Wayne Stefancin, Magnus Hammar, 2017-02-15

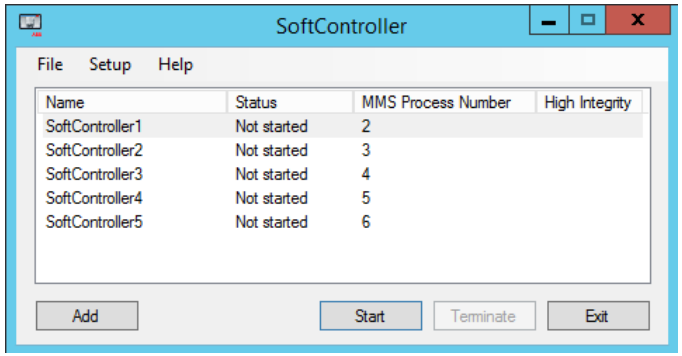
Simulation
ABB offering

Agenda

- Simulation purpose
  - Test platform for additional functions, simple manual process feedback simulation
  - 800xA Simulator for complete 800xA operator training and full automatic process feedback
- 800xA Simulation portfolio
- Simulation with Harmony

ABB 800xA Simple Simulation with AC800M
No process model feedback

- System 800xA has soft controllers available. Up to 10 AC800M controllers can be simulated in the same PC.
  - Could be used for very simple training purposes, i.e. get acquainted with Graphic Displays/Faceplates etc.
  - Uses the same control logic and HMI as in active plant
  - No Connection to any process model
  - Library Modules can be set in Sim mode, automatic simulation of discrete process feedback, for valves motors etc.
  - Analog process feedback must be done manually from faceplate or via excel OPC interface
- Main purpose: Test environment for new application code.



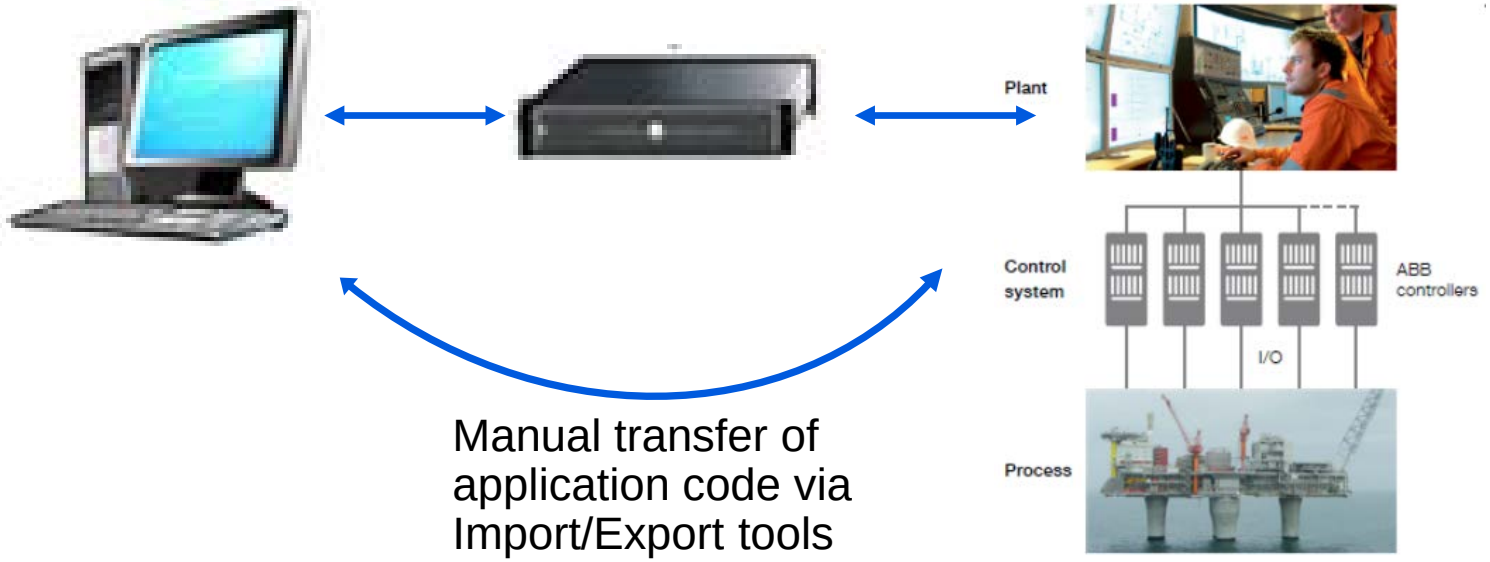
Single node for engineering and test simulation

