



2013 Honeywell Users Group Americas

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Effective Use of Large Screen Technology Using Visual Thesaurus Shapes

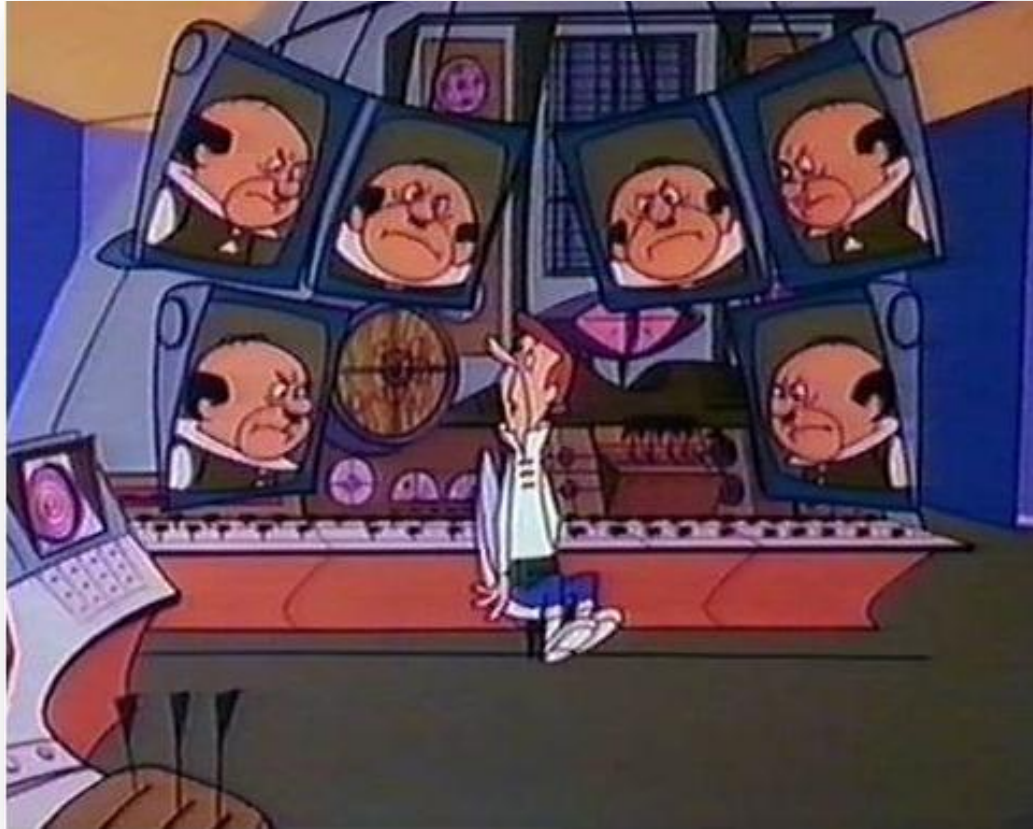
Outline

- Introductions
- Aspects of Situation Awareness and Display Challenges
- Abnormal Situation Management (ASM) Consortium Research Using Visual Thesaurus Shapes
- Phillips 66 Rodeo Site Information
- Large Screen Technology Project
- Summary

Introductions

- Andy Nichols, Phillips 66
 - San Francisco Refining Complex
 - Process Control Supervisor
 - Rodeo, California U.S.A
 - HUG Steering Committee
- Bob Zapata, Phillips 66
 - Corporate Refining Business Improvement Group
 - Controls Systems Security and Automation Lead
 - Houston, Texas U.S.A
 - P66 Representative on ASM Consortium

Proper Use of Large Screen Technology?

