TRAX International Presentation

TRAX International®

Presentation Topics

- Overview
- TRAX Capabilities
- TRAX Simulators

TRAX International®

Overview

TRAX International

- Founded in 1979
  - Became TRAX International in 2004
- Headquartered in Las Vegas, NV
- Employee-Owned Company
  - Over 2,500 experienced employees
  - Multiple U.S. and international locations
- Government and Commercial Clients
- Core Capabilities
  - Test and Evaluation services
  - Engineering & Analysis for government and energy markets
  - Modeling and Simulation for energy markets

TRAX International®

Overview

TRAX International Site Locations

- Las Vegas, NV
- Greenbelt, MD
- Aberdeen, MD
- Lynchburg, VA
- Norman, OK
- White Sands, NM
- Fort Huachuca, AZ
- Yuma, AZ
- El Paso, TX
- Panama, Suriname, Honduras, China

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Overview

TRAX Lynchburg Operations

- Commercial energy market focus
- Houses engineering staff, software staff, management, & support staff
- ISO Certification mid-2014
- Simulator training facilities
- Corporate and customer data center
  - Hosts all Cloud applications
- Engineering & Sales office, Beijing, China

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Overview

Global Clients and Projects

Commercial Clients

Malakoff Group
Doosan
Doosan Babcock
Hyundai Heavy Industries
Ansaldo
GE
Emerson
Siemens
ABB
TNB
Foster Wheeler
Bechtel
Fluor
Southern Company
Duke Energy
Areva
Babcock & Wilcox

Global Installed Projects

U.S.
South Korea
Saudi Arabia
Italy
France
China
Brazil
Indonesia
Malaysia
Canada
Australia
Vietnam
U.K.

TRAX International®

Presentation Topics

- ✓ Overview
- ❖ TRAX Capabilities
- ❖ TRAX Simulators

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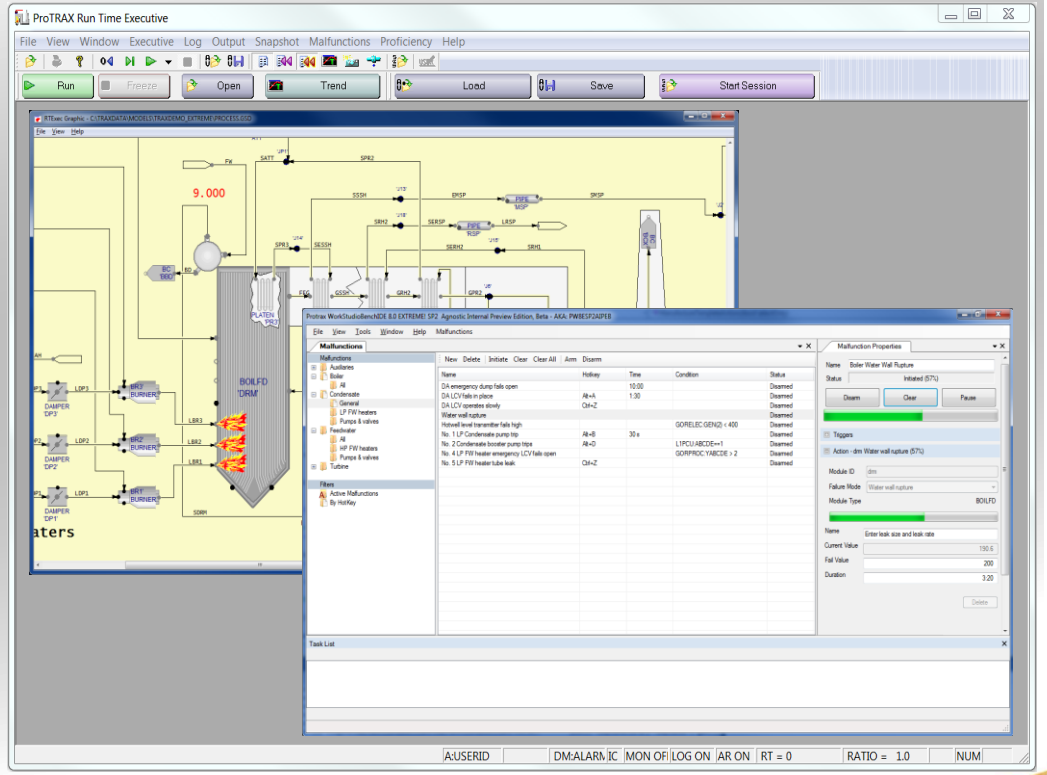
TRAX Capabilities

ProTRAX High-Fidelity Engineering Grade Software

- Graphical User Interface
- Object Oriented Model Building
- First principles modeling
- Extensive module library
- Serves as …
  - Engineering tool
  - Training system tool



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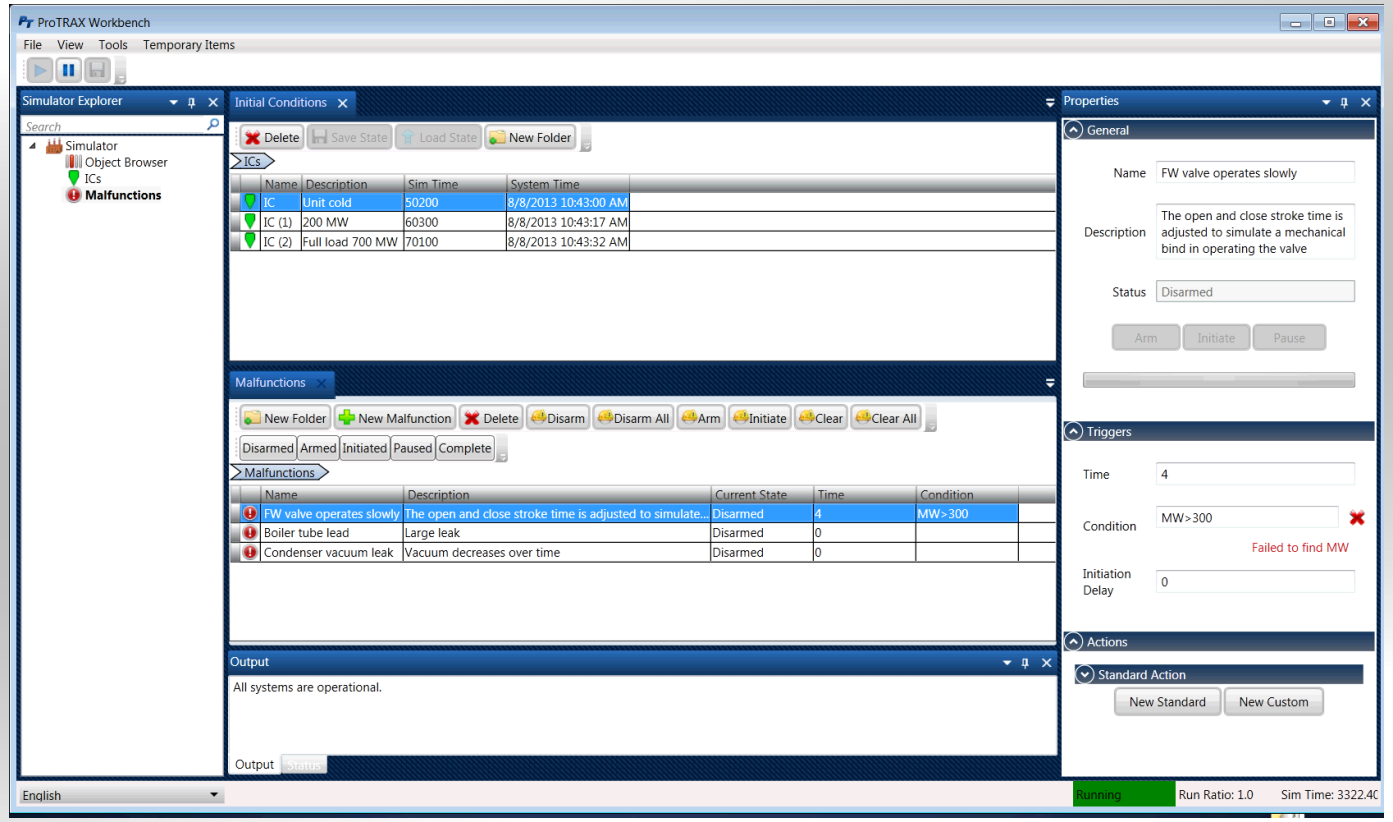
TRAX Capabilities

High-Fidelity Engineering Grade Software



Interfaces to DCS and PLC hardware

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TRAX Capabilities

Electrical Modeling - ETAP

- 3000 Companies
- 300 Countries
- 100,000 Licenses

- Integrated Solutions
- Multiple Interfaces
- Extensive Equipment Libraries

AUTODESK AUTOCAD 2014 · MicroStation · PDF Adobe · SmartPlant Electrical · e-DPP · Microsoft SQL Server · ODBC · ProTRAX Power Plant Simulation · ESRI

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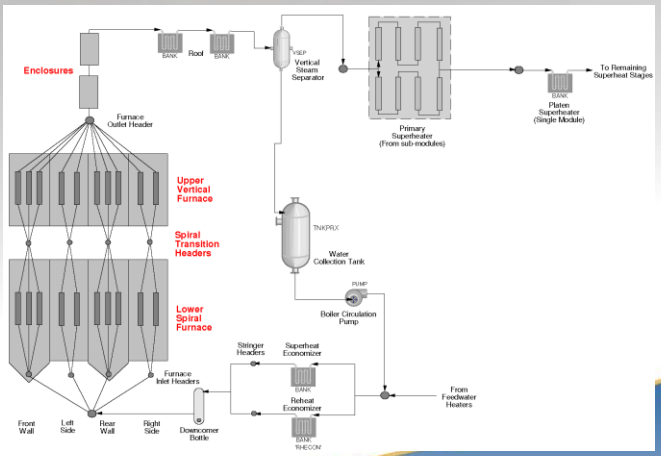
TRAX Capabilities

Engineering Analysis

- Process modeling
- Electrical modeling
- Design verification
- Transient and steady-state modeling
- Environmental additions
- Control system design
- Equipment specification
- NFPA compliance



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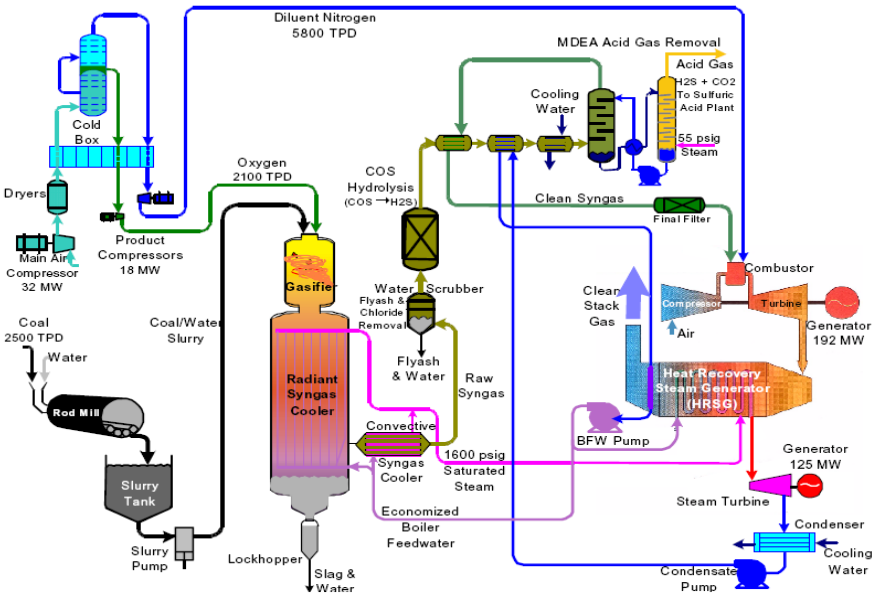
TRAX Capabilities

Engineering Analysis

Process and Design Analysis for Energy – Unconventional

- Solar
- Coal or oil gasification
- Oxy-combustion
- Fuel cells
- CO_2 Capture
- Desalination
- Micro-turbines



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TRAX Capabilities

Engineering Analysis

Process Plants

- Desalination
- Wastewater
- Gasification
- Sulfuric acid
- Diesel fuel reforming
- Sour gas stripping
- Oxygen separation
- LNG distribution system

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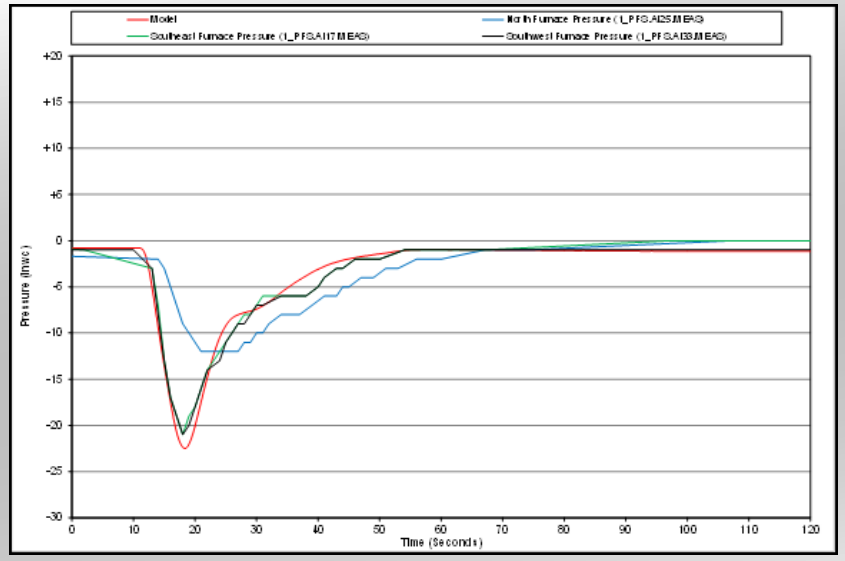
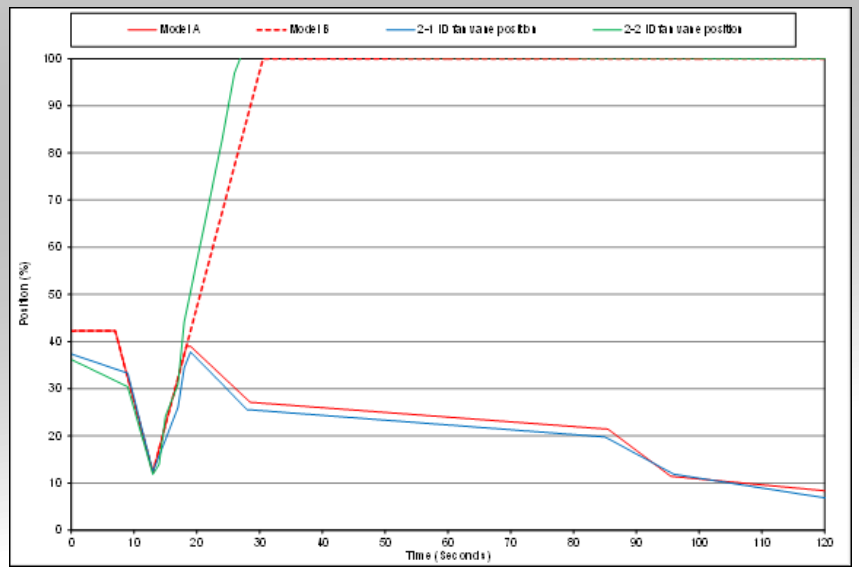
TRAX Capabilities

Engineering Analysis

Existing Plants - Model Validation





✓ Exceeds ISA Standard

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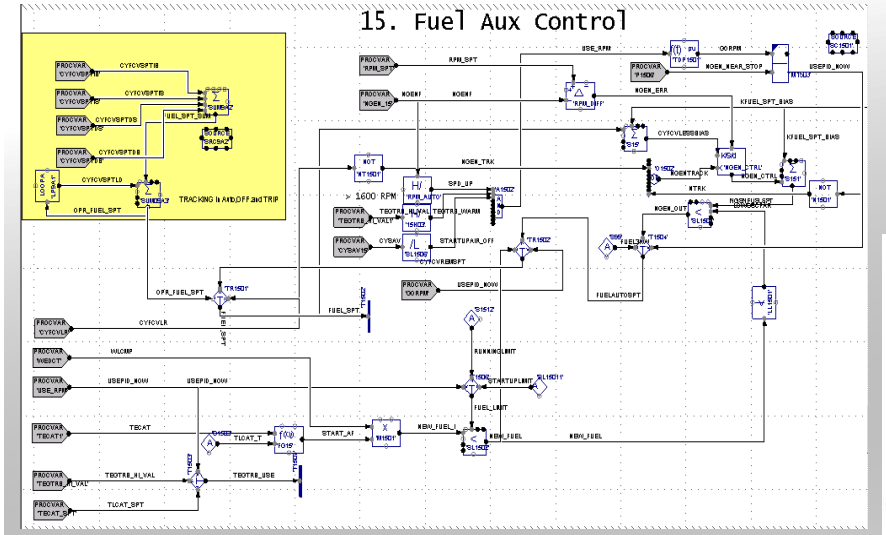
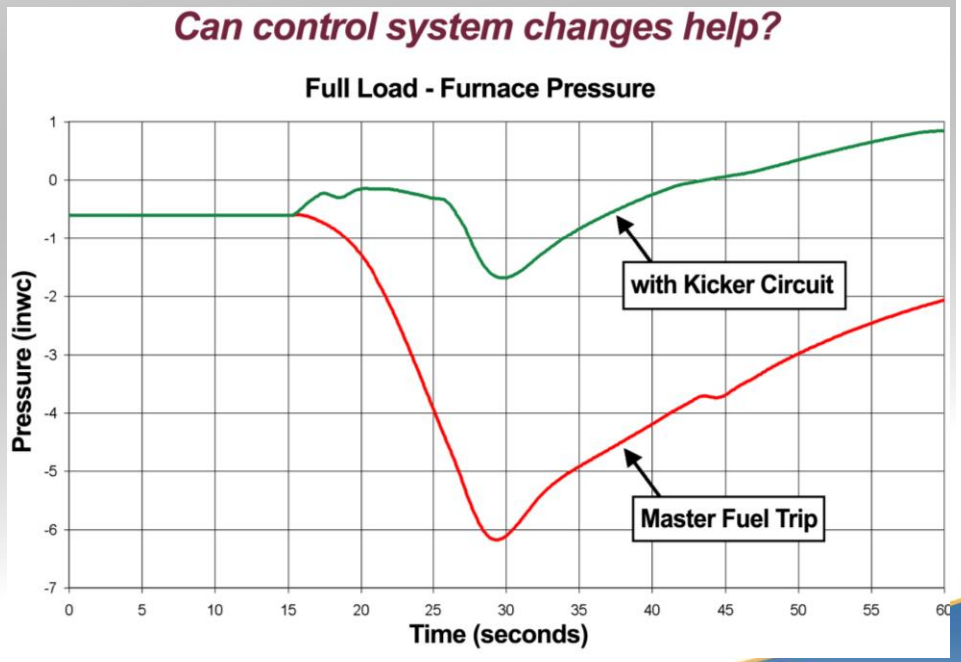
TRAX Capabilities

Control Design



- Design and tune logic
- Test new control strategies
- Examine control problems
- Detailed checkout before installation

- Optimization
- Model-based controls
- Adaptive gains / Gain scheduling
- Multi-variable controls



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TRAX Capabilities

Engineering Analysis – Case Studies

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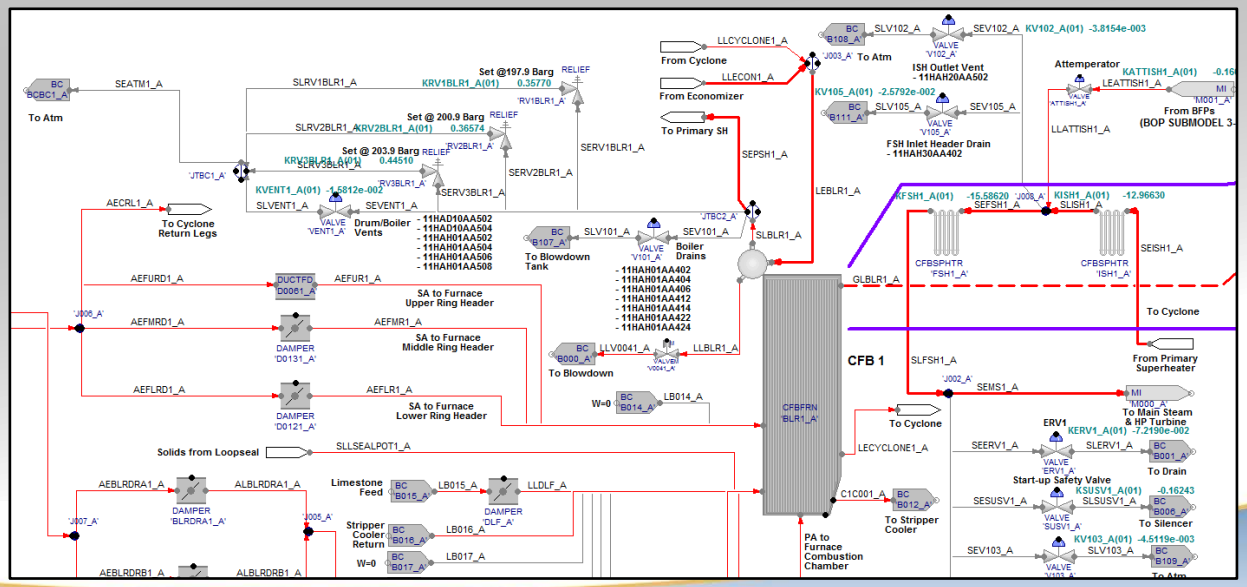
TRAX Capabilities

Mong Duong Unit 1 - Dynamic Simulation Study

- CFB boiler
- Full HP and LP bypass system
- Load rejection
- Prevent safeties from opening
- Prevent BFP & CEP cavitation
- Maintain bypass temperature



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TRAX Capabilities

Fuel Conversions

DRAX Units 4 and 5
Yorkshire, UK

Drax Power Limited

Coal-to-Biomass

- Existing coal plant in Yorkshire, UK
- Co-fire up to 50% biomass pellets
- Addition of SCR

Coal-to-Gas

- Axiall 2-unit conversion in Natrium, WV, USA
- Convert to 100% gas-fired
- Marcellus Shale supply

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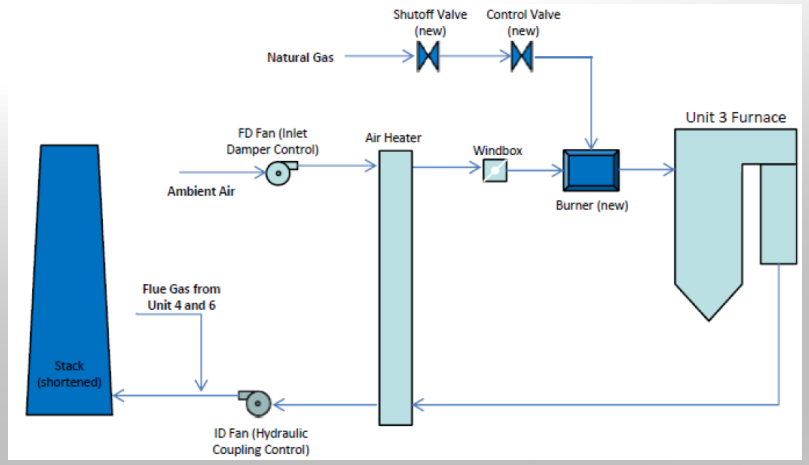
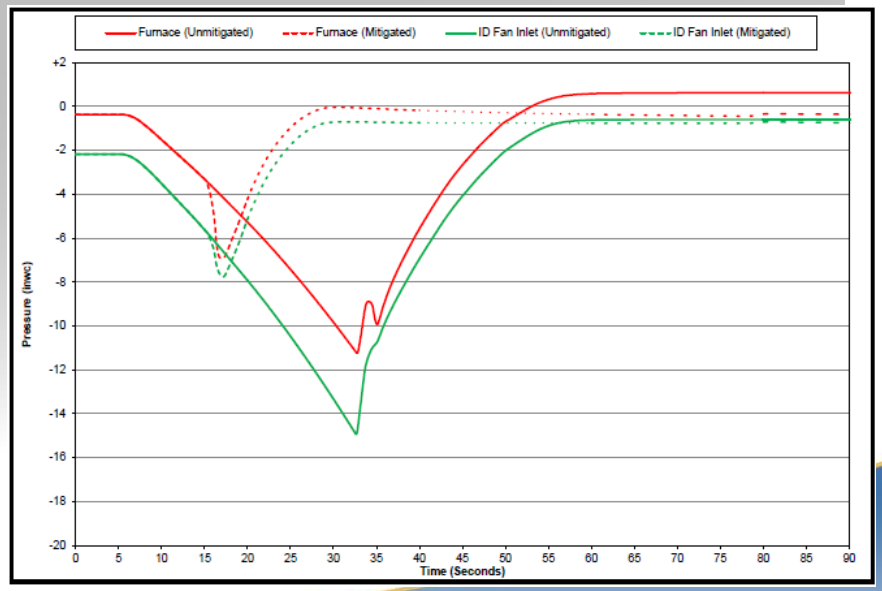
TRAX Capabilities

Coal to Gas Conversion

- Validate model with coal data
- Process Modifications:
  - Removal of pulverizers and exhausters
  - Addition of natural gas burners
  - Shortening of brick portion of the stack
  - Removal of baghouse
- Transient Analysis with natural gas:
  - Modify and tune controls
  - Verify pressures within limits
  - Ensure NFPA 85 compliance





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TRAX Capabilities

Hybrid Power Generation: Combined Cycle + Solar

FP&L Martin Next Generation Solar Energy Center, Florida, USA

- Concentrated solar-thermal power
- 190K mirrors; 75 MW of superheated steam
- World's first hybrid solar energy complex
- Solar field capacitance & piping modeled
- TRAX verified performance & controls design
- Startup procedure for solar field

FPL

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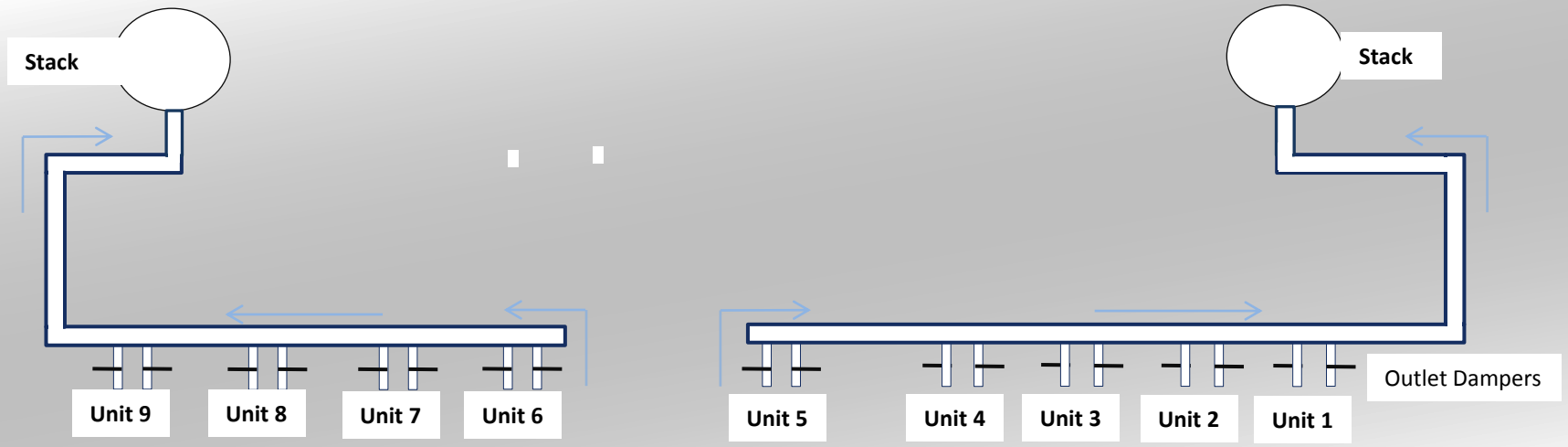
TRAX Capabilities

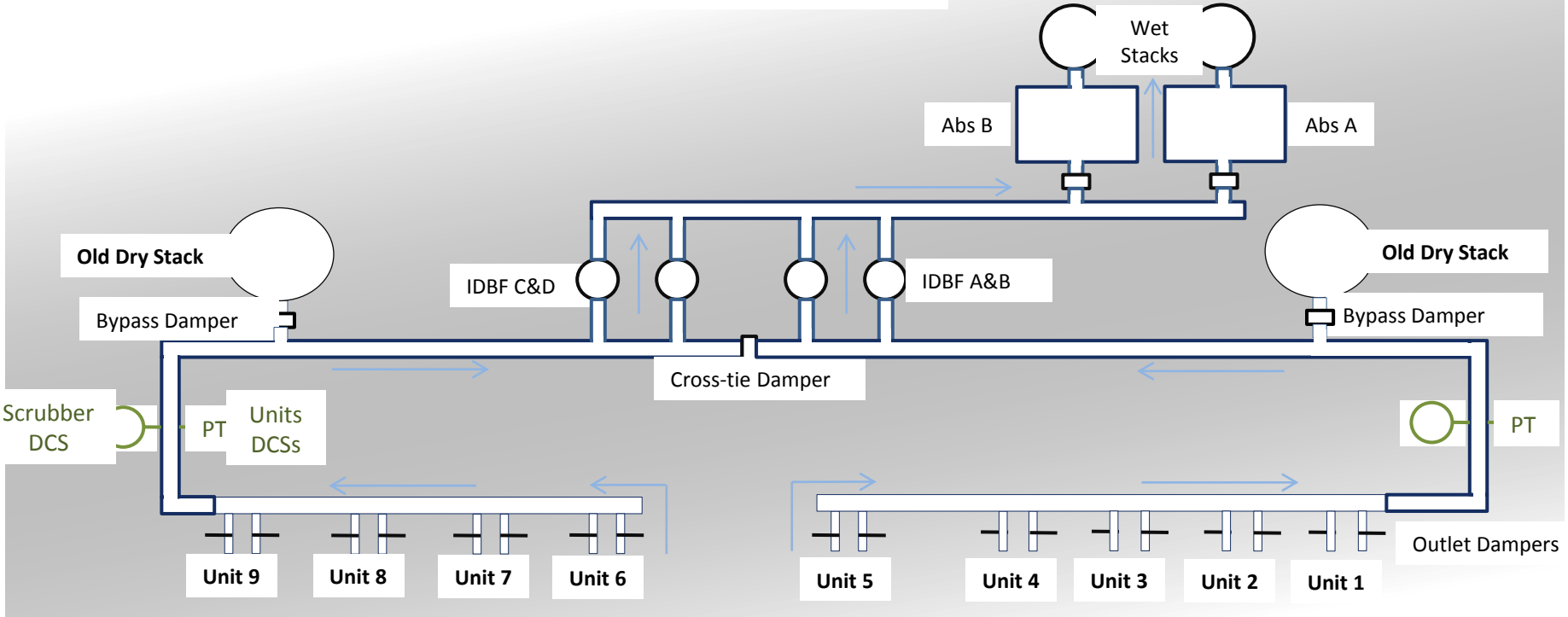
Furnace Implosion



Draft System Before Scrubber

TRAX Capabilities

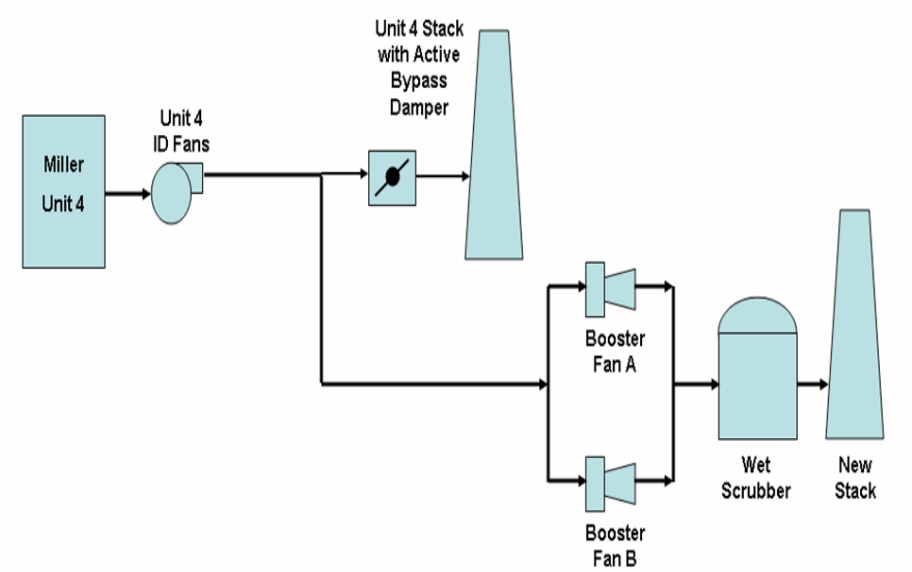
Furnace Implosion



Draft System After Scrubber

TRAX Capabilities

Furnace Draft - Active Bypass Damper Control



- Addition of scrubbers, baghouses, SCR
- Active bypass damper
- Axial fan stall
- Advanced control strategies
- Keep pressures within structural limits

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TRAX Capabilities

Renewable Energy: Hydro

SCE - Big Creek Hydro - USA

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL℠ Company

- First large-scale integrated hydro project in U.S.
- 6 reservoirs & 9 powerhouses
- Generating capacity ≅1,000 MW
- Pumped storage
- Guaranteed water flow
- TRAX optimization control modeling

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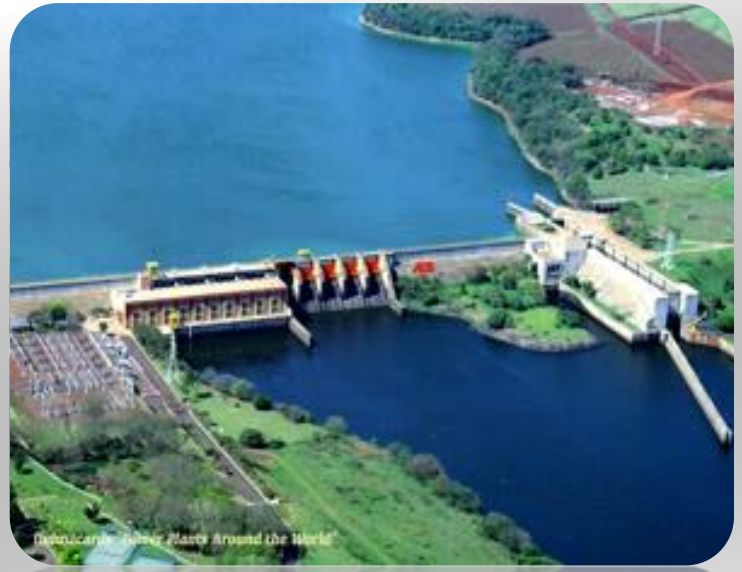
TRAX Capabilities

Renewable Energy: Hydro Optimization



- Economic dispatch of units to water usage
- Level Control
- Power Distribution in River Chain
- Predict effects of modified operation
- Cost of operations

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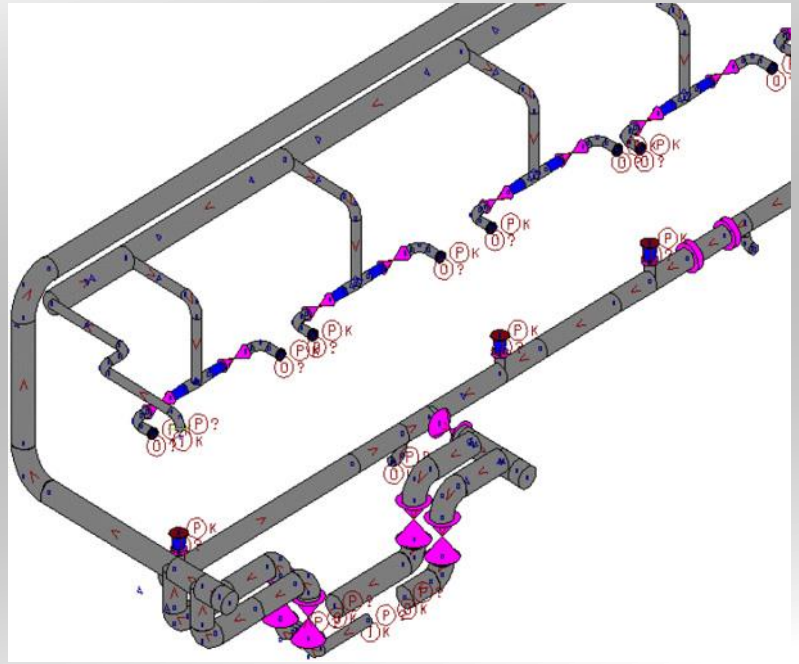
TRAX Capabilities

Steam Distribution Network



- Long piping runs
- Multiple boilers
- Multiple consumers
- Headers and pressure regulation
- Steam traps
- Optimization

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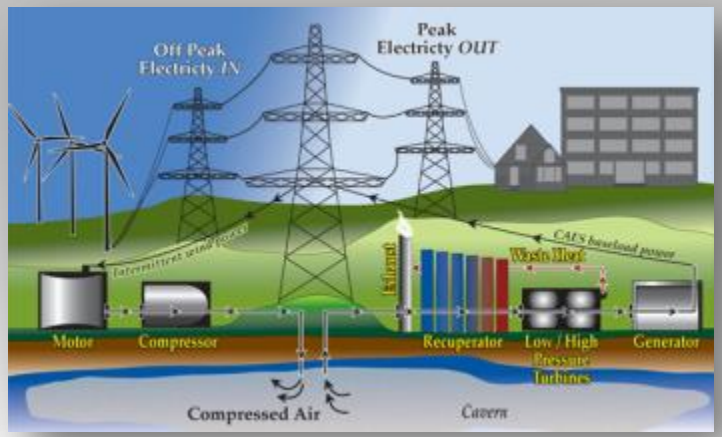
TRAX Capabilities

Compressed Air Energy Storage

- Best ‘utility scale’ energy storage technology after Hydroelectric
- Two installations in the world: Huntorf, Germany & McIntosh, AL, U.S.
- In U.S., TRAX modeled all process components including underground cavern



Storage Cavern:	19 M cu/ft.
Full Pressure:	1100 PSI
Compression Time:	41 Hrs.
Air Generation Time:	26 Hrs.
Full Load Output:	110 MW

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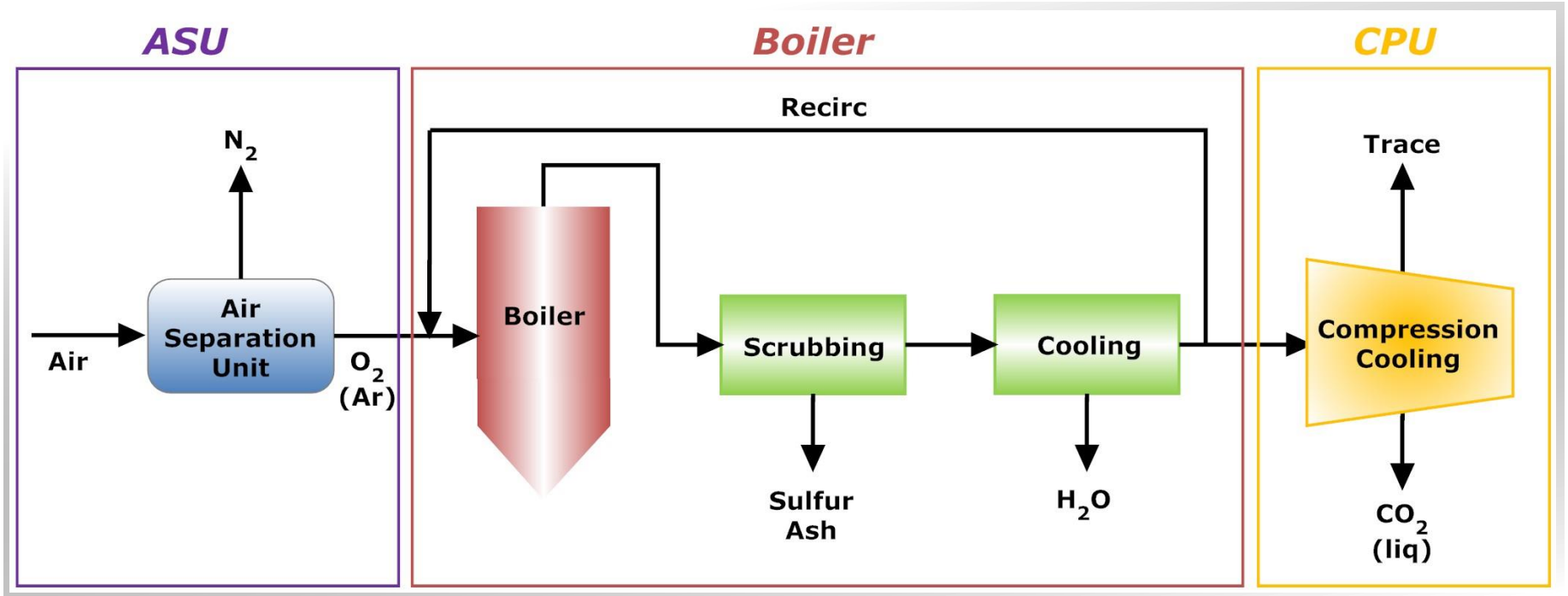
TRAX Capabilities

Oxy-Combustion



Advantages:

- Limited emissions (CO, NOx)
- No back end scrubbers

Disadvantages:

- Air separation plant

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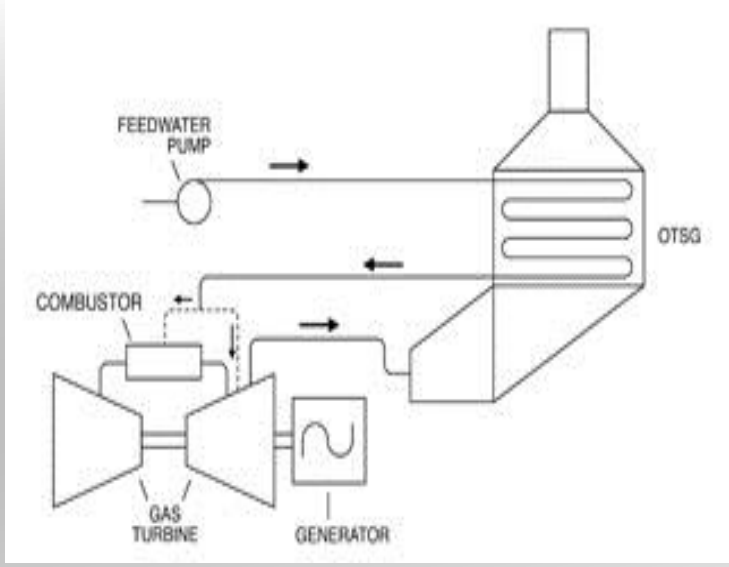
TRAX Capabilities

ProTRAX Dynamic Models: Once-Through Steam Generator



- New turbine design
- High combustion temperature
- Steam cooled parts
- Determine minimum startup time

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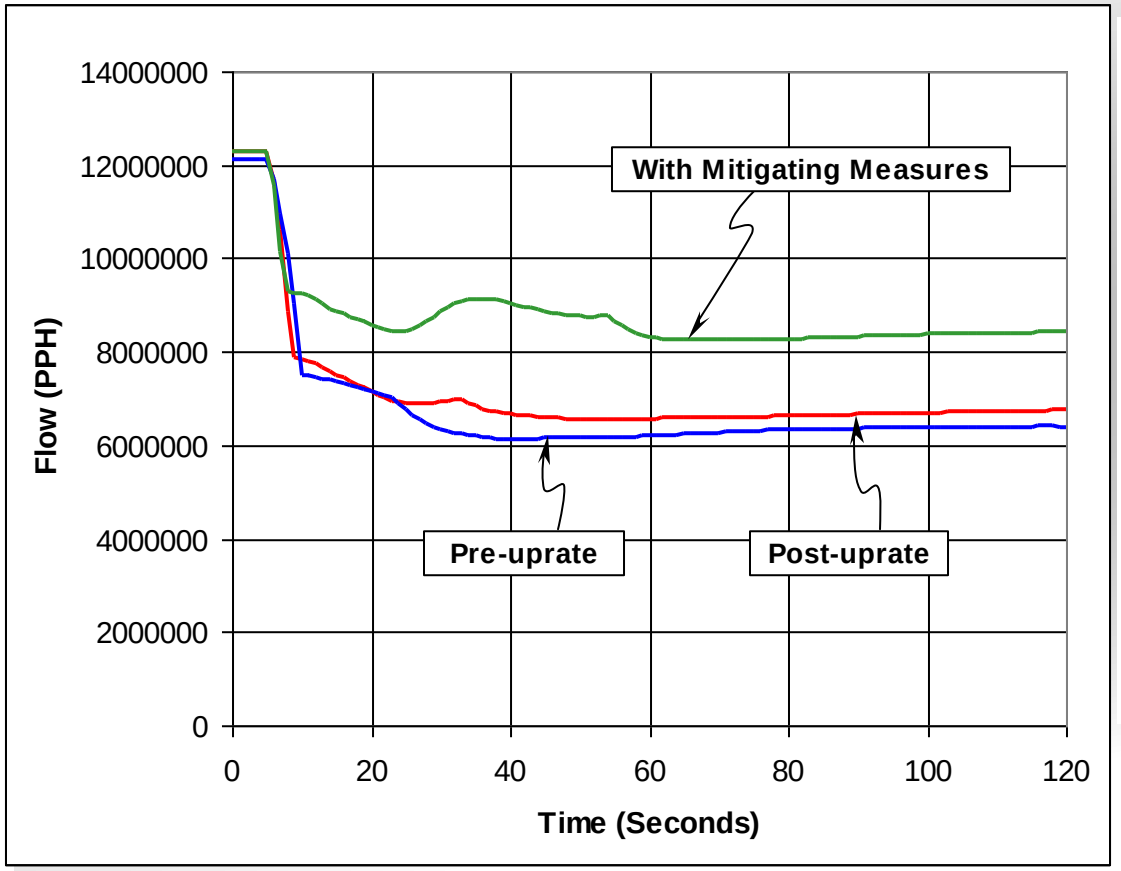
TRAX Capabilities

ProTRAX Dynamic Models: Nuclear BOP



Feedwater Flow

- Condensate pump trip
- Reactor trips on low SG level
- Heater drain pump NPSH drops below the trip setpoint for about 34 seconds
- Modify condensate pump head curve to eliminate trip

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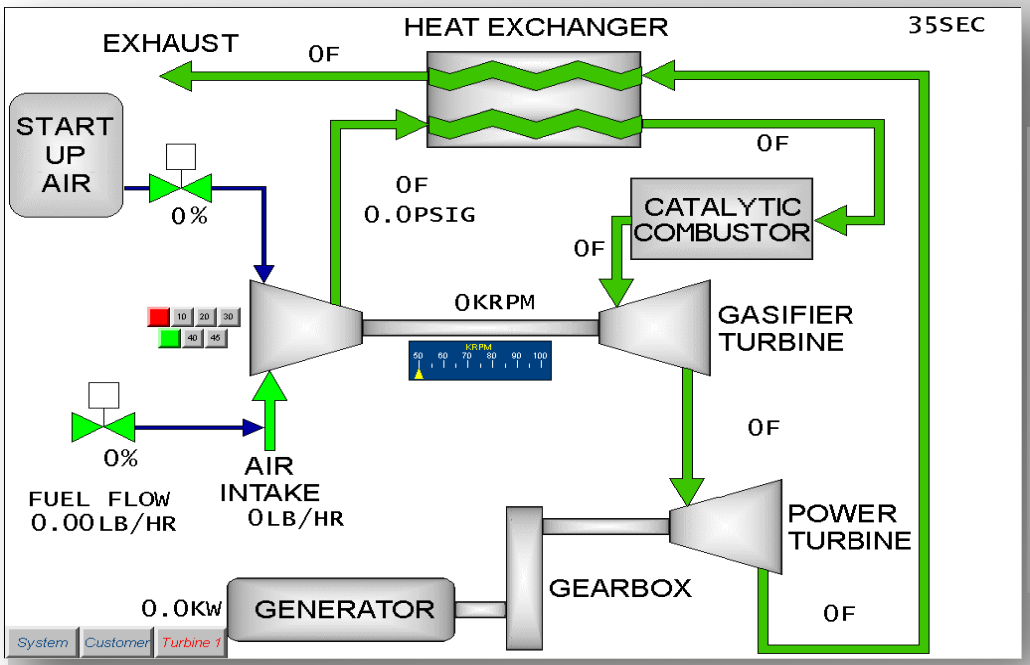
TRAX Capabilities

ProTRAX Dynamic Models: Turbine Overspeed



- Turbine trip
- High pressure fuel still present
- How much overspeed

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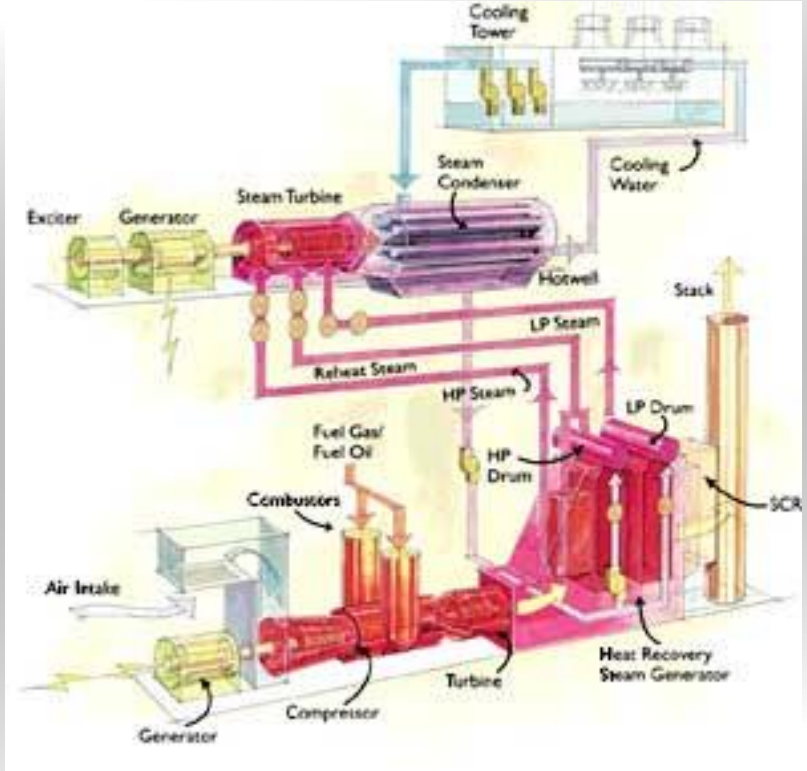
TRAX Capabilities

Engineering Analysis: Combined Cycle Plants



- New plant design
- Gas turbine + HRSG
- Performance guarantees
- Startup characteristics

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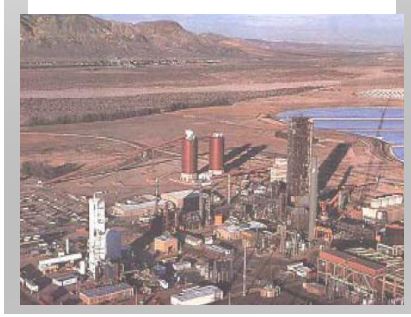
TRAX Capabilities

TRAX IGCC Experience

Cool Water



- Texaco gasifier
- Shell gasifier
- Engineering simulator

Wabash River

- Conoco gasifier
- Training simulator

TECo Polk

- Texaco gasifier
- Controls checkout
- Training simulator

ISAB

- Texaco gasifier
- Controls checkout
- Engineering simulator

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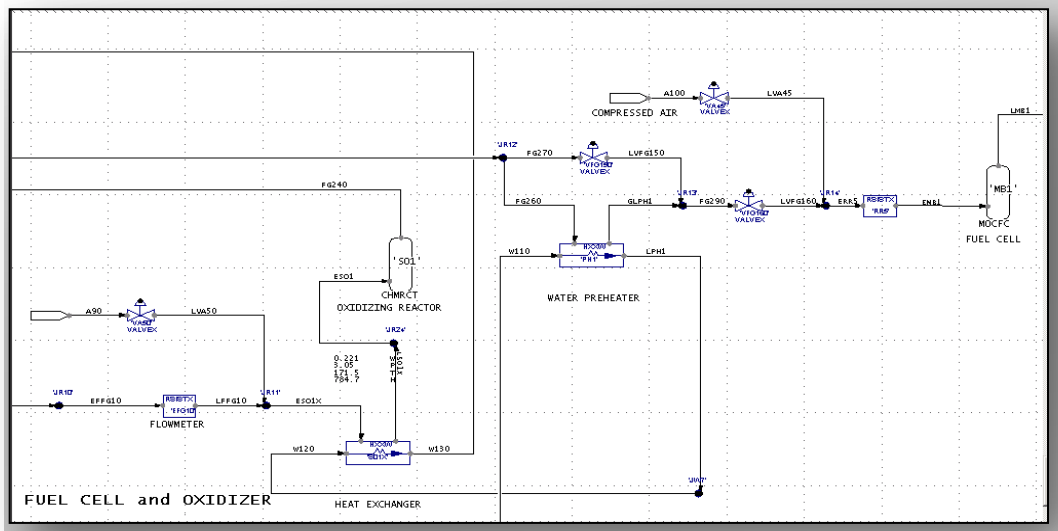
TRAX Capabilities

Process Applications – Diesel Fuel Reforming



- Diesel Fuel → H2
- Feedstock for fuel cell
- Multiple catalytic - reactors
- Steam reformers
- Heat exchangers
- Improve startup time

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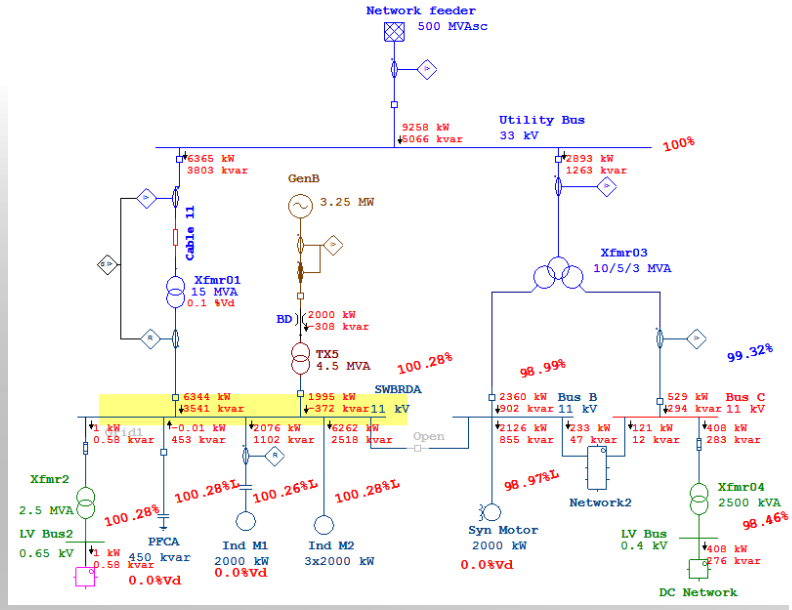
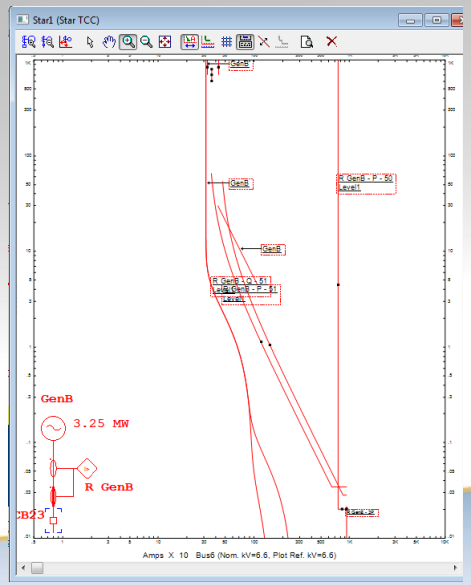
TRAX Capabilities

Electrical Modeling

Electrical analyses include:

- Economic
  - Optimal Load Flow
  - Optimal Capacitor Placement
- Reliability
  - Short Circuit (AC & DC)
  - Protective Device Coordination
  - Reliability Assessment
  - Transient Stability
- Safety
  - Arc Flash (AC & DC)
  - Electric Shock Protection

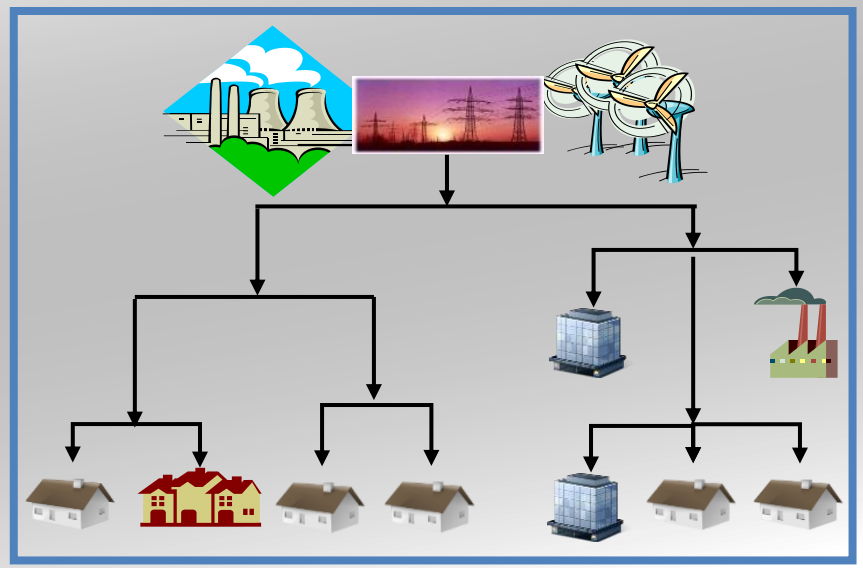




TRAX Capabilities

Electrical Modeling – Smart Grid

- Macro or Micro grids
- Self-healing
- Self-coordinating
- Arc Flash studies



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Presentation Topics

- ✓ Overview
- ✓ TRAX Capabilities
- ❖ TRAX Simulators

TRAX International®

TRAX Simulators

Modeling & Simulation Experts

- TRAX core technology to fossil power – ProTRAX™
- Industry leader with 200+ training simulators delivered
- Configurable products for rapidly changing industry
- Implementation centers in U.S. and China
- Demonstrated experience in:
  - Gasification
  - Carbon capture
  - Biomass
  - Hybrid plants

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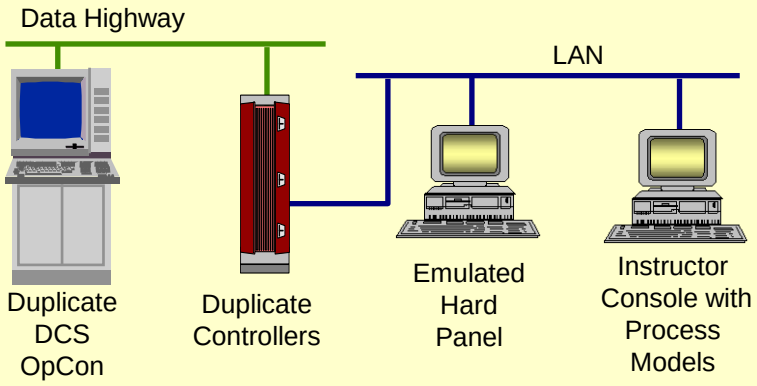
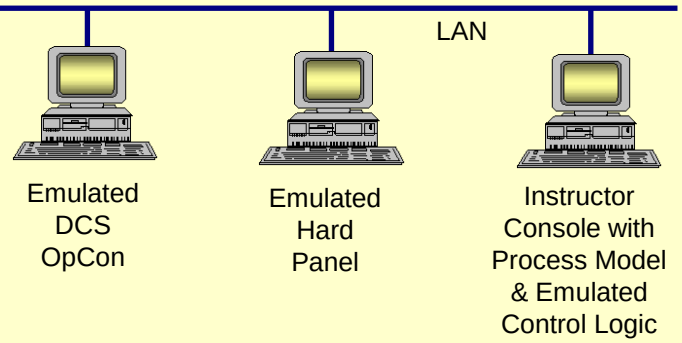
TRAX Simulators

Simulator Configurations

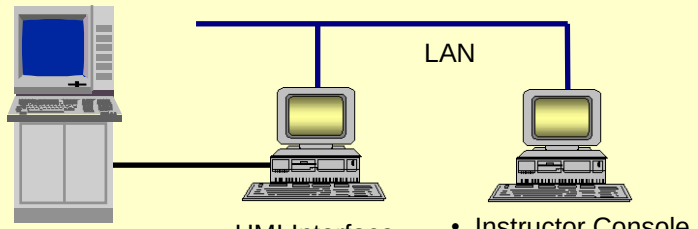
Stimulated



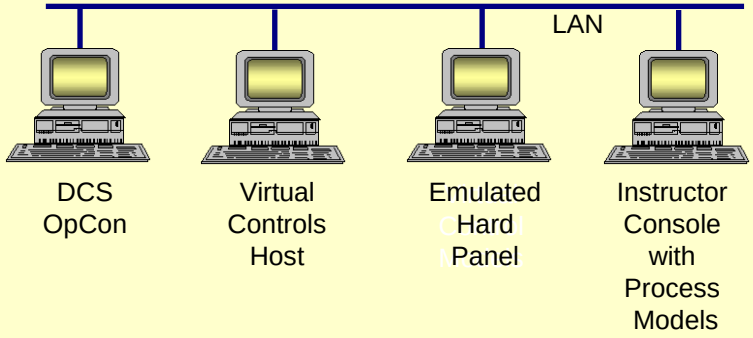
Emulated



Hybrid



Virtual



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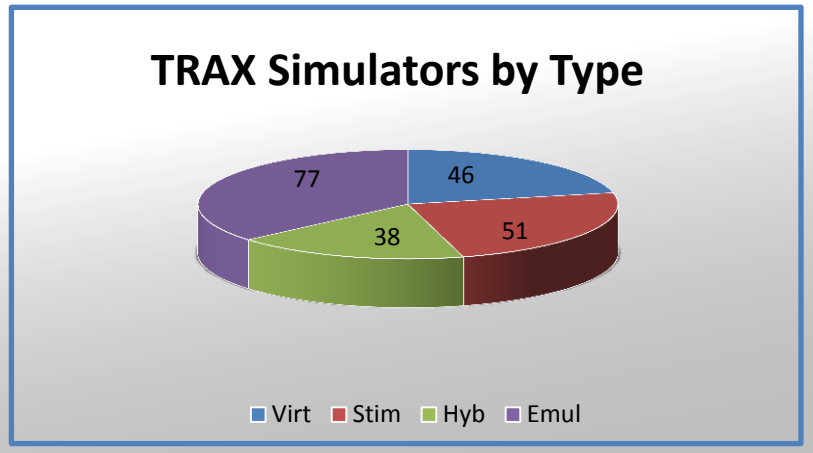
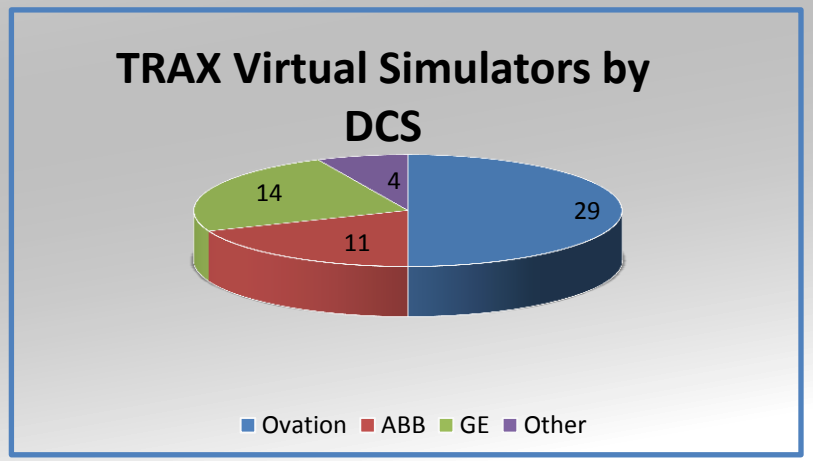
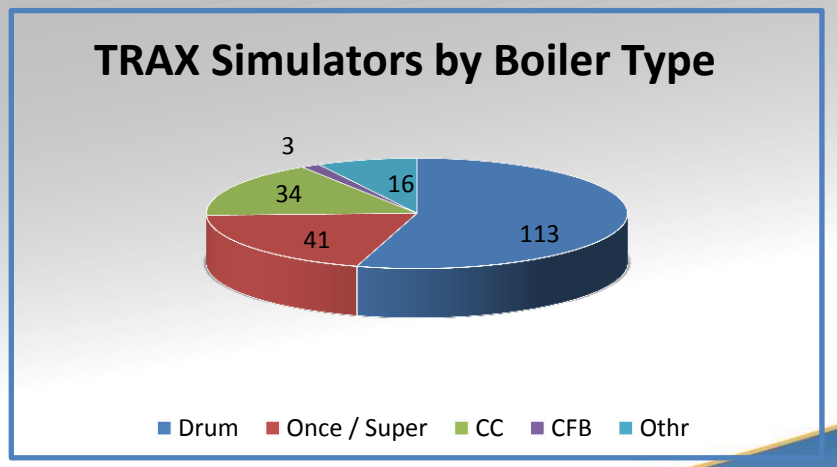
TRAX Simulators

Simulator Experience



- Over 200 Delivered
- Experienced in all simulator types
- Nearly 30 Emerson Virtual's delivered
- Siemens Virtual as part of Shin-Boryeong





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TRAX Simulators

Repeat Customers

- **Ameren**
  - 10 Units
  - 20+ Simulator copies
- **TVA**
  - 6 TRAX built Simulators
  - 6 Internally built Simulators
  - 2 Co-built CCGT Simulators
- **Southern Co.**
  - 8 Simulators
  - 2 New units in process
- **KCPL**
  - 9 Simulators
- **Duke Energy**
  - 6 Simulators
- **SCE&G**
  - 4 Simulators
- **MidAmerican Energy**
  - 4 Simulators

Customer Participation

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TRAX Simulators

Simulator Uses – Case Study

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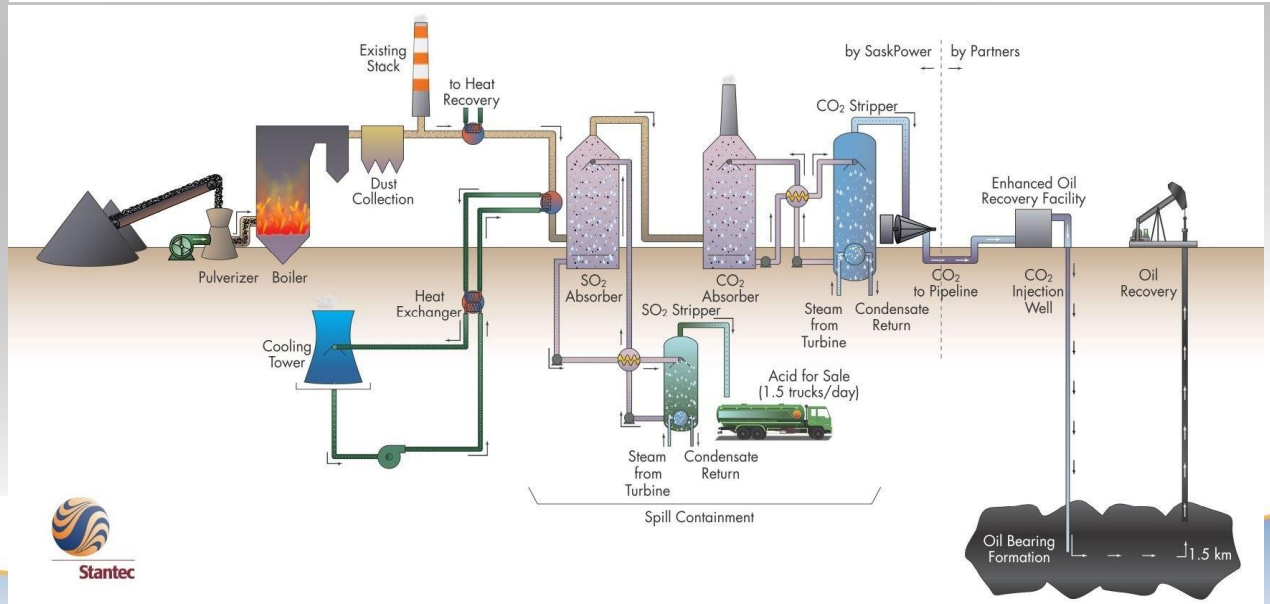
TRAX Simulators

Project Overview

Carbon Capture Addition

- World's first post-combustion coal-fired CCS facility
- Capturing full gas stream – not slip stream
- System provides both CO2 and SO2 capture
- CO2 transported via pipeline to Weyburn enhanced oil recovery site 100 km away
- 90% CO2 capture rate
- Estimated Cost = $1.24 Billion



Carbon Capture Utilization and Storage Process

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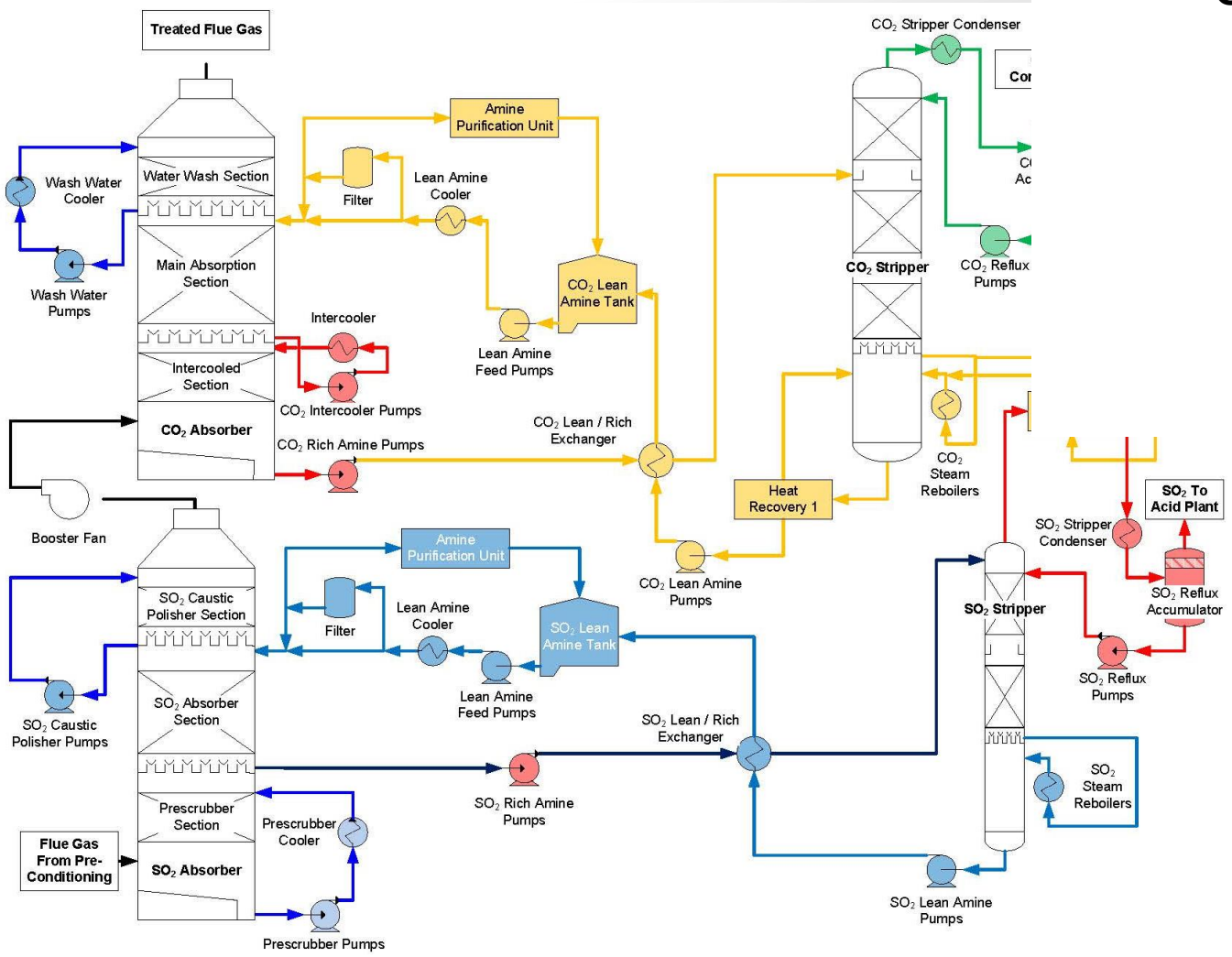
TRAX Simulators

Project Overview



Carbon Capture Addition

- SO_2 stripper
- CO_2 stripper

} Cansolv

- Acid plant - Fenco
- CO_2 compression - ManTurbo
- CO_2 pipeline - Sunstone

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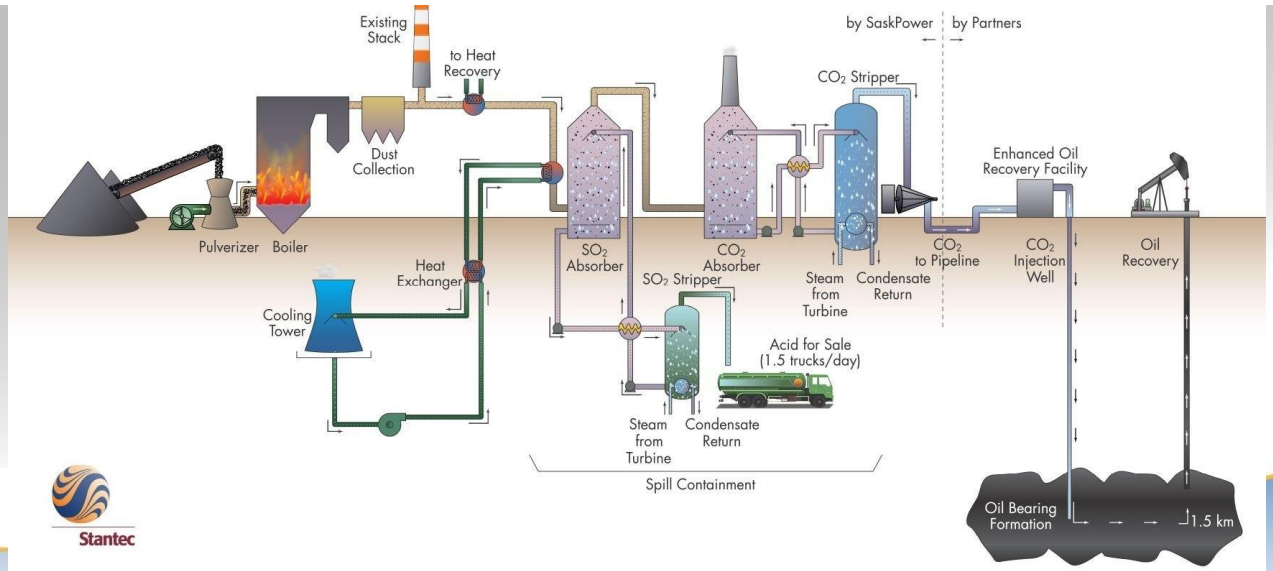
TRAX Simulators

Simulator Objectives

Goal for Simulator

- Controls / Process checkout
  - Test and Verify unique and first-of-a-kind control philosophies
  - Help to debug details of control logic prior to plant commissioning
  - Refine and validate sub-system interactions
- Training
  - Familiarize operators with unfamiliar HMI screens and processes
  - Provide a comprehensive and unified platform to train operators on all aspects of new plant operations



Carbon Capture Utilization and Storage Process

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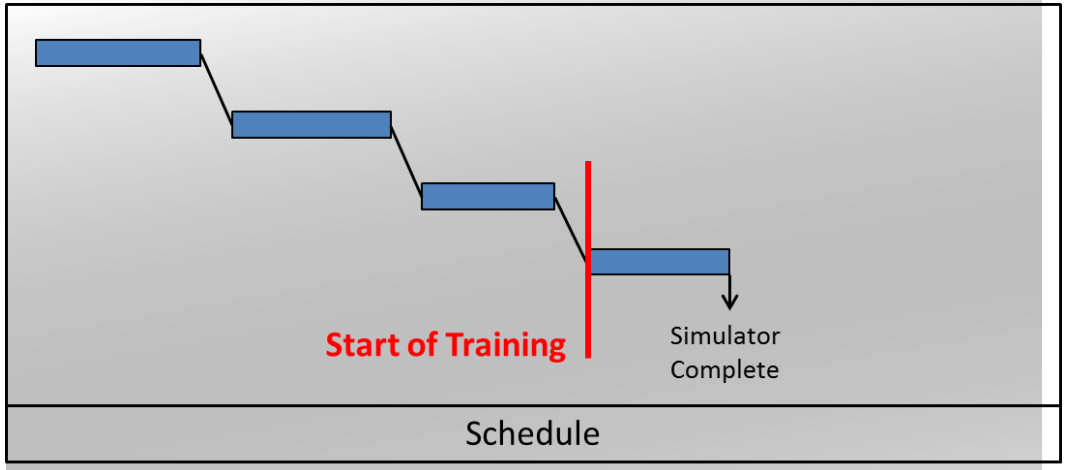
TRAX Simulators

Challenges



Short schedule

- Unique challenges of a first-of-a-kind plant caused a delayed start
- Intellectual property concerns delayed source data and contracts
- High priority customer needed to investigate process interactions – could result in process changes
- Need to begin training operators – multiple unfamiliar systems to learn
- Both engineering testing and training were needed before a sequentially staged project could be completed

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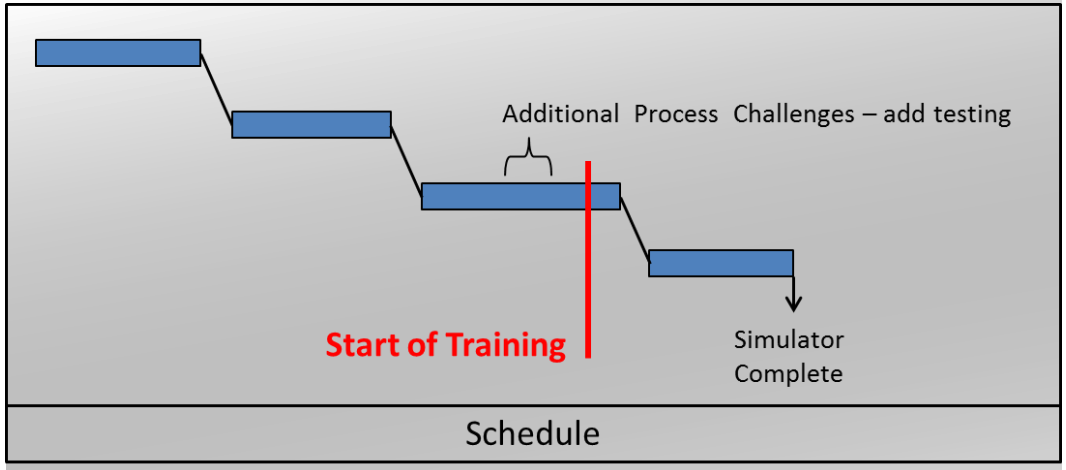
Challenges



- Short schedule
- **Process Simulation Challenges**
  - First implementation of Cansolv process. Steady state theoretical design. No dynamic information.
  - Many initial design questions: Can the goals be met with a single Instructor station or separate? How will the different islands interact? How will the PLCs be represented? Which process conditions require the most fidelity?
  - Intellectual property issues with the companies involved limited what design information was available
  - Real-time simulation using CO2 properties calls

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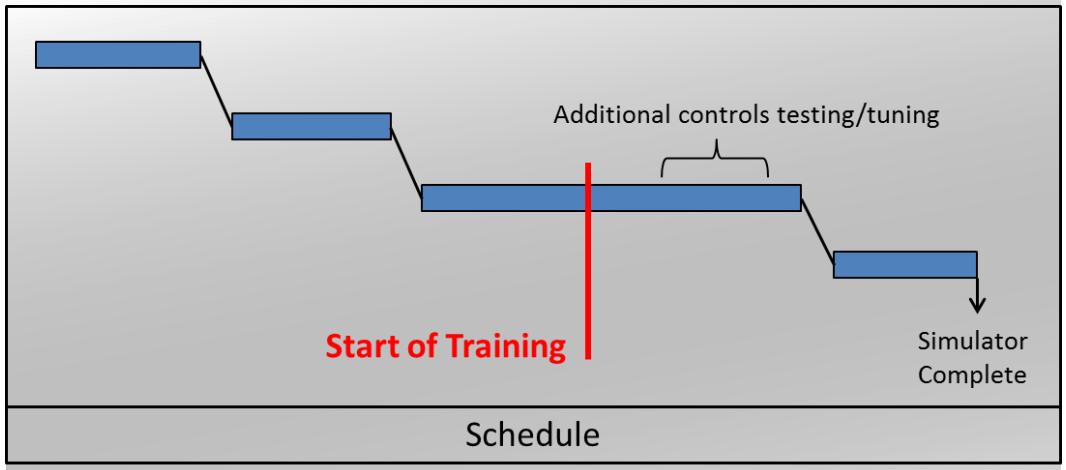
Challenges



- Short schedule
- Process Simulation Challenges
- **Controls Challenges**
  - First implementation of control philosophies
  - Multiple controls teams in the US, Canada, and Netherlands
  - Complexity and diversity in control scheme
    - ABB 800XA DCS
    - Numerous Allen Bradley PLC's
      - CO2 compression
      - CO2 APU
      - SO2 APU
      - SO2 AFU

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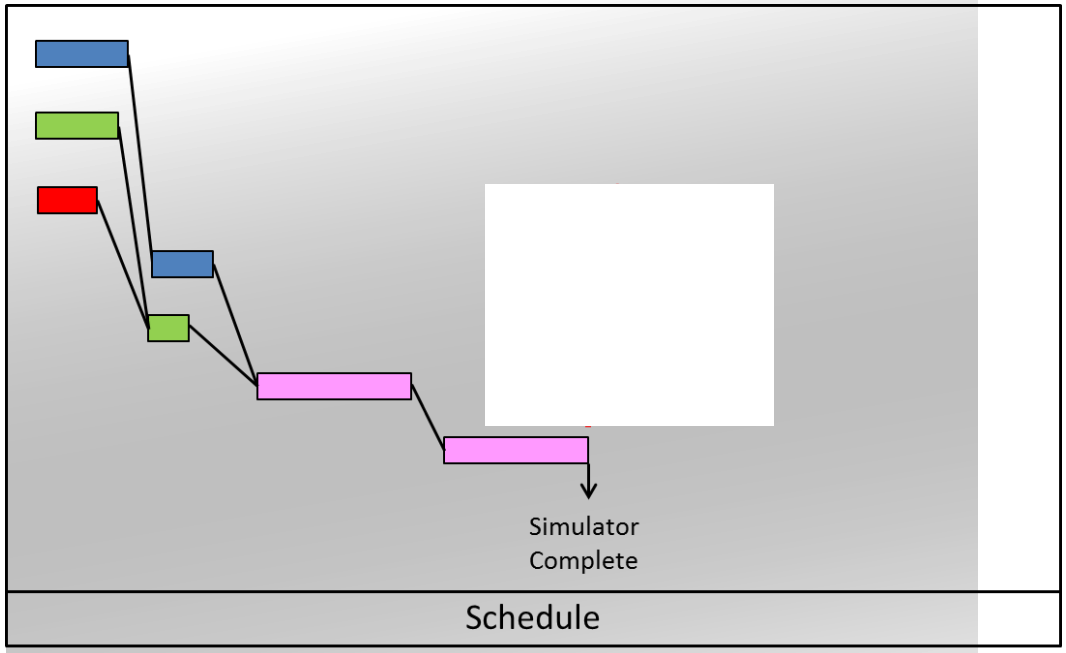
Solution



Work Plan

- Replace single development path with multiple parallel development efforts
- Purchase and configure four simulator platforms with independent hardware and licensing
- Modular standalone testing of new systems when possible
- Use a combination of permanent and temporary licenses
- Intimate support of DCS vendor – ABB.
- On-simulator, real-time control modification/correction
- Continual customer involvement
- Consolidate the stand-alone systems into a single platform as the stages are delivered

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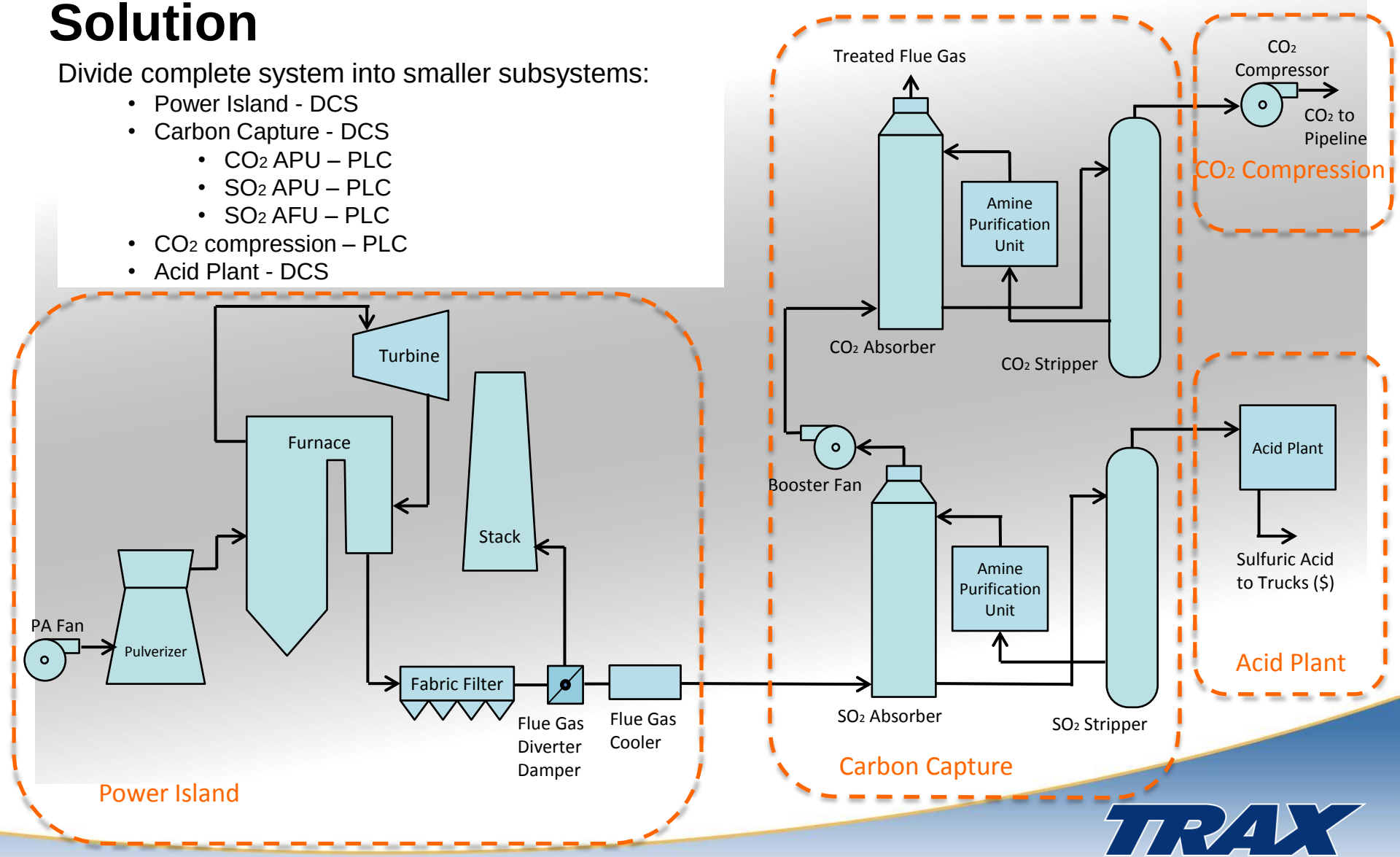
Solution

Divide complete system into smaller subsystems:

- Power Island - DCS
- Carbon Capture - DCS
  - CO_2 APU – PLC
  - SO_2 APU – PLC
  - SO_2 AFU – PLC
- CO_2 compression – PLC
- Acid Plant - DCS



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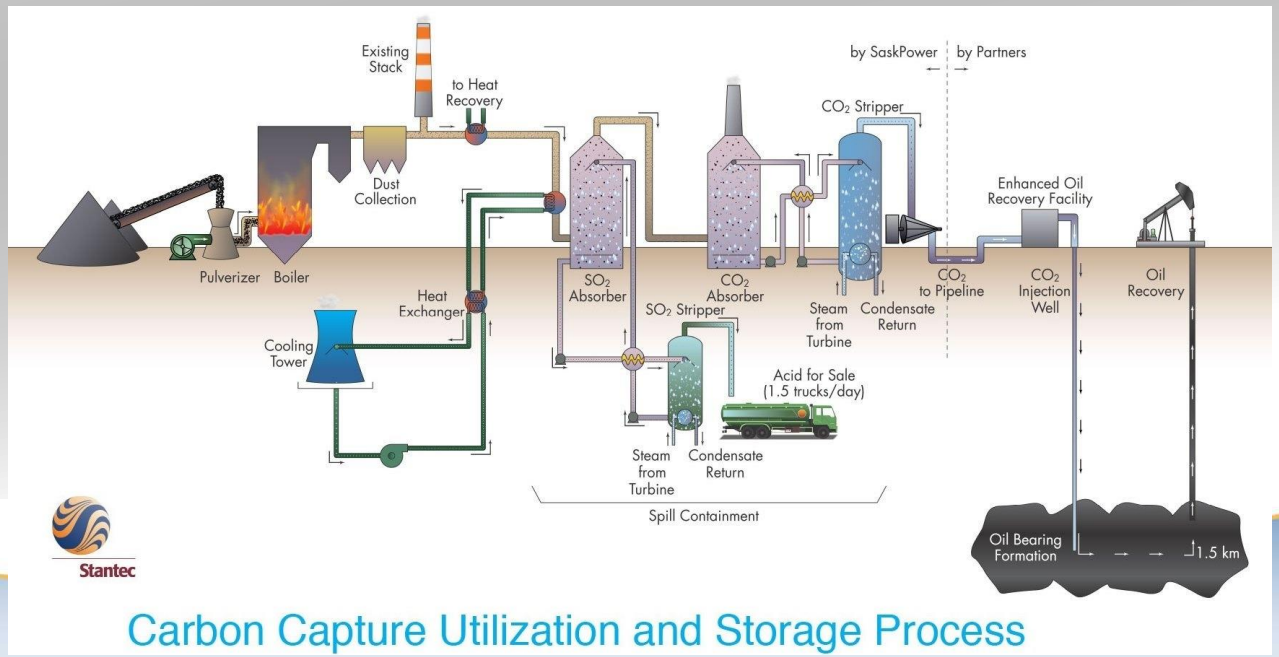
Final Outcome of Simulator Development

- Customer designed and tuned controls
- Understanding of system interactions
- Simple control logic errors were discovered and corrected
- Controls tuning was performed, which should help to expedite the commissioning process
- Helped in development of initial plant Operating Procedures
- Simulator delivered on time – allowing valuable operator training to commence on schedule



Carbon Capture Utilization and Storage Process

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Representative Simulators

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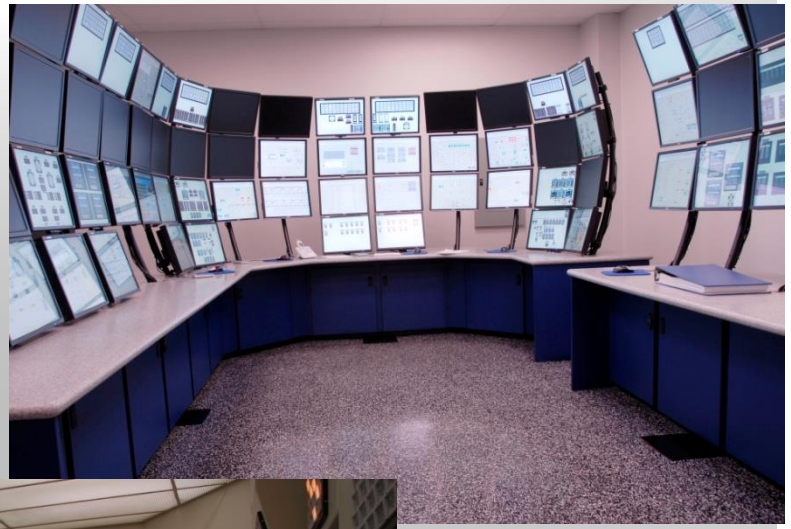
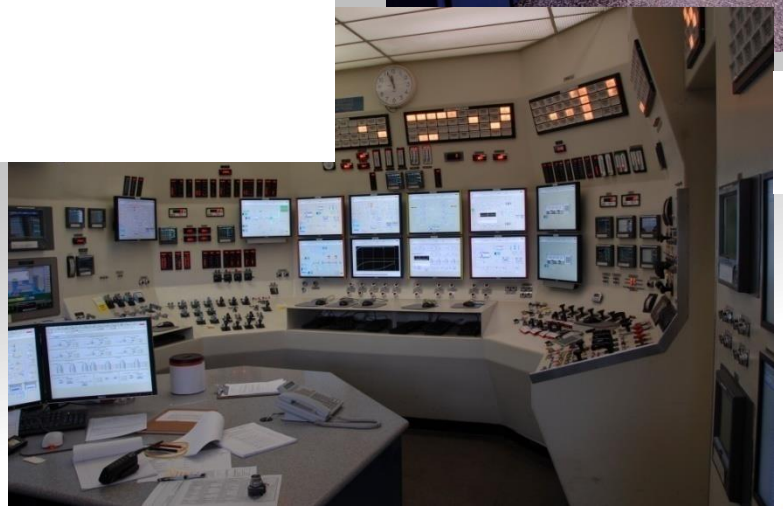
TRAX Simulators

TVA – Colbert Unit 5

- Hybrid ABB Symphony DCS / PPA HMI
- B&W Subcritical Once-through
- 550 MW Parsons Cross Compound TG
- Large emulated soft panel
- Delivered 2008, 2011





Control Room vs. Simulator

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Xcel Energy – Sherco Unit 3

- Foxboro I/A DCS & HMI - Virtual
- B&W Natural Circ / Balanced Draft Drum Boiler
- 915 MW GE Steam Turbine
- GE Mk II Turbine Controls
- ~ 36,000 I/O

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TVA – Widows Creek Unit 8

- 500 MW Coal Plant with twin furnace CE boiler
- ABB DCS – HTS Virtual
- BBC Cross Compound STG w/ ABB ProControl Turbine controls
- Fully modeled wet FGD, SCR and lime Injection systems
- HPE system with 56 LCD displays

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Duke Energy – Cliffside Unit 6

- 905 MW Supercritical balance draft boiler
- Ovation DCS - Virtual
- Toshiba STG w/ TOSMAP emulated turbine controls
- GE Mk VI BFPT Virtual controls
- Fully modeled wet FGD, dry FGD and SCR systems
- Delivered 2011

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Shenzhen Energy – Heyuan Power Plant

- 600 MW Ultra-Supercritical coal-fired Power Plant
- ABB DCS – Hybrid w/ PGP HMI
- MHI / Harbin Boiler and STG
- Fully modeled wet FGD system
- Delivered 2009

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Georgia Power – Plant McDonough

- 2x2x1 CCGT Plant Configuration – 840 MW plant output
- Ovation DCS - Virtual
- MHI M701G2 Gas Turbines
- Toshiba Steam Turbine
- Nooter-Eriksen HRSG’s
- Includes Simulator Training Program (STP) w/ Teaching Assistant

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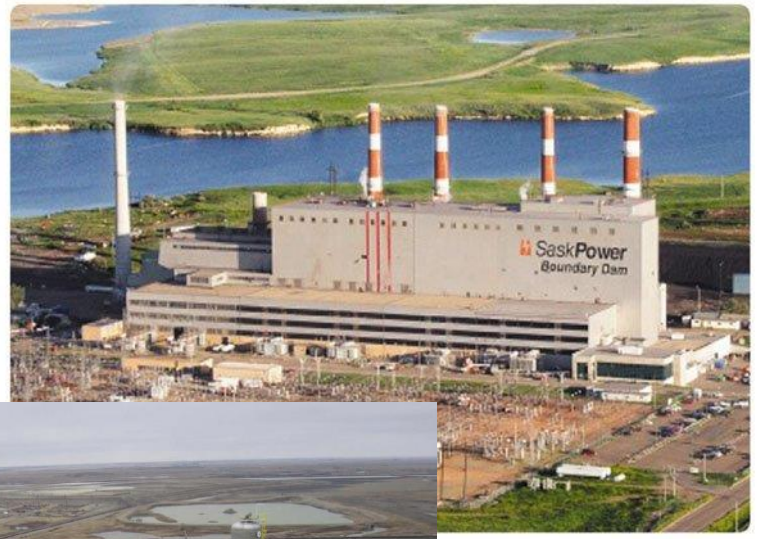
SaskPower – Boundary Dam Unit 3

- 160 MW coal-fired Power Plant with Full flow flue gas Carbon Capture
- Cansolv amine based CO2 and SO2 removal processes
- Power Island, Acid Plant and CO2 compression
- Multi-phased simulator delivery
- ABB 800xA DCS with PPA HMI



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Training Systems

Training Tools

- Full scope training services on-site or at TRAX, delivered with simulator projects
  - Needs-assessment
  - Curriculum development
  - Instructor and power plant operator training
- Self-guided simulator training: TRAX Teaching Assistant available on-demand around the clock: ‘Instructor-less’

New ProTRAX Cloud

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ProTRAX® CLOUD

ANYTIME ANYWHERE SIMULATION

ProTRAX CLOUD®

- Real Time
- Full Scope
- High Fidelity
- Train Efficiently
- Train Anytime, Anywhere
- Flexible
- Utilize any modern device and web browser
- No software install or downloads needed
- Priced Per Named User

TRAX




Thank You

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