ABB 800xA Simple Simulation with AC800M
Topology

Single node for engineering and simple test simulation

MS sharepoint server with ACM (Application change management)

Production System



Manual transfer of application code via Import/Export tools

ABB 800xA Simulator
Product introduction

- System 800xA Simulator is the control system part of a simulator:
  - System 800xA runs in simulator mode for training scenarios
  - Uses the same control logic and HMI as in active plant
  - Connects to model for process dynamics and instrumentation
- System 800xA Simulator provides a safe and realistic environment where operators can learn to master the process, thereby reducing risks and number of unplanned shutdowns
- System 800xA Simulator is a powerful tool for optimization and engineering studies to improve productivity and energy savings

ABB 800xA Simulator
Concept

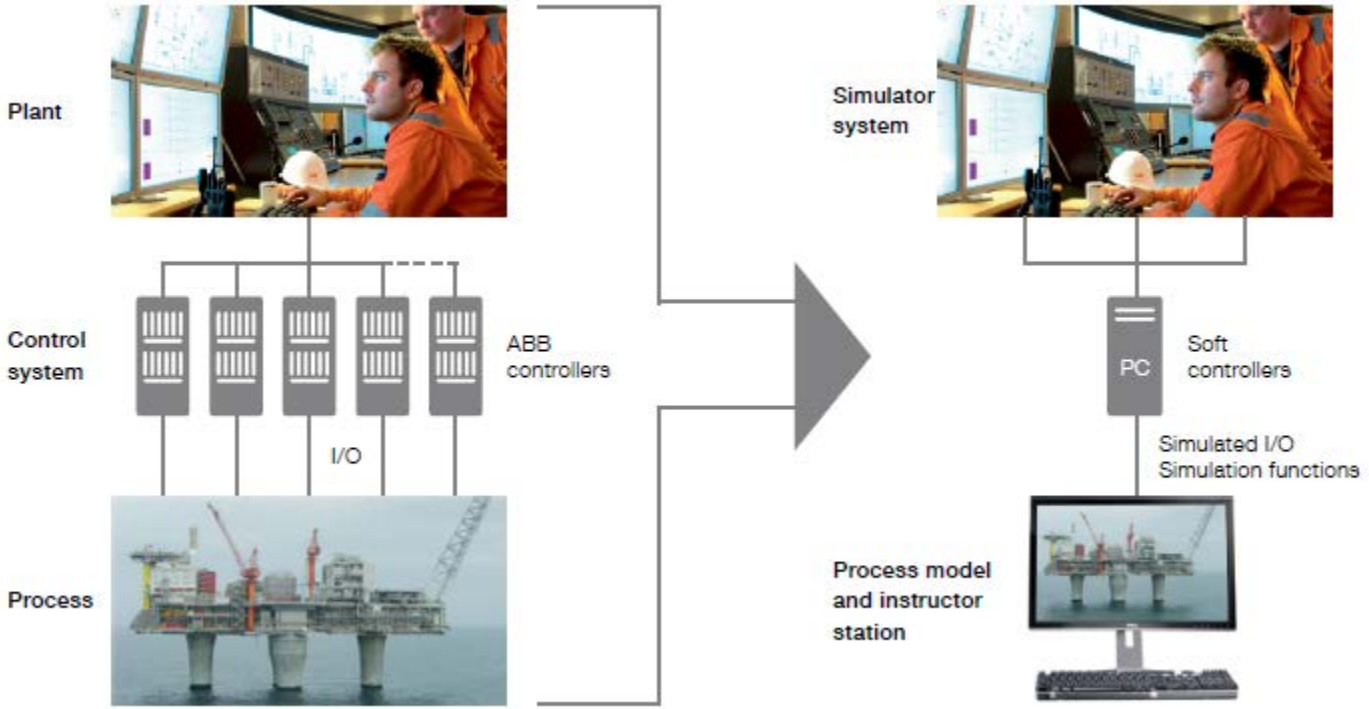
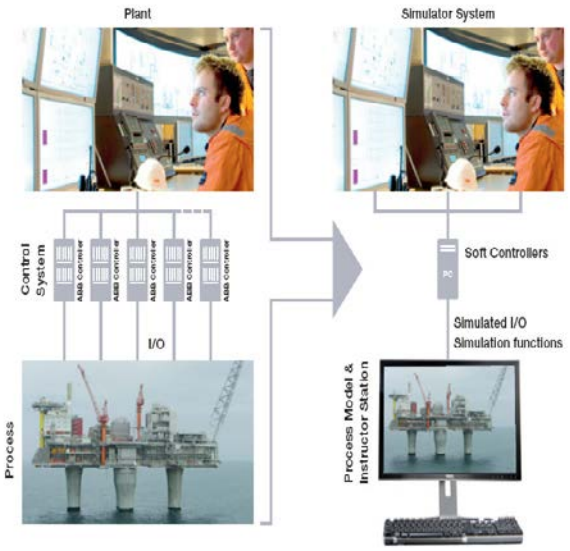
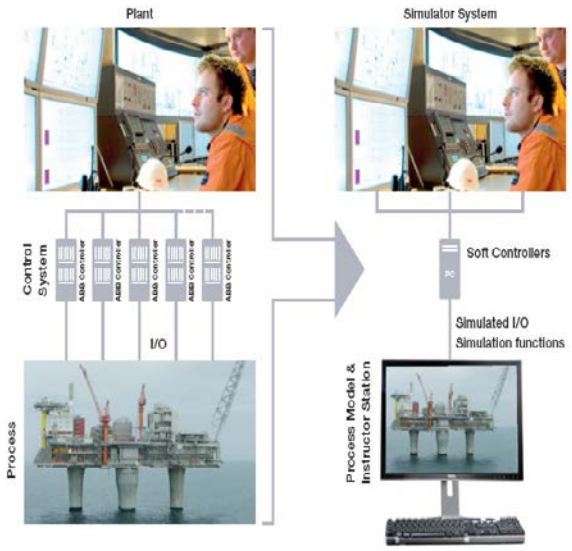


ABB 800xA Simulator
Features



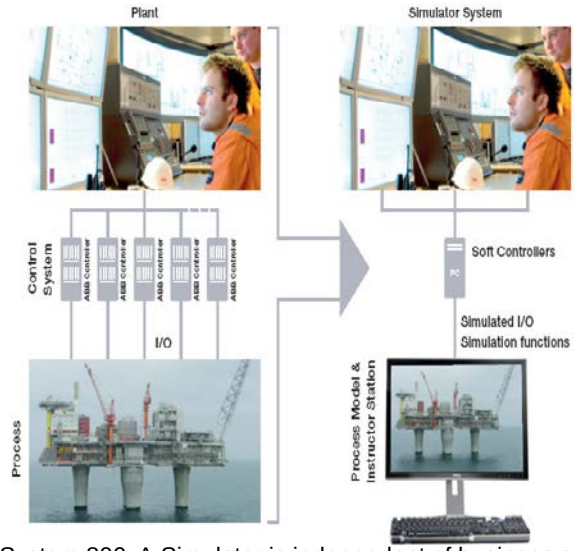
- Solution is based on System 800xA with additional simulator functionality for testing and training scenarios:
  - Start, stop, freeze and resume
  - Speed up/down
  - Snapshots
  - Initial conditions
  - Step execution
  - Record and replay
  - Soft controllers

ABB 800xA Simulator
Features



- Direct reuse of control code from real plant control system
  - SoftController for **AC 800M, Advant Master, Melody, Harmony, Freelance**
- Direct reuse of real plant HMI
  - System **800xA, Advant Station 500**
- **I/O** redirected from HW I/O to high-speed communication with dynamic model representing process