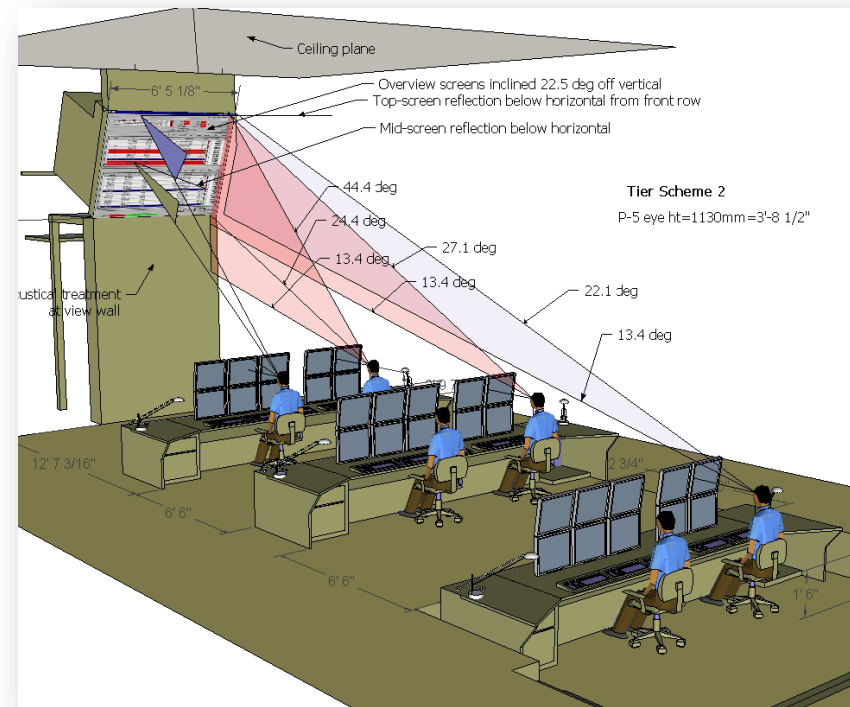


Large displays – are not for personnel monitoring

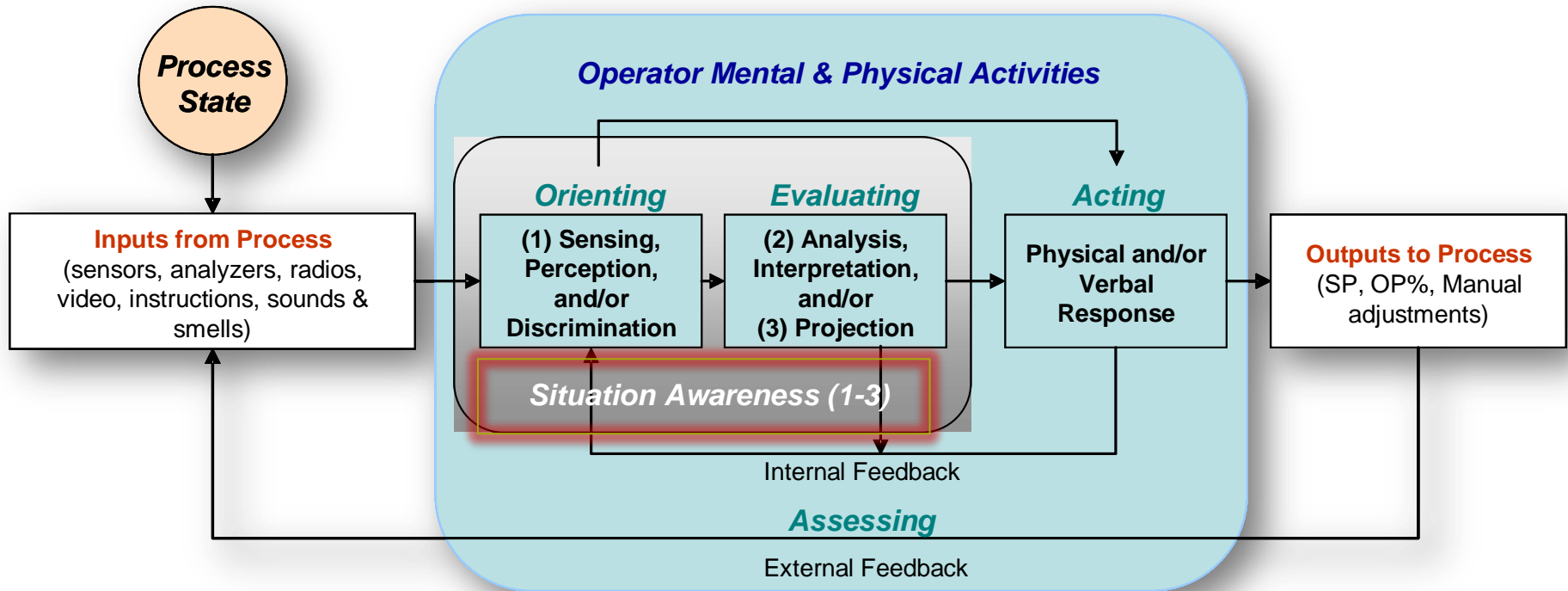
Then What are We Speaking About?

Why Large Overhead Displays?

- To bring back that at-a-glance situation awareness that operators claimed they had with panel boards
- Improved Situation Awareness
 - A high-level status of the critical few variables that give a snap-shot summary of the health of their various units
 - To orient to high level status changes
 - To decide what units or areas require attention



Stages of Distinct Intervention



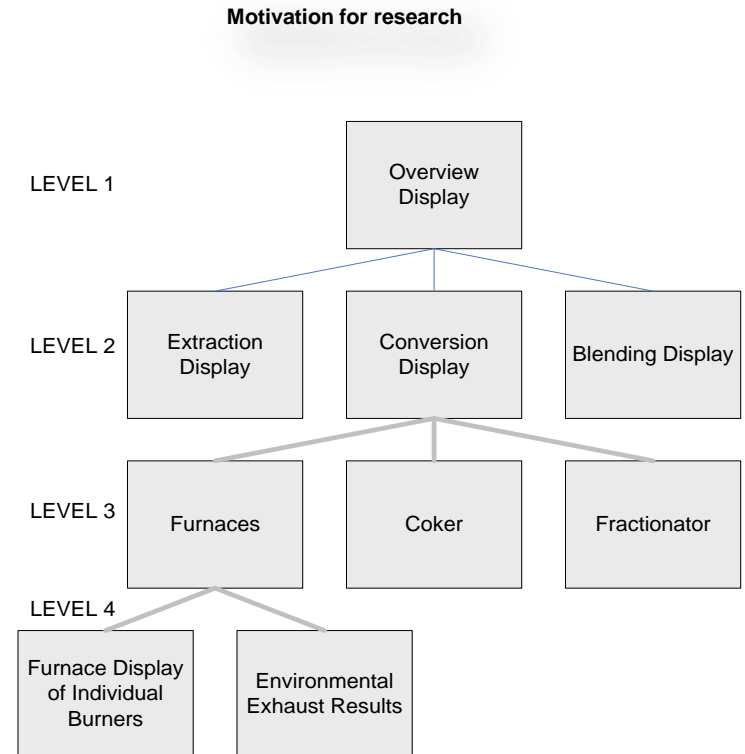
Human stages of distinct intervention in preventing or responding to an abnormal situation. The **design of an operator interface** will determine the extent of information processing components required to perform work tasks and influence the **efficiency and effectiveness of human performance**

Key Aspects of Situation Awareness (SA)

- Aspects of situation awareness are relevant for understanding proactive monitