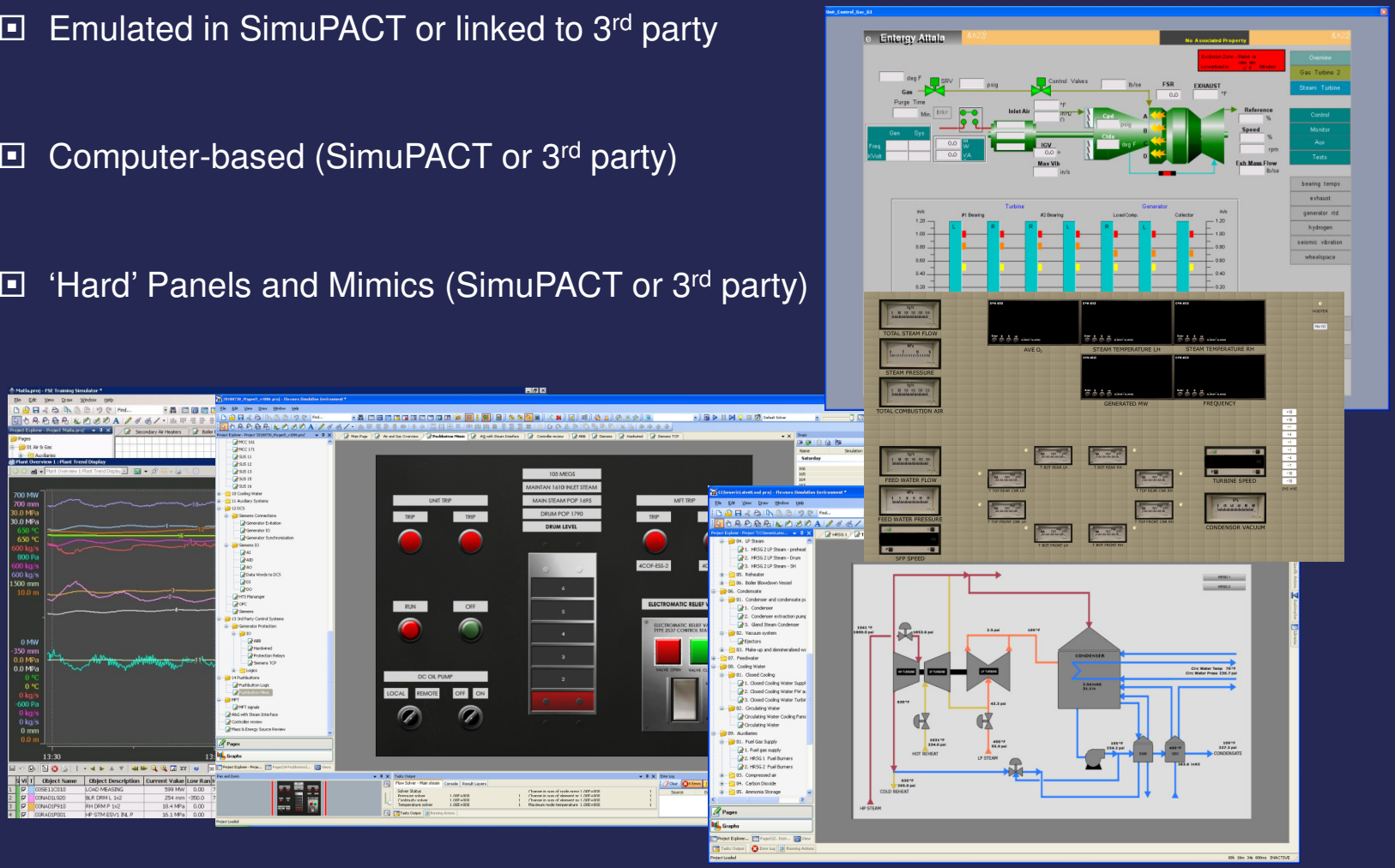
- OPC Library allows SimuPACT to connect to any OPC aware control system
- SimuPACT includes a comprehensive generic control system library



Operator Interfaces (HMI)

Human Machine Interface (HMI), including Alarm Handling, Trending, Multi Monitor Support