ABB 800xA Simulator
Features



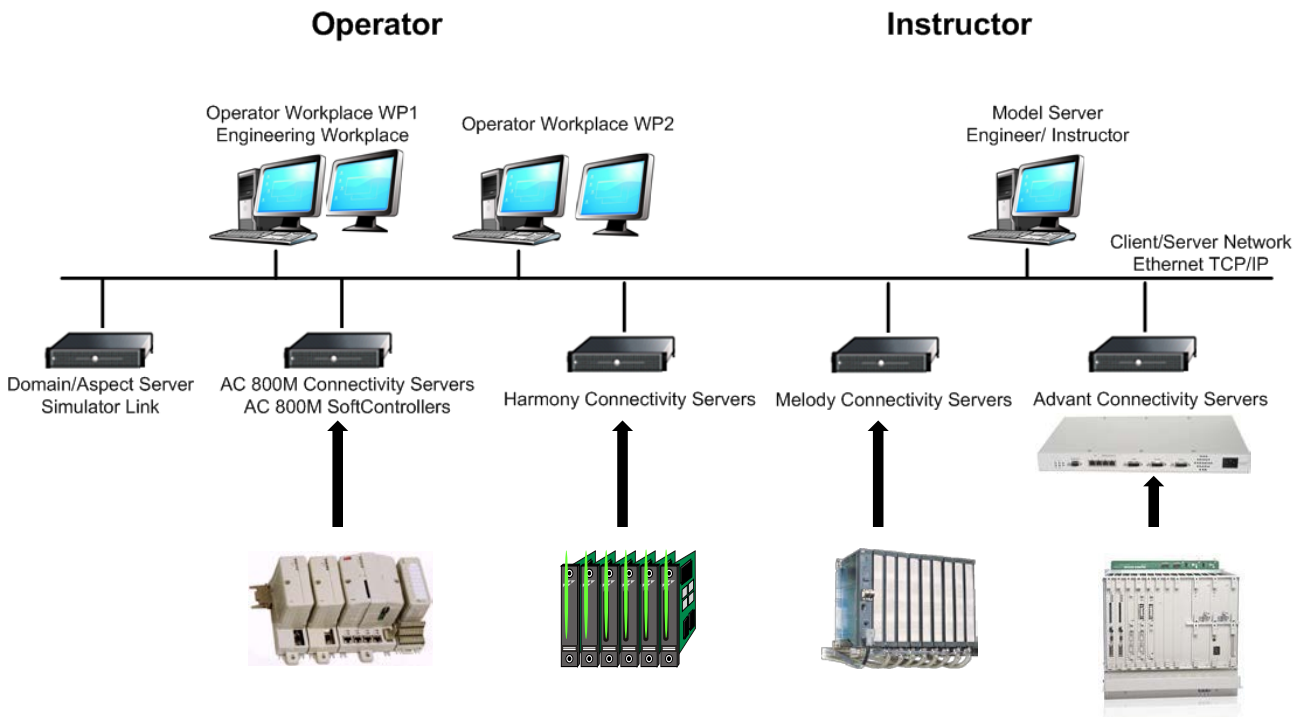
System 800xA Simulator is independent of business areas

Process models are more related to business area

ABB is independent of process model vendor

- Links control system to third-party process model
  - GSE (Power plants and nuclear power plants)
  - SimSci (Schneider/Invensys) (Power plants)
  - Trax (Power plants)
  - Samahnzi (Power plants)
  - Westinghouse (Nuclear power plants)
  - KSU (Nuclear power plants)
  - AspenTech (project specific: nuclear waste treatment)
  - Cape Software (Chemical and petrochemical)
  - Andritz Ideas (Pulp and paper)
  - Metso (Pulp and paper)
  - Kongsberg O&G Technologies (Oil and gas)
  - RSI (Oil and gas)
  - Honeywell UniSim (Oil and gas)
  - Optimation (Minerals and mining)
  - …

ABB 800xA Simulator
Typical topology



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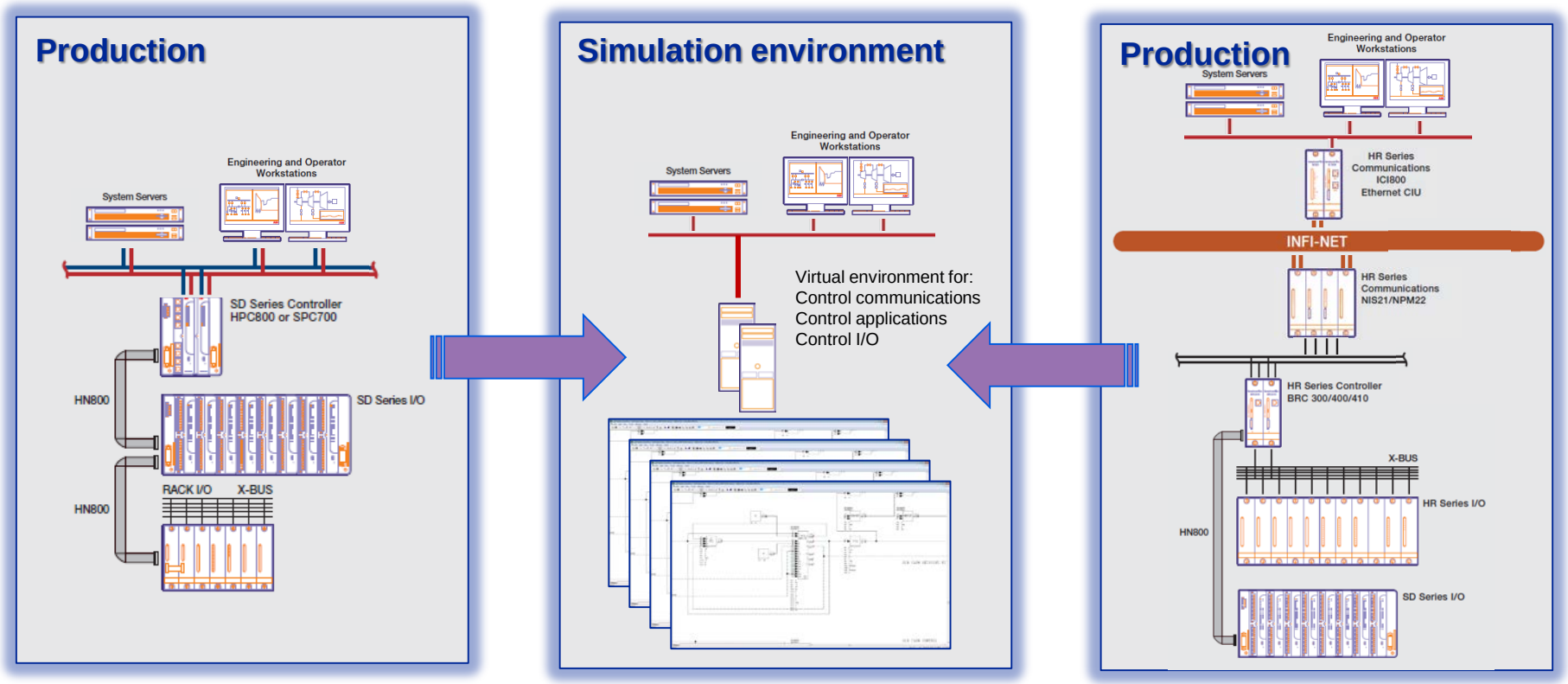
Simulator Solutions
ABB Virtual Controller Provides the Core

- ABB provides a Virtual Controller for Harmony (HTS)
  - Executes the plant control logic **true to physical controllers**
  - Supports simulation commands (run, freeze, step, snapshot etc.)



SD Series | Virtual Controller | HR Series

Simulator Solutions
Types of Models

- High Fidelity Model simulator solutions
  - 3rd party high fidelity models drive I/O via HTS OPC interface
  - 3rd party instructor station manages the simulation scenarios, fault insertion & sends simulation commands to HTS via OPC interface
- Function Code Model simulator solutions
  - Tie-back and/or function models (low/medium fidelity) are done in function code logic and drive I/O via an inter-controller mapping
  - Scenarios & simulation commands driven from HTS user interface
  - Fault insertion done from an Operator Workstation via faceplates
  - Option for 3rd party instructor station exists

Simulator Solutions
Lining up with the Plant's Goals

Functionality	Check-out	Concept Training	Basic Op Training	Extended Training	Engineer Grade
Graphic Verification (drive I/O & values)	X	X	X	X	X
Device Verification (w/permissive)	Option	X	X	X	X
Normal Operations (start-up/shut-down etc.)		Limited	X	X	X
Scenarios w/in plant systems			Limited	X	X
Scenarios between plant systems			Limited	X	X
Virtual Commissioning				Limited	X
Standard Component Failures	Limited	X	X	X	X
Specific Equipment Malfunctions			X	X	X
Complex Malfunctions between plant systems			Limited	X	X
Malfunctions for extreme plant conditions					X
Pipe empty startup (optional)				Limited	Option
Black start				Lim Opt	Option
Picture Realistic Panel Support				Lim Opt	Option

Integrated Instructor Station
State-of-the-art training platform w/lower cost models

