An Effective DeltaV Operator Interface for Sunrise

Dan Janzen - Husky Energy Operations Manager
Jamie Errington – Human Centered Solutions
Patrick Aimar - Emerson Project Manager
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**EmersonExchange@Emerson.com**

Thank you.
Presenters

- Dan Janzen
- Jamie Errington
- Patrick Aimar
Introduction

- Husky Energy Background
  - Sunrise Project
  - HOIMS – Husky Operational Integrity Management System
- Operator Interface Requirements
- Library Development (Process and Team)
- Final Dynamo and Display Examples
- Conclusions & Discussion
Husky Energy Sunrise Project

About Husky
- Large integrated energy company in Canada
  - operating worldwide with Upstream, Midstream and Downstream business segments
  - Active in the exploration and production of heavy oil in Western Canada

Sunrise Oil Sands Project
- Utilization of Steam Assisted Gravity Drainage Technology (SAGD)
- Joint venture project with BP
- Located 60 km Northeast of Fort McMurray, Alberta
- Reservoir with 3.7 billion barrels of possible reserves
- 1st Phase
  - 2.5 B$ investment to produce 60,000 barrels of oil per day
  - Production targeted for 2014
- Regulatory approvals in place for 200,000 barrels.
Husky Operational Integrity Management System (HOIMS)

- HOIMS
  - A comprehensive system that integrates elements of occupational safety with process safety.
  - Consists of 14 elements which set the minimum requirements for the management systems

- HOIMS program set foundation for the Project
  - Specifically Element 2 (Safe Operations)
1. Leadership, Commitment and Accountability
2. Safe Operations
3. Risk Assessment and Management
4. Emergency Preparedness
5. Reliability and Integrity
6. Personnel Competency and Training
7. Incident Management
8. Environmental Stewardship
9. Management of Change
10. Information, Documentation and Effective Communication
11. Compliance Assurance and Regulatory Advocacy
12. Design, Construction, Commissioning, Operating and Decommissioning
13. Contracting Services and Materials
14. Performance Assessment and Continuous Improvement
Applying Human-Centered Design

To meet the HOIMS objectives, Husky Energy Sunrise project has used a Human-centered design approach on key design aspects including:

- Operator Interface
- Console
- Control Room
- Manufacturing Centre
- Training System
- Procedure Management
What is Human-Centered Design (HCD)?

- HCD is a design methodology & work process
- The HCD work process is often characterized by four main activities which form the main cycle
  - Specify the context of use
  - Specify requirements
  - Create design solutions
  - Evaluate designs
- Multi-disciplinary Science
  - Emphasis:
    - Understanding the people
    - Understanding the work domain
    - Understanding the design space
  - Working with End-Users & Stakeholders
  - Follow through with Implementers
Overall Development Process

- Operator Interface was initial component for the design
  - Start with HMI vision, philosophy and style guide
  - Designed the console to accommodate the HMI

- Educational workshops with Operations Team to:
  - Create understanding of Human Factors
  - Get buy-in on design approach

- Prototype Library Development
  - Testing of all elements

- Developed Displays
What Husky Sunrise Wanted – the “Vision”

- Evaluated previous HMI experience at Husky’s Tucker Plant
  - Good “single-window” design in DeltaV
  - Did not meet the major elements of the ASM Consortium’s® Effective Operator Display Guideline

- Wanted comprehensive, human centered system
  - Supports Situation Awareness for operations teams
  - Effective prevention and response to abnormal situations
What Husky Sunrise Wanted – the “Vision”

ASM Consortium Guidelines
Effective Operator Display Design
2008

<table>
<thead>
<tr>
<th>Categories</th>
<th>No. of G/Ls</th>
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</thead>
<tbody>
<tr>
<td>1: Display Types</td>
<td>7</td>
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<tr>
<td>2: Display Content</td>
<td>7</td>
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<tr>
<td>3: Display Style</td>
<td>6</td>
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<td>4: Display Layout</td>
<td>5</td>
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<tr>
<td>5: Navigation</td>
<td>6</td>
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<tr>
<td>6: Color</td>
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<td>7: Symbols and Process</td>
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<td>8: Text and Numbers</td>
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<tr>
<td>9: Interactions and Displays</td>
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<tr>
<td>10: Alarm Configuration</td>
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<td>11: Audible Annunciation of Alarms</td>
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<tr>
<td>12: Visual Annunciation of Alarms</td>
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<tr>
<td>13: Training Program</td>
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<td>14: Online User Assistance</td>
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<td>15: Design Methodology</td>
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<td>16: Management of Change</td>
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<td><strong>Total</strong></td>
<td><strong>14</strong></td>
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</table>

**6.1**

Use a minimum of color codes consistently across display hierarchy levels.

<table>
<thead>
<tr>
<th>Why?</th>
<th>Priority 1</th>
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</thead>
<tbody>
<tr>
<td>Consistent, distinguishable color codes allow operators to learn the codes and the meaning behind them.</td>
<td></td>
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</table>

**How It Works**

The number of colors used to code categories of objects should be kept to seven or less, and be consistently applied. Seven corresponds to the number of items that can generally be kept in short term memory (Wickens and Hollands, 1999). The seven color codes do not limit the coding of other information separate from the category information. For example, an unacknowledged, high alarm could be a brighter, more saturated yellow, which is distinct from an acknowledged high alarm that would be a paler, less saturated yellow. These two states of high alarms are distinct from red color-coded emergency alarms, which are either more or less saturated depending on their state of acknowledgement.