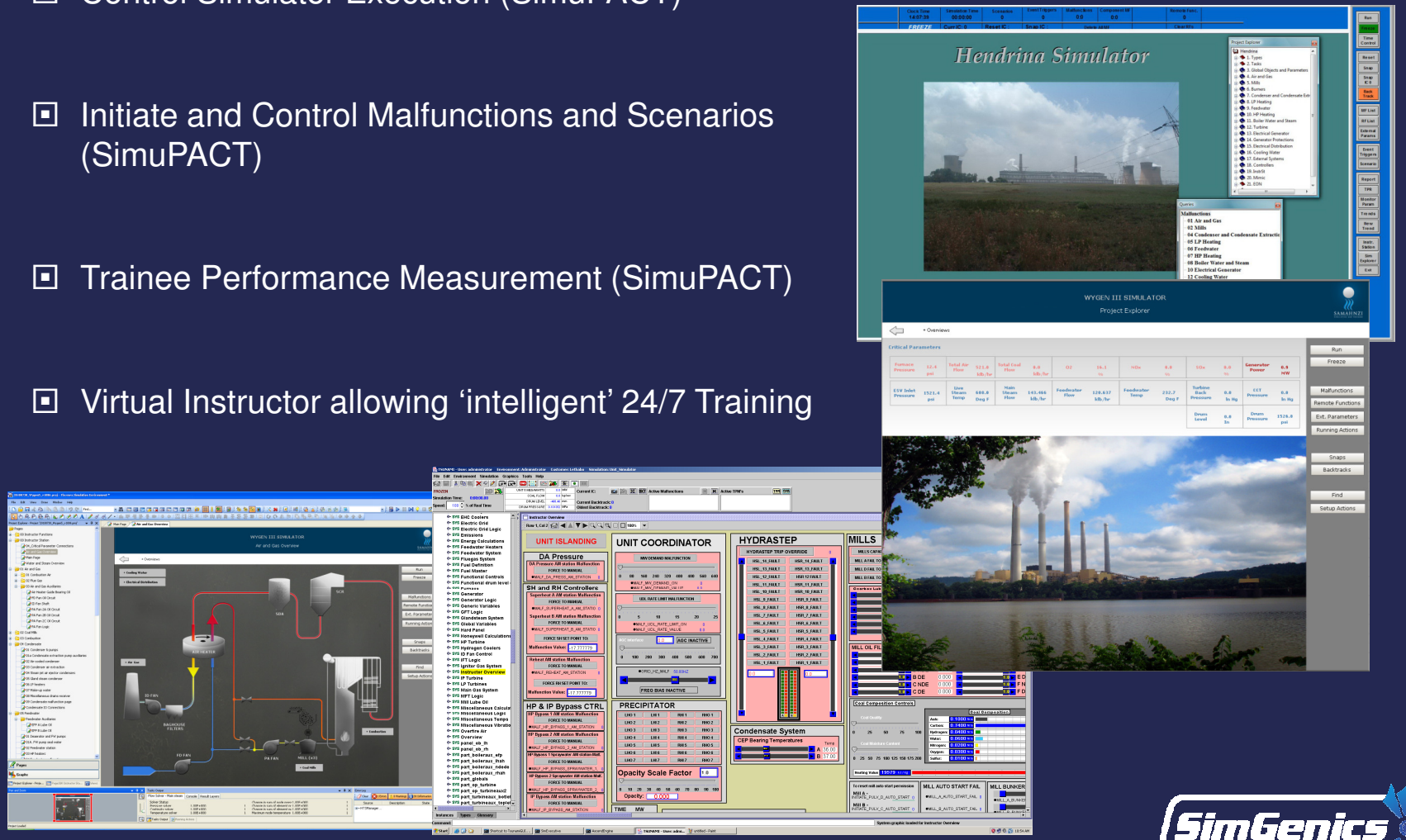
- Emulated in SimuPACT or linked to 3rd party
- Computer-based (SimuPACT or 3rd party)
- ‘Hard’ Panels and Mimics (SimuPACT or 3rd party)



Instructor Station

Instructor Station

- Control Simulator Execution (SimuPACT)
- Initiate and Control Malfunctions and Scenarios (SimuPACT)
- Trainee Performance Measurement (SimuPACT)
- Virtual Instructor allowing ‘intelligent’ 24/7 Training



SimGenics

Virtual Instructor (VI)

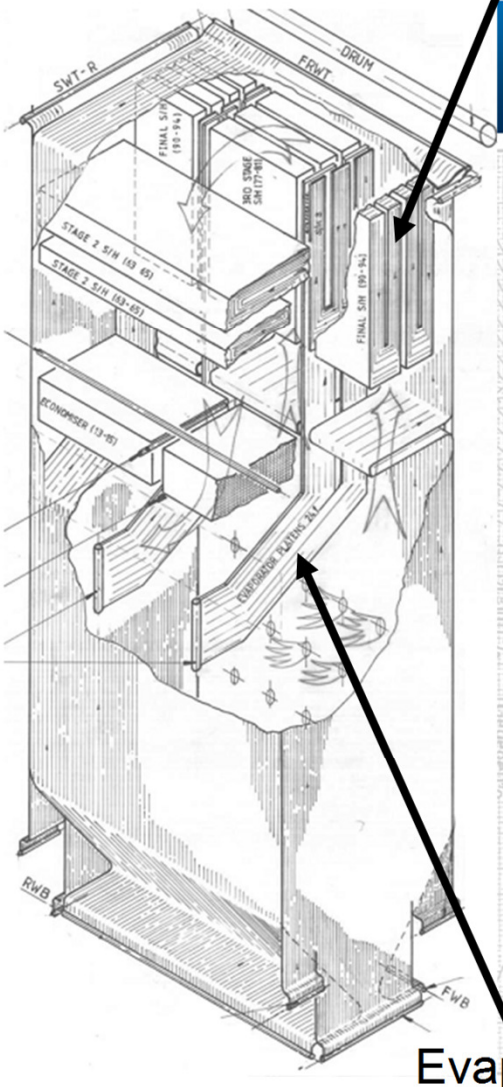
- Easily create interactive training modules that guide the trainee through an operating procedure, and optimize knowledge capture from experienced staff

- Unrivalled Trainee Performance Measurement (TPR) options:
  - Instructor can compile elaborate performance requirements for trainee to comply with while executing procedures/scenarios
  - Out Of Bounds (OOB) Monitor to ensure trainee never receives negative training
  - Tutorial (TUT) messages to assist trainee during training sessions, with flexible scoring penalties if assistance is required during test situations

- Instructorless 24/7 training possible using the VI's powerful scenario/procedure builder

SimGenics

Flownex Model of Boiler (Flow Components)



Super heaters

Drum

Headers

Steam side

Water walls

Flue gas side

Evaporative platens

Steinmüller

CFD linked to SimuPACT

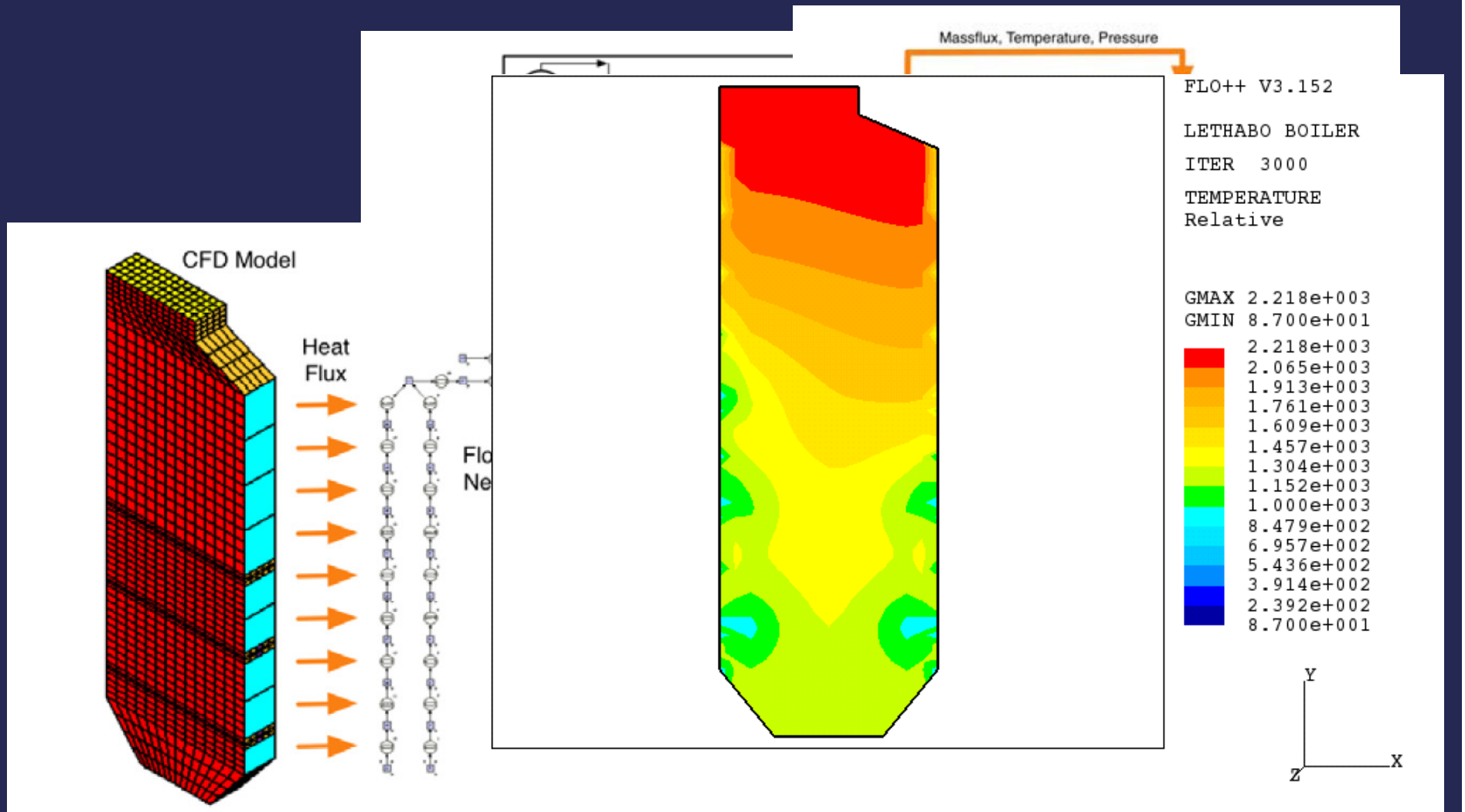
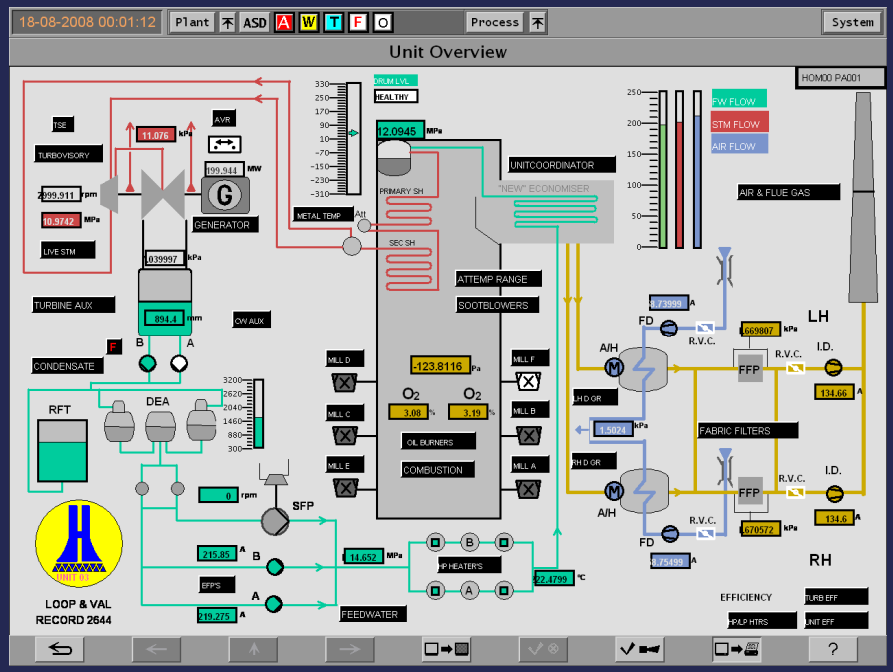


Figure 4 : Element and cell based information exchange iler thermal circuit

Simulator Examples
200 MW Drum Boiler

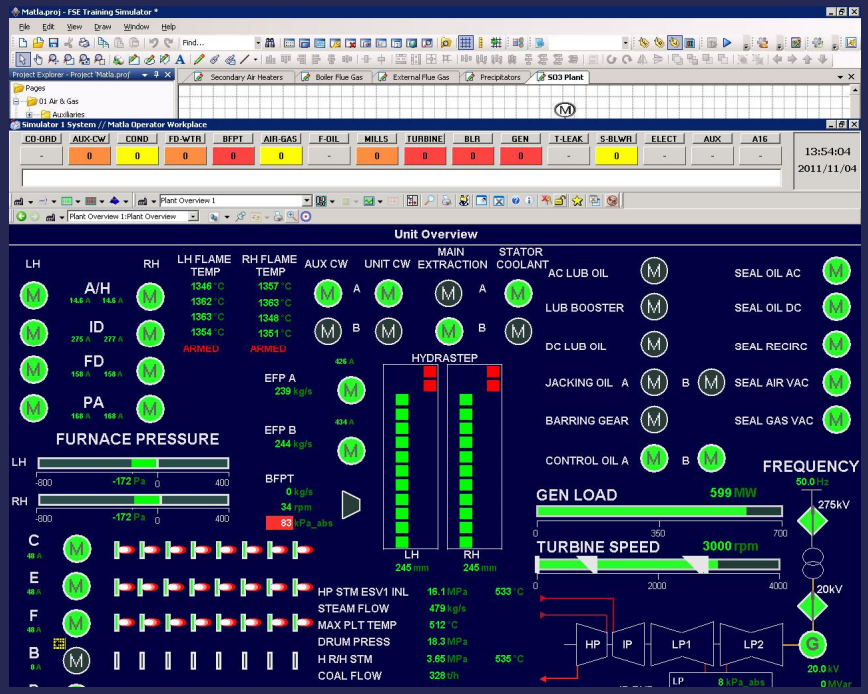
	200 MW Drum Boiler Unit
Similar Eskom units	*Hendrina*, Grootvlei, *Camden*, *Arnot*, Wygen
Distributed Control System	Siemens Teleperm XP (EON) Siemens T3000 (S3000) ABB P13/14 & 800xA (SP) ABB Harmony/PPB (ABB)
Turbine Control/Protection	Woodward 505 Gov (SP) Siemens S7 (SP) Siemens PCS7 (PLCSIM/WinCC)
Boiler/Furnace	Economizer, Single Drum 2 SH, No Reheat
Mills	6 Vertical Spindle Type
Burners	4 per Mill
Fans	2 FD, 2 ID One PA per Mill
Steam Pressure (at Turbine main stop valves)	11 MPa
Steam Temperature	540 ℃
Max Steam Flow	200 kg/s
Steam Turbine	1 HP, 1 LP No Reheat, 6 Extractions
Generator	222 MVA
Feedpumps	2 EFP, 1 SFP (BFPT)
Condensate/Feedwater Heaters	GSC, DDC, 2 LP, Deaerator 3 HP



SimGenics

Simulator Examples
635 MW Drum Boiler

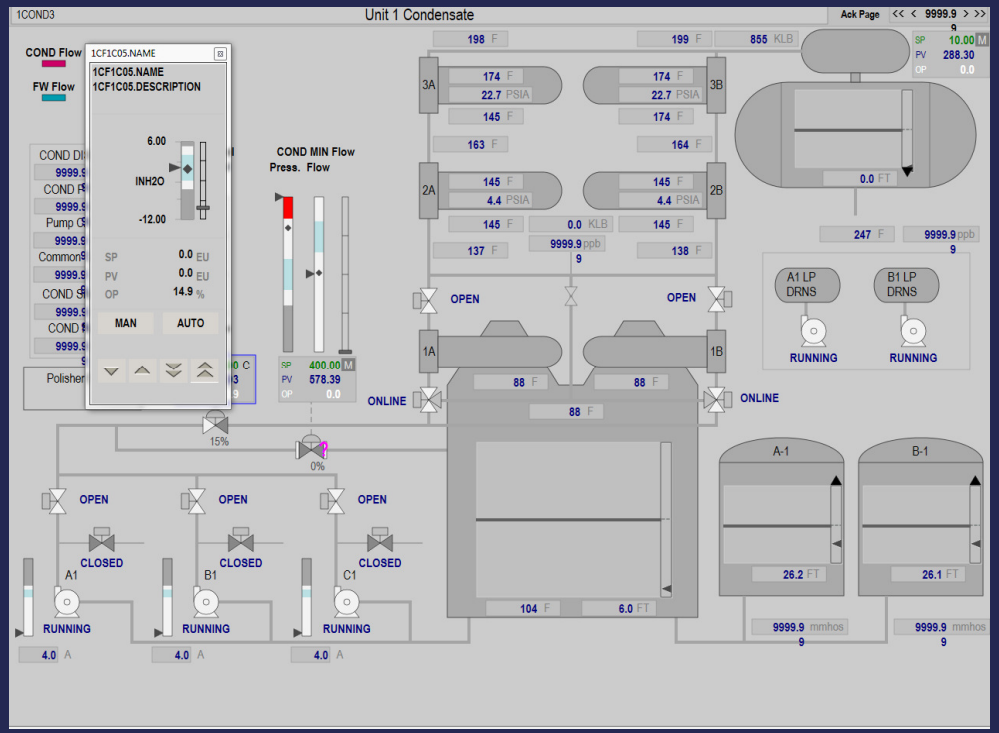
	635 MW Drum Boiler Unit
Similar Eskom units	*Lethabo*, Matla
Distributed Control System	ABB 800xA with Melody AC870P (ABB)
Turbine Control/Protection	Mauell
Boiler/Furnace	Economizer, Single Drum 3 SH, 2 RH
Mills	6 Vertical Spindle Type
Burners	6 per mill
Fans	2 FD, 2 PA, 2 ID
Steam Pressure (at Turbine main stop valves)	16.1 MPa
Steam Temperature	535 ℃
Max Steam Flow	500 kg/s
Steam Turbine	1 HP, 1 IP, 2 LP 6 Extractions
Generator	700 MVA
Feedpumps	2 EFP, 1 SFP (BFPT)
Condensate/Feedwater Heaters	GSC, 3 LP, Deaerator 2x2 HP



SimGenics

Simulator Examples
700 MW Drum Boiler

	700 MW Drum Boiler Unit
Units	*Gerald Gentleman Station, Nebraska, USA*
Distributed Control System	Honeywell Experion (SP) Foxboro I/A (SP)
Turbine Control/Protection	Triconex (SP)
Boiler/Furnace	Economizer, Single Drum 3 SH, 2 RH
Mills	8 MPS 89 (Roll Wheel) Type
Burners	4 per mill
Fans	2 FD, 2 PA, 2 ID
Steam Pressure (at Turbine main stop valves)	18 MPa
Steam Temperature	540 ℃
Max Steam Flow	550 kg/s
Steam Turbine	1 HP, 1 IP, 2 LP 6 Extractions
Generator	757 MVA
Feedpumps	2 EFP, 2 SFP (BFPT)
Condensate/Feedwater Heaters	GSC, 2x3 LP, Deaerator 2x3 HP



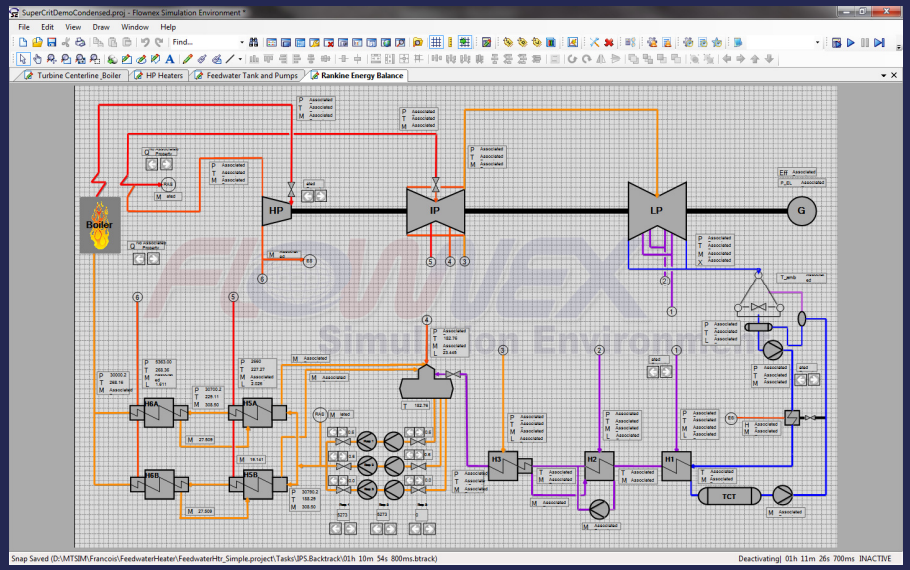
SimGenics

Simulator Examples
609 MW Benson (Subcritical)

	609 MW Benson Boiler Unit (Once-Through)
Similar Eskom units	*Tutuka*, *Duvha*, Kriel
Distributed Control System	Siemens T3000 (S3000) ABB ProControl P14 (SP) POS30 (SP)
Turbine Control/Protection	ABB ProControl P14 (SP)
Boiler/Furnace	Once-Through Benson Type Economizer, 4 SH, 2 RH
Mills	6 Ball Type
Burners	6 per mill
Fans	2 FD, 2 PA, 2 ID
Steam Pressure (at Turbine main stop valves)	16.1 MPa
Steam Temperature	535 ℃
Max Steam Flow	500 kg/s
Steam Turbine	1 HP, 1 IP, 2 LP 6 Extractions
Generator	700 MVA
Feedpumps	2 EFP, 1 SFP (BFPT)
Condensate/Feedwater Heaters	GSC, DC, 3 LP, Deaerator 2x2 HP

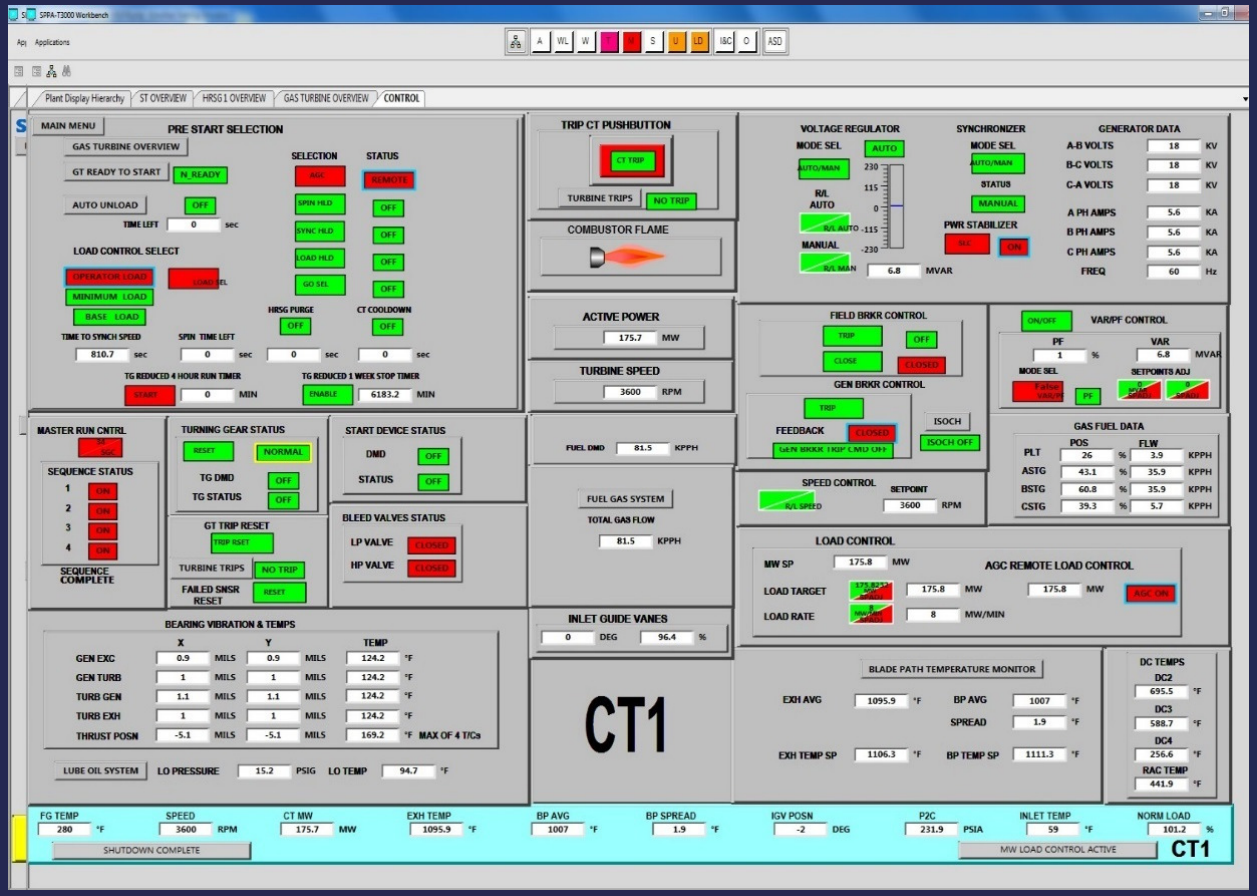
Simulator Examples
795 MW Benson (Supercritical)

	795MW Super critical Boiler Unit (Once-Through)
Similar Eskom units	*Medupi, Kusile*
Distributed Control System	Alstom ALSPA P320 (SP) ABB 800xA with AC870P (ABB)
Turbine Control/Protection	Alstom ALSPA P320 (SP)
Boiler/Furnace	Once-Through Supercritical Type Economizer, Evaporator, 3 SH, 2 RH
Mills	5 Vertical Wheel Type
Burners	6 per mill
Fans	2 FD, 2 PA, 2 ID
Steam Pressure (at Turbine main stop valves)	24.1 MPa
Steam Temperature	560 °C
Max Steam Flow	617 kg/s
Steam Turbine	1 HP, 1 IP, 2 LP 6 Extractions
Generator	900 MVA
Feedpumps	3 EFP
Condensate/Feedwater Heaters	GSC, DC, 3 LP, Deaerator 2x2 HP



Simulator Examples
320MW Combined Cycle

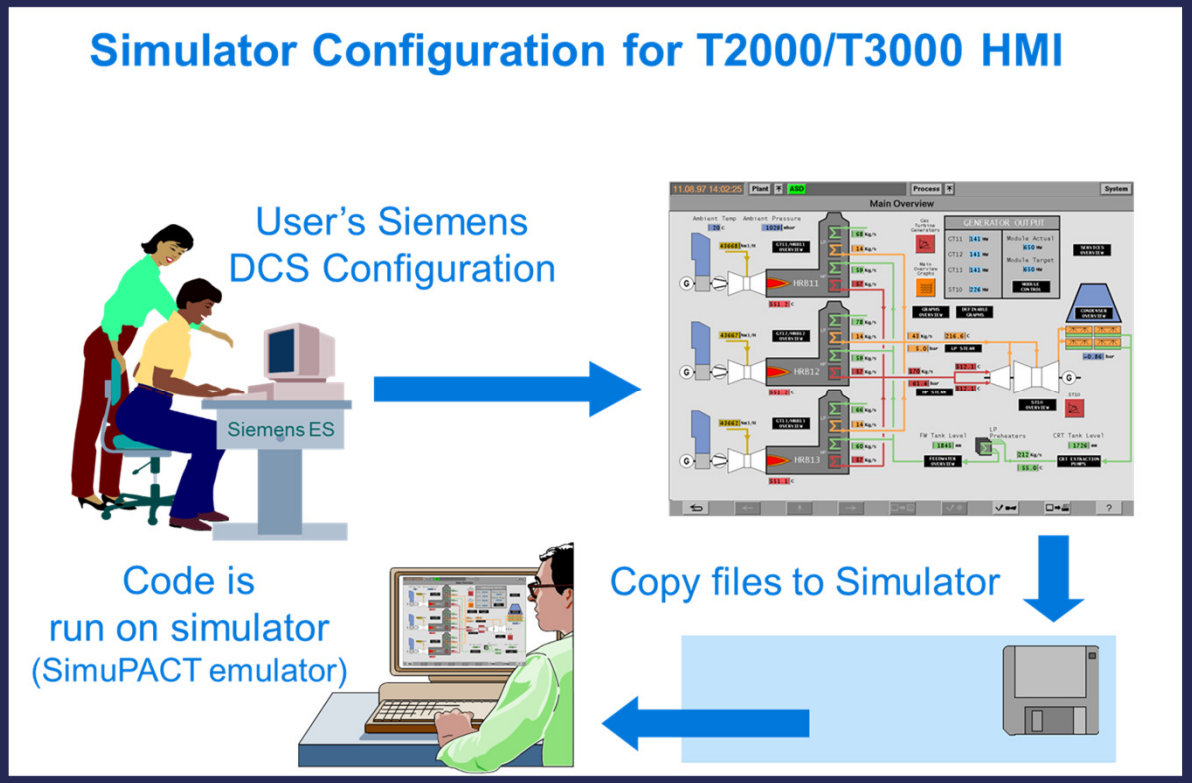
Siemens T3000 – Using full-scope SimuPACT emulation



SimGenics

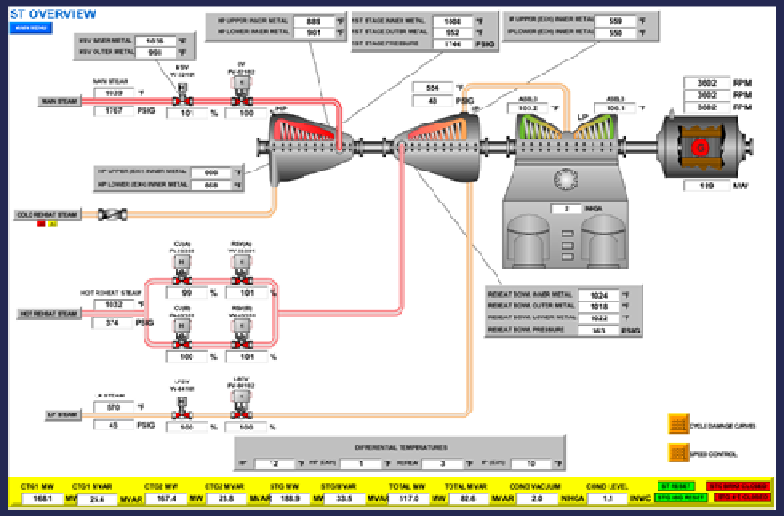
Simulator Examples
320MW Combined Cycle

Siemens T3000 – Using full-scope SimuPACT emulation

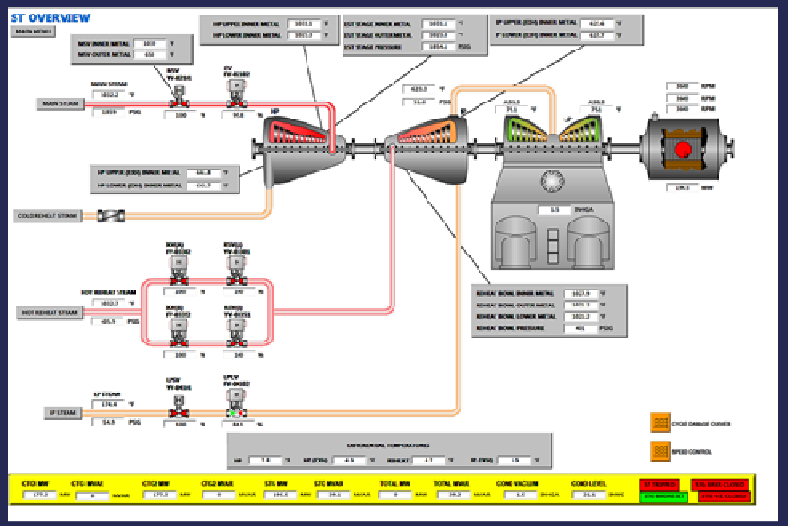


Simulator Examples
320MW Combined Cycle

Screenshot from
Actual Plant

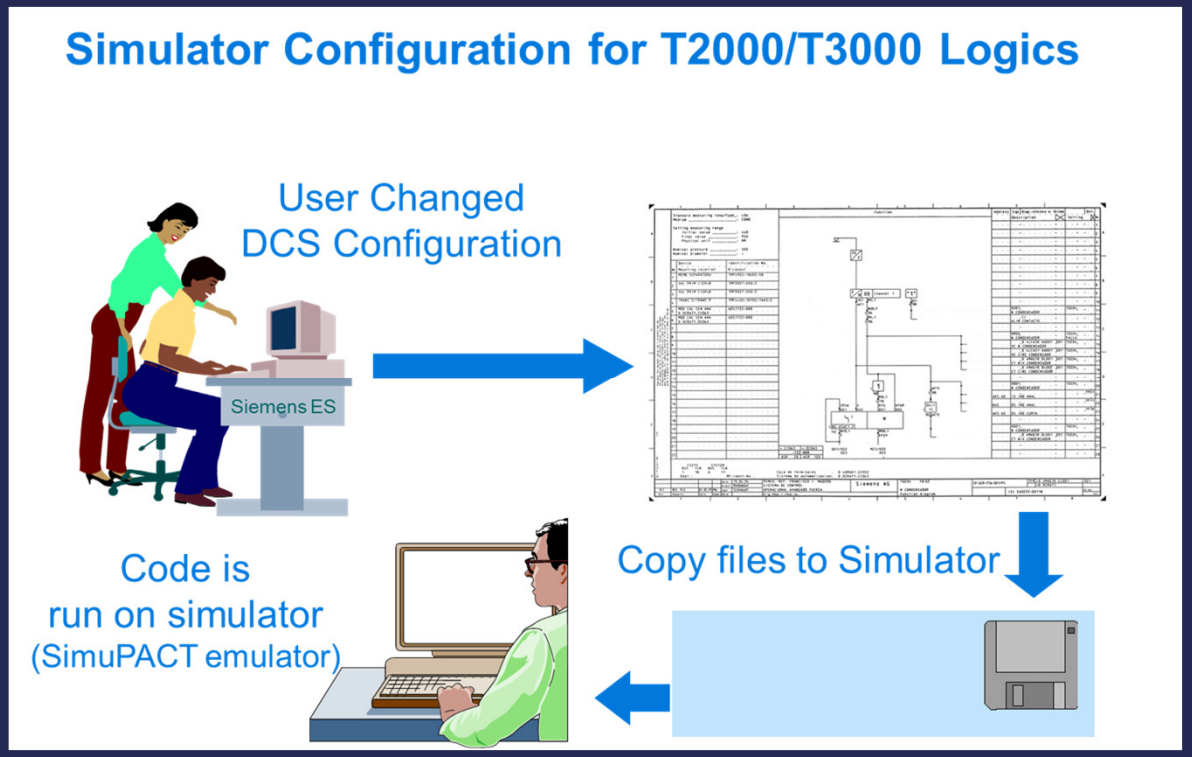


Screenshot from
SimuPACT Emulation



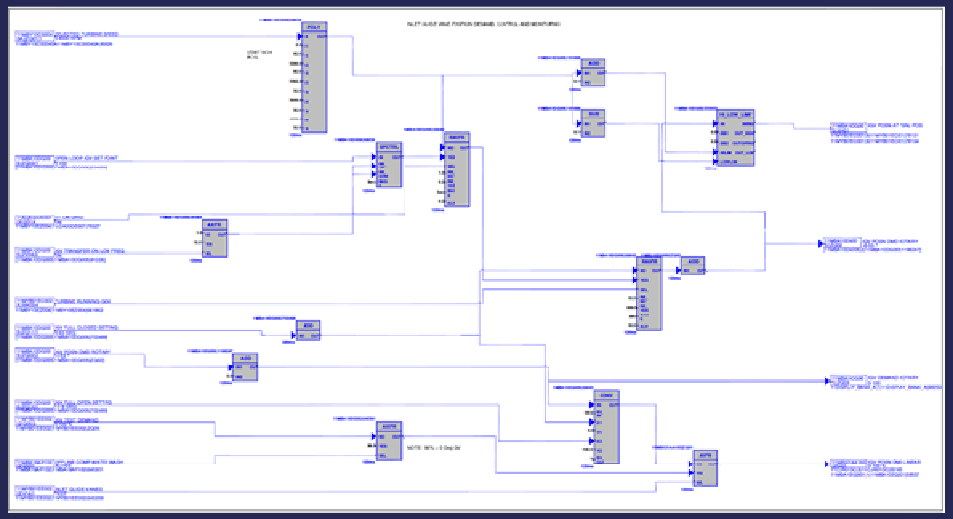
Simulator Examples
320MW Combined Cycle

Siemens T3000 – Using full-scope SimuPACT emulation

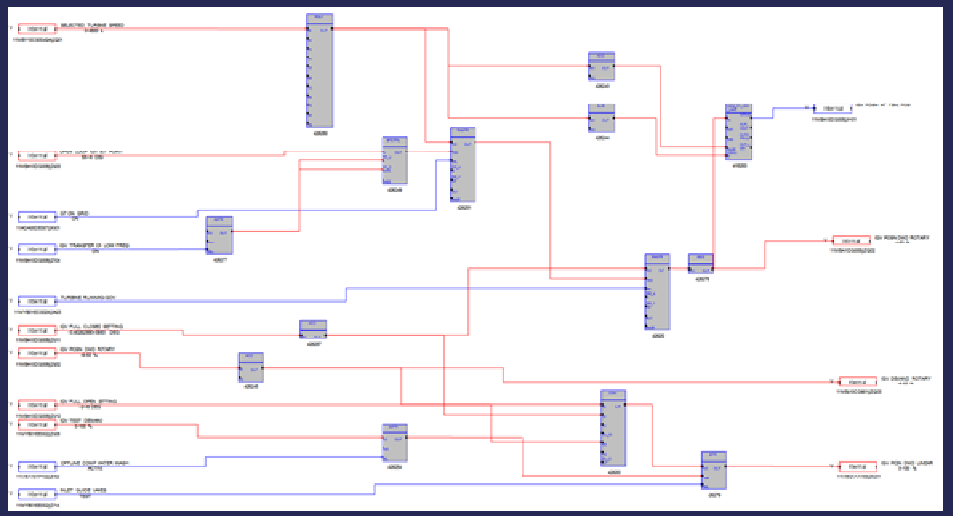


Simulator Examples
320MW Combined Cycle

Screenshot from
Siemens ES



Screenshot from
SimuPACT Engineering View



Petro-chemical Simulator Programs Fundamental

- A range of generic simulator programs is available for the petrochemical industry:

Mix Tank – VR	Reboiler – VR
Centrifugal Pump – VR	Vacuum Condenser System - VR
Centrifugal Pumps – VR	Air Cooler - VR
Pump & Valve – VR	Steam Boiler-VR
Fluid Flow – VR	Centrifugal Compressor - VR
Heat Exchanger (liquid/liquid)- VR	Dual Filters
pH Control Systems – VR	Basic Instrumentation I
Flash Drum – VR	Fundamentals VI – Instrumentation
Cooling Water Tower – VR	Reciprocating Compressor
Condenser – VR	Flare System

VR = Virtual Reality/Outside Operator Capability

SimGenics

Petro-chemical Simulator Programs Intermediate

- A range of generic simulator programs is available for the petrochemical industry:

Distillation - VR	Gas Fired Steam Boiler
Desalination – Single Pass RO –VR	Natural Draft Heater
Natural Gas Turbine	Coal Fired Steam Boiler
Dual Fuel Fired Heater	

VR = Virtual Reality/Outside Operator Capability

SimGenics

Petro-chemical Simulator Programs Advanced

- A range of generic simulator programs is available for the petrochemical industry:

Desalination – MEE Multiple Effect Evaporation - VR	Advanced Instrumentation I
Desalination – Double Pass RO w/ Energy Recovery – VR	Amine Gas Treating Unit
Atmospheric Crude Unit- VR	Gas Oil Separation Process (GOSP)
Fixed Bed Exothermic Reactor - VR	Multi-Stage Refrigeration
Fluidized Catalytic Cracking Unit - VR	Centrifugal Compressor w/ Utilities
Batch Reactor	
Delayed Coker Unit	
Vacuum Crude Unit	

VR = Virtual Reality/Outside Operator Capability

SimGenics

PLEASE LET US KNOW IF YOU HAVE ANY QUESTIONS?

WWW.SIMGENICS.COM