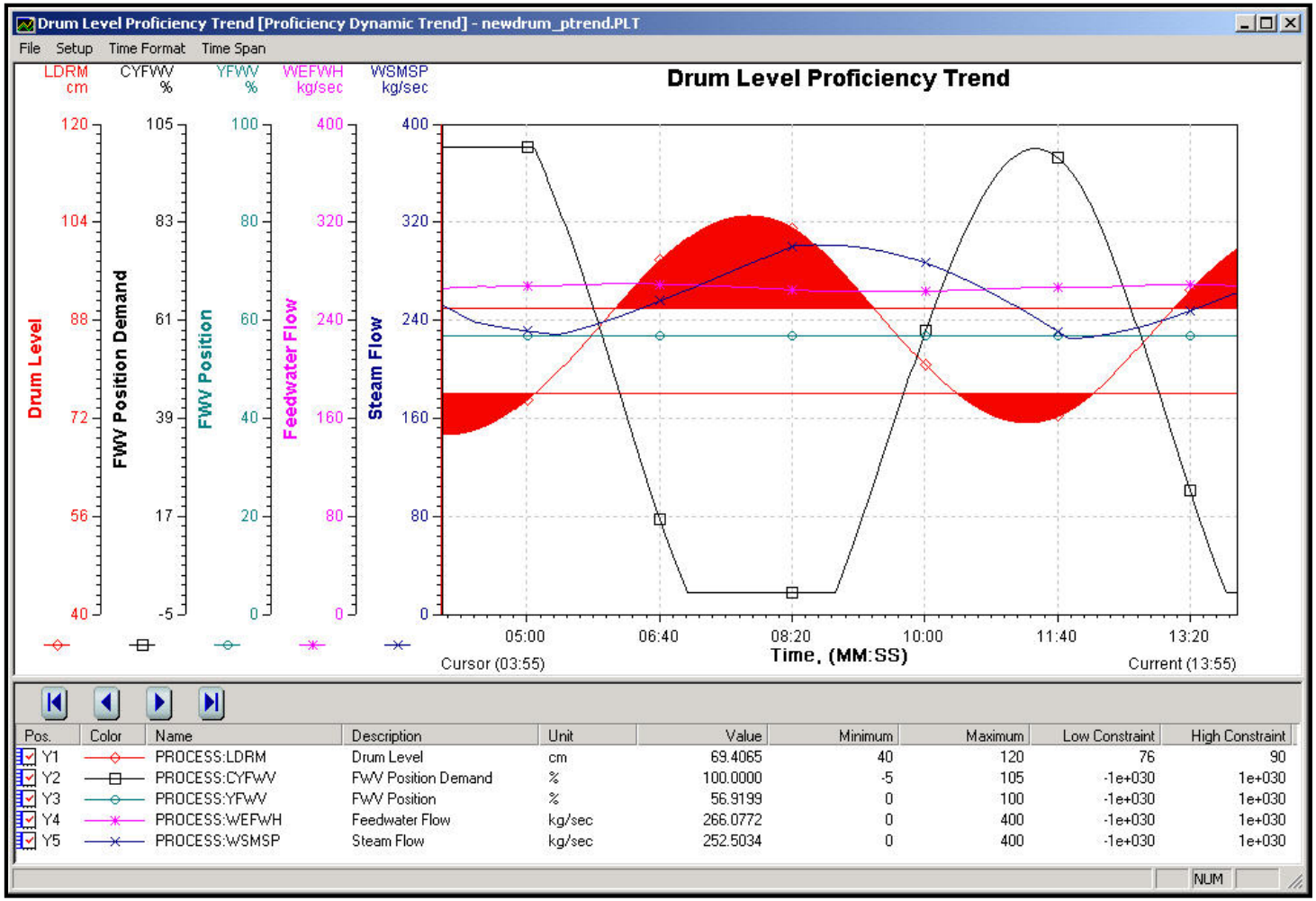
- Supports both instructor lead and self-paced training
  - Initializes the simulator for training
  - Tracks and records trainee proficiency
  - Provides tools to build and modify training scenarios
  - Invokes malfunctions
  - Records data
- Supporting the Panel Emulation solutions
  - Displays locally operated control screens (LOS)
  - Displays hard panel emulation screens
- Supports a mix of Function Code and High Fidelity models
  - Allows future expansion/evolution
  - Supports integration of 3rd part virtual controls/HMI

Integrated Instructor Station
Tracking and recording student proficiency

Data Recorded on Lesson Results

- Instructor and student name
- Files loaded to initialize the lesson
- Date and time at start and end of training lesson
- Duration of lesson
- Duration score – This score indicates if the session was completed within a defined time limit
- Constraint score – This is an average score that indicates how well all critical system parameters were maintained within defined limits. Additional data recorded for each critical parameter includes:
  - Number of times defined limits are exceeded
  - Minimum and Maximum value of parameter that exceeded limits
  - Total violation time
- Procedure score – This score indicates how well the student followed a defined procedure (available when using the Teaching Assistant)
- TA Test Score – This score indicates the student's performance on a multiple choice test (available when using the Teaching Assistant)
- Line and bar graphs of critical system parameters

Integrated Instructor Station
Tracking and recording student proficiency



Trend Showing Constraint Violations

Integrated Instructor Station
Curriculum Development services

Simulator Training Program (STP)

Instructor-Guided Lessons

Instructor Manual

Chapters

1. Introduction
2. Lesson Overview
3. Using STP Documents
4. STP Administration

Appendices

A. Course Syllabus
B. Initial Conditions
C. Scenario File Definitions
D. Feedback Questionnaire
E. Simulator Training Record
F. Role Playing
G. Instructor Checklists
H. Simulator Skills Evaluations
I. Lesson Plans