In general, color coding to indicate materials in process lines is not recommended in normal display view because it can draw the operator’s attention away from more critical information. If one insists on showing lines colored based on material they contain, then colors should be implemented such that they can be toggled on and off (or show this representation in a view generated by the IT system supporting the plant).
What is Situation Awareness

- Situation Awareness is:

  “knowing what is going on around you so you can figure out what to do”\textsuperscript{1}

SA Failure Studies in Aviation

- Research in the fields of military and civil aviation has identified situation awareness failures as the leading contributor to accidents.
- One study found that 88% of major airline accidents involving pilot error were problems with SA rather than decision making or flight skills.

Situation Awareness for Operations

Perception:
- Detect presence of abnormal/emergency situation
- Detect location of situation
- Detect speed of change

Comprehension:
- Understand potential threat
- Understand possible causes
- Determine appropriate course of action

Projection:
- Understand outcomes of actions
- Estimate when undesirable consequence
- Estimate time to respond for alternatives
How Do We Get Situation Awareness

**External Cues**

- Perception:
  - Notice patterns, deviations, and changes
  - Listening to radio transmissions
  - Hearing audible alarms & reading alarm descriptions
  - Seeing activity on another console

- Comprehension:
  - Having a **mental model** that can be applied to:
    - How the process works
    - How close to critical limits is the operation
    - Stability of the process

- Projection
  - Anticipating how quickly the process might exceed a limit
  - Knowing whether a control action will have the desired affect
  - Knowing the time to steady-state
Solution Elements to Support SA

- Console Design
- Console-wide overviews
- Simultaneous, multi-level views

Designed for the Console Operator:
- View Angles
- Secondary support position
- Ancillary equipment
Operator Interface Concept

Key Design Features

- Single, Integrated View of Multi-Level Hierarchy
- Simultaneous views of increasing detail
  - Level 1 – Console Overview
  - Level 2 – Unit Summary
  - Level 3 – Equipment detail
  - Level 4 – Group & Point detail
- Effective Window Management and Layout
- Effective Navigation Scheme
- Visual Coding Scheme
- Integrated alarm management
- Integrated Trending
HMI Design

- **Select Screen Size and Resolution**
  - Wide-screen format for long-term support
  - Selected Samsung MD230 high resolution, narrow bezel, good viewing angle support

- **Build prototype for evaluation**
  - Set Window format and sizes
  - Use preliminary display hierarchy
  - Used PCSD module library

- **Utilized Tucker Displays**
  - Good starting point for many areas

- **Utilized vertical faceplate to reduce library development effort**
Level 1 – Console-wide Overview

Provides high-level assessment of span of control for console operator
Multiple, Tiled Views

Level 2 – PFD Summary

Provides summary of large section of console area
Level 3 – P&ID / Task Display
Instrument details or task-specific function displays
Level 4 – Multi-Faceplate
Supports task specific activities (control, logic, etc.)
Multiple, Tiled Views

Tag Detail – Standard Faceplate
Focus tag details with “strip-chart” trend
Navigation Techniques

- **Tabbed Navigation**
  - On screen, integrated with Alarm aggregations

Alarms Roll Up To Tabs For Quick Navigation
Navigation Techniques

- **Tabbed Navigation**
  - On screen, integrated with Alarm aggregations

- **Off-screen connectors**

  Links the process flows
Navigation Techniques

- Tabbed Navigation
  - On screen, integrated with Alarm aggregations
- Off-screen connectors

Selecting Tab Opens New Displays
Navigation Techniques

- **Tabbed Navigation**
  - On screen, integrated with Alarm aggregations

- **Off-screen connectors**

Selecting Tab Opens New Displays

Area Selected by Tab

Corresponding Level 3

& Level 4
Display Coordination

- **Linked Displays**
  - Selecting a target on an upper level display
  - Automatically opens more corresponding detailed displays
Display Coordination

- **Linked Displays**
  - Selecting a target on an upper level display
  - Automatically opens more corresponding detailed displays

- **Selected tag is put in Focus**
  - Opens new Faceplate
  - Detail Trend

Selected tag is put in focus
How to Get There for Sunrise?

- Project Team looked at:
  - Latest Emerson standard libraries (PCSD)
  - Existing Husky Tucker site Library
  - HCS Library Specification

- Want to stay with “main-stream” product for long term support and maintenance

- Elected to enhance PCSD to meet HCS Specification
  - Used local project team with support from EEEC to develop initial background programming and early dynamos
  - Built prototype displays
  - Mapped out display hierarchy from PFDs and P&IDs
Library Development

- Working from Library Specification – modified latest PCSD library elements
- Created background scripting to support windows management
- Created 50+ shapes
Dynamo Examples – Build Mode
Dynamo Examples – Run Mode

- Normal
- Principle Focus
- Associated Focus
Level 1 – Overview Display

- Console-wide “At A Glance” monitoring view
Level 2 PFD Display

- High-level view of major sections of the plant
Level 3 P&ID Detail

- Display shows instrument details for:
  - Process monitoring
  - Problem resolution
  - Task-specific activities
Level 4 – Control Mini-Faceplates

- Pre-arranged Mini-Faceplates based on:
  - control structure
  - Operator interaction requirements
- Operators can quickly make multiple changes without “managing windows”

![Diagram of control mini-faceplates](image)
Whole Picture – Quad Display
Summary

- Operator Interface has been created for Husky Sunrise Project
  - Supports Situation Awareness
  - Enhancement of latest PCSD library

- Benefits will be in improved plant operation and abnormal situation prevention and response
Where To Get More Information

- Emerson Calgary
- Human Centered Solutions, LLC

References: