Offshoredag Esbjerg, Elise Thorud, May 31st, 2012

Operator Training Simulator
Offshoredag Esbjerg
Operator Training Simulator

- Speaker name: Elise Thorud
- Speaker title: Sales & Product Manager
- Company name: ABB AS
- Location: Oslo, Norway
ABB Norway
Simulator experience and product responsibility

- 20 years of experience, more than 100 deliveries
  - ~40 Advant/Master Operator Training Simulators
  - ~80 800xA Simulator systems delivered

- Follow 800xA release plans
- Control system integration
  - AC 800M
  - Advant Master
  - Melody
  - Harmony
- Mixed control system types
Key Business Areas for Simulator

- Oil & Gas
- Refineries, Petrochemicals
- Nuclear Power Production
- Fossil Power Production
- Pulp & Paper
- Minerals & Mining

- ABB’s 800xA Simulator is independent of business areas
- Process models are more related to business area
What is a Simulator?

A Virtual Plant

The term “Simulator” is being used to describe all from simple to complex simulators!
What is a Simulator?

A Virtual Plant

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Multidiscipline product tailored/customized to client’s plant
Why Simulator?
Invest to reduce losses and increase production

- Example from ARC 2007:
  - The global process industry loses $20 billion, or five percent of annual production due to unscheduled downtime and poor quality
  - For the global process industry almost
    - 80 percent of these losses are preventable and
    - 40 percent are primarily the result of operator error

Average Dollar Loss By Cause (millions of dollars)

- Operational error
- Design error
- Process upset
- Mechanical failure
- Unknown
- Natural hazard
- Sabotage / arson

HPI (Hydrocarbon Processing Industry) Market Data 2003
Source: J&H Marsh & McLennan, Inc
Why Simulator?
Invest to reduce losses and increase production

HPI ACCIDE

HPI Market Data 1956-1986

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Why Simulator
Justification - Business Results Achieved

BP study on the benefits of OTS:

- 5-year period, BP installed OTS at four of its major sites Chemical sites in the UK.
- Four quantifiable categories:
  1. initial startup savings of 8 days,
  2. 1 saved day on subsequent startups on overall turnaround,
  3. 2 production days saved each year from improved recovery from upsets,
  4. 1 percent improvement in costs through better control of the plant.

- At another site, BP estimates its OTS saved nearly $20 million dollars over a 5 year period given a simple payback in excess of twenty times its original investment.

Uses and Benefits of Dynamic Simulation for Operator Training Systems,
Dr. Tom Fiske, ARC Insights, August 9, 2007
Why Simulator Operator Training

Train Personnel

Operator hazard Training

Design → DCS Configuration → Production Start → Plant Operation → Modification
Why Simulator Operator Training
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Why Simulator Operator Training

Learn to master the process in a safe and realistic environment

Confidence
Why Simulator Operator Training

Focus for the operator training:

- Safety
- Avoid shut-down
- Increase production
- Avoid breakdown of complicated and expensive equipment
- Realistic training in safe environment
- Enables training that otherwise would not be possible or too expensive
- Higher confidence:
  - Higher regularity
  - Higher process flow
Why Simulator Operator Training

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Example: BP, Hull: Simulator training typically saves:

- 1 week saved on plant start up, as operators & technicians are up to speed on DCS/ESD/Operating procedures due to “Just in Time Training” on the simulator prior to operating with the plant HMI and DCS.
- 1 plant trip/shutdown avoided per shift team per year (6 in all) due to the operators & technicians being better trained and being able to take pre-emptive action before a plant trip
Runtime Simulation Functions
Comprehensive set of simulator functions

- Run mode features
  - Transfer I/O between controllers and simulator model
  - **Freeze** simulation without bumps
  - Record and replay
  - Save snapshot in background
  - Time synchronization between simulator model and control system
  - Running in Real Time speed, as well as slower or faster than Real Time
  - Acknowledge Alarms

- Freeze mode features
  - Save or load Initial Conditions (ICs)
  - Save and load Snapshots
  - Save Snapshots as Initial Condition
  - Resume simulation without bumps

- Instructor functions
  - Built in scenarios
  - Training evaluation
Runtime Simulation Functions
Comprehensive set of runtime simulator functions
Runtime Simulation Functions
Comprehensive set of runtime simulator functions

Value

Time

Snapshot
Initial Condition

Data storage
Runtime Simulation Functions
Comprehensive set of runtime simulator functions

Value

Time

Data storage
Runtime Simulation Functions
Comprehensive set of runtime simulator functions
Why Simulator?
Benefits

- Safety benefits:
  - Reduced risk to people, environment and equipment through training and testing.
    - Human error is a critical aspect in most accidents
  - Learn to master the process in a safe and realistic environment
  - Test control modifications before transferring them to plant

- Cost benefits:
  - Reduced commissioning costs
  - Training before production start
  - Increased product quality and productivity
  - Reduced down time and time for restarts after shutdown
Why Simulator?
Example: Intermountain Power Service Corporation

"The simulator paid for itself as a result of the DCS-Checkout alone."

Bill Morgan
Project Manager on DCS Project

DYNSIM-Power Simulation Software Validates Controls and Trains Operators on new DCS

Goals
- Replace the existing simulator as part of a DCS upgrade project to help prepare operations for the new user interface and control logic changes.
- New simulator to replicate the actual dynamic response of the operations and without any significant loss of megawatt production.

Challenges
- Validate the control logic against actual operations
- Build operator knowledge and confidence in the new DCS prior to going on-line
- Eliminate unplanned downtime or emergency shutdowns

Solutions and Products
- DYNSIM® Power simulation

Results
- Validated control logic and identified and fixed critical errors prior to going online
- Controls placed in automatic within 24 hours of start-up after DCS Upgrade
- Avoided potential losses to plant due to shutdown estimated at $1,000,000 a day
- Assists in maintaining a constant plant output of 13 million megawatt (MW) hours a year

• Avoided potential losses to plant due to shutdown estimated at $1,000,000 a day
Life Cycle Simulator
Simulator Concept
Life Cycle Simulator
Simulator principal
Life Cycle Simulator
800xA Simulator

- **Stimulated solution**
  - Direct reuse of control code from the real plant control system
  - Direct reuse of the real plant HMI
  - I/O redirected from HW I/O to high speed communication with the dynamic model representing the process

- **Results**
  - Ensures realistic and correct behavior identical to the automation system
  - Effective and error free transfer of code between plant system and simulator
  - Reduced maintenance and operating cost
  - No negative training
Life Cycle Simulator
Process model vendor

- 800xA Simulator links the control system to 3rd party dynamic process model
  - Kongsberg O&G Tech.
  - RSI
  - Esscor (Invensys)
  - GSE
  - KSU
  - Westinghouse
  - IDEAS
  - Honeywell
  - Aspentech
  - CapeSoftware
  - Trax
  - …
Life Cycle Simulator
800xA Simulator Application and HMI
Life Cycle Simulator
800xA, AC800M, Harmony, Melody, Advant
Life Cycle Simulator
Simulator topology

Operator
- Alarm Printer
- Operator Workplace WP1
- Operator Workplace WP2
- Domain and Aspect Server Simulator Link
- AC 800M Connectivity Servers
- AC 800M SoftControllers

Instructor
- FOD Station
- Model Server Engineer/Instructor
- Color Laser Printer

Client/Server Network
Ethernet TCP/IP
Life Cycle Simulator

Ormen Lange: Process Design Verification

Operators in Swedish nuclear powerplants need to be certified each year in the simulator training facilities run by KSU

- Equipment Design Verification and Test
- Hazop

- Safety and Automation System Verification and Test
- Verification of Operational Procedures

- Training of Operators
  - Optimization and What IF studies

- Modifications Test

“...The simulator paid for itself as a result of the DCS-Checkout alone.”

Bill Morgan
Project Manager on DCS Project

Ormen Lange: Start-up 3 weeks ahead of schedule
Safety Culture Post Macondo
Continuous Improvement Culture in Operations

- Review training and development programs
- Continued review of competency assurance programs
- Revised operating procedures
- Additional capture and dissemination of best practices
- Regularly assessed by Performance Monitoring Audit and Assessment (PMAA)
  - Required every two years on active rigs
  - Verify compliance with Company Management System
  - Monitor, evaluate and identify actions to continuously improve performance
  - Evaluate effectiveness of Company Management System
Project Ormen Lange

Ormen Lange natural gas plant
The largest industrial project in Norway

2004 Q1 → Process Design Verification
Process model from Kongsberg Maritime

2004 Q3 → Control logic engineering
1 800xA Simulator system for engineering connected to process model
Start Control logic verification. One by one section added.

2005 Q3 – Control cabinets shipped to site
15,000 I/O in total, mainly on HART and Profibus

2006 Q2 – Control logic programming finished
– Operator Training
  2 operator training systems used (1 leased to production start)
  Simulator facility close to the operation center
  Operator training in parallel with process case studies and control logic updates on engineering simulator
Project Ormen Lange (cont.)

Ormen Lange natural gas plant
The largest industrial project in Norway

2007 Q3 – Production start 3 weeks early
Process optimization and modification studies.
Examples:
- Added new process sections (electrification) for operator training
- Test all changes on simulator before implementing on real plant (e.g. library updates)
- Detecting remaining control logic errors when running case studies on simulator

2008 Q4 – Uptime of 99 %
“Teknisk Ukeblad” 28.10.2008:
According to Production Manager Hollen, the plant at Nyhamna has an uptime of 99%.”
800xA Simulator Installations
SCA Obbola & Östrand

- Recovery Boiler
- Control System Test
- Operator Training

**Project report:**
Until now the main use for the (Östrand) simulator has been education. The simulator was part of the system from ABB that controls the new recovery boiler from Andritz. This was ready in October 2006. Andritz also delivered the process model. From day one, the new recovery boiler was run by experienced operators, largely due to training in the simulator.

“No one was allowed to operate the recovery boiler without one week of simulator training”, Fredrik Jönsson explains.
Why Simulator?

ARC INSIGHTS

INSIGHT# 2007-38MPH
AUGUST 9, 2007

ARC Survey OTS Best Practice:
Benefits Cited by Users

- Improved Startups
- Enhanced Operator Performance
- Trip and Incident Avoidance
- DCS Checkout and Factory Acceptance Testing
- Test Proposed Operational Changes
- Knowledge Capture

Engineering Simulator
Check out
Training Personnel
Operator hazard Training
Optimization Changes

Design
DCS Configuration
Production Start
Plant Operation
Modification
Contact information
Contact information

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