Student Manual

Chapters

1. Introduction
2. Plant Operating Procedures

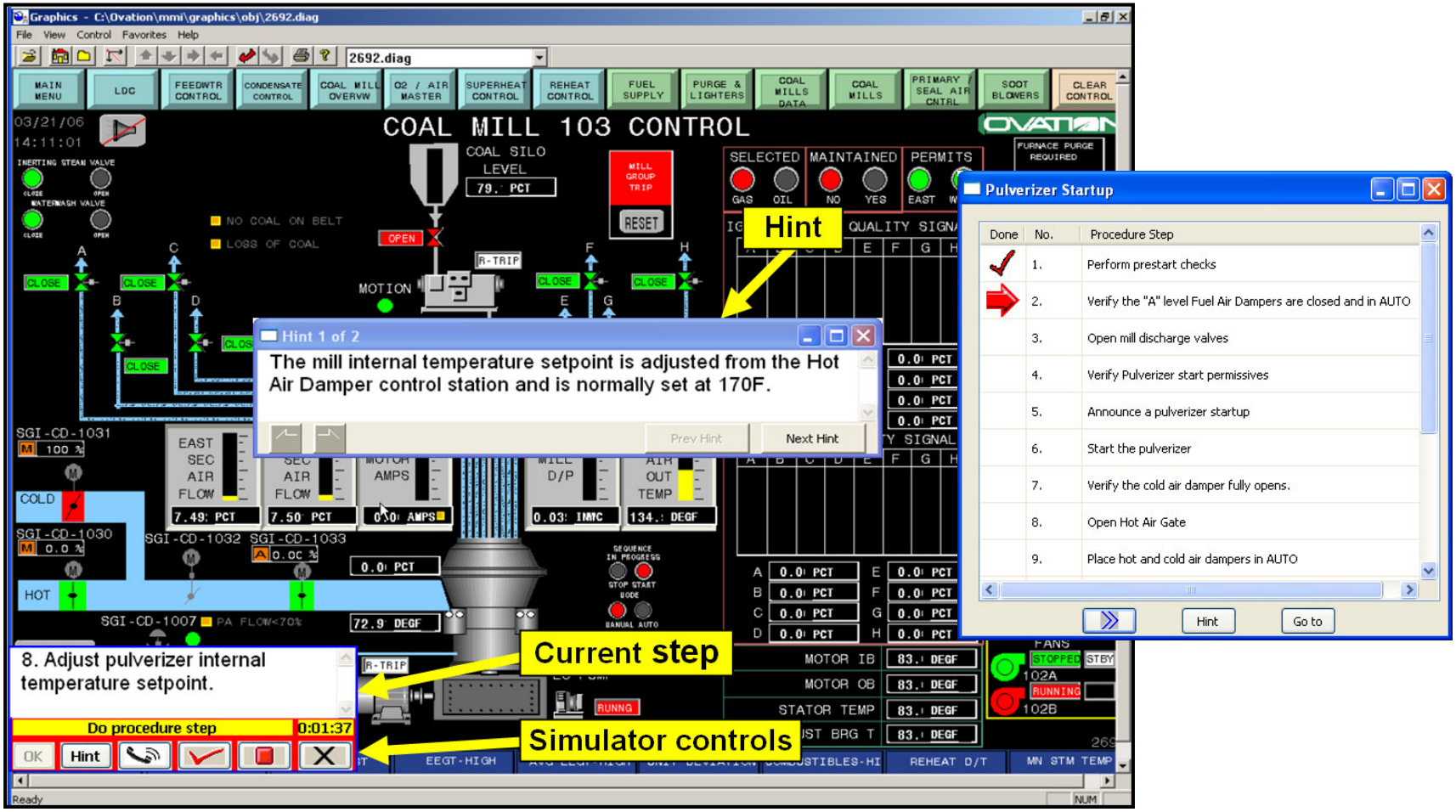
Appendices

A. Student Training Process
B. Training Levels
C. Lesson Summaries
D. Simulator Description

Teaching Assistant (TA)

These self-study lessons use the Teaching Assistant software installed on the simulator. A hard copy Overview of TA Lessons is provided in the STP Instructor Manual.

Integrated Instructor Station
Teaching Assistant - self paced learning examples



Operator help can exist while learning but be hidden during testing

Integrated Instructor Station
Teaching Assistant - self paced learning examples

Good self paced examples limited to 20 or less steps

- Condenser Circulating Water System Startup
- Closed Cooling Water System Startup
- Steam Turbine Prestart
- Boiler Prestart
- Combustion Air and Gas System Startup
- Boiler Lightoff and Warmup
- Condenser Air Evacuation
- Steam Turbine Startup
- Ramp the Unit to Minimum Load
- Ramp the Unit to Full Load
- Pulverizer Startup
- DCS Screen Familiarization
- Generator Synchronization
- Tying the HRSGs together (CCPP 2-on-1)

Integrated Instructor Station
ABB provides supporting workshop

Simulator System Workshop Outline

1. **Introduction**
   - Simulator Training Program development
2. **Simulator System Concepts**
   - Simulator System Architecture Overview
   - Simulator Hardware and Software
   - HTS operations
   - HTS components – VICI, VPCU, HTS Manager
   - Insights to the HTS modeling and how to interact with it
   - Understand standard device failure modes
   - Understand pre-programmed malfunctions
3. **Operating the Instructor Station**
   - Simulator Startup and Shutdown
   - Logging on the Instructor Station
   - Initializing the Simulator for Training
   - Instructor Screens
   - Loading, Running, and Saving Initial Conditions
   - Snapshots
   - Button Overlay Bar (BOB)
4. **Building Training Scenario Files**
   - Command, Data Log, and Trace Windows
   - Building Logs, Trends, and Plots
   - Creating, Modifying, and Initiating Malfunctions
   - Forcing I/O
   - Scoring Trainee Performance
5. **Running Training Scenarios**
   - Setting Up and Running Scenarios
   - Monitoring Trainee Performance
   - Archiving a Training Session
   - Student Management
6. **Maintaining the Simulation System**
   - Details of addressing and setting up Loop, PCU, Modules
   - Details on creating OPC lists (config.txt files)
   - HTS troubleshooting & using the ABB engineering tools
   - What to do if the location of an I/O point changes

Consulting Services Outline for Advanced Simulator Operations Training workshop

1. **Preparing for Simulator Training**
   - Training Scenario preparation
   - Evaluated Scenario preparation
   - Organizing STP documentation and handouts
2. **Conducting the Scenario Briefing**
   - Training objectives
   - Discussion topics
   - STP documentation
   - Initializing the simulator for training
3. **Conducting the Training Scenario**
   - Effective use of Role Playing
   - Coaching, questioning, and effective communication techniques
   - Discussion topics
   - Monitoring student performance
   - Effective use of the Instructor Station
   - Malfunctions
   - STP documentation
4. **Conducting the Post-Scenario Critique**
   - Identifying strengths and areas for improvement
   - Supporting documents – notes, trends, plots, lesson results
   - Student feedback
   - STP documentation

Product Update
Scaled Licensing for More Options

- Harmony Training Simulator Licensing:
  - HTS Tags (Virtual ICI sizing)
  - HTS OPC server points (simulated Hard/Soft I/O)
- Base HTS Server
    - 5,000 HTS Tags,
    - 250 OPC Server Points
    - up to 100 Virtual Controllers
    - 2 virtual ICIs (concurrent connections)
- Standalone Simulate and Test Package
  - Soft Controller: For Engineering Test Bench
    - 2,500 HTS Tags,
    - No OPC Server Points
    - 1 Virtual Controllers
    - 2 virtual ICIs (concurrent connections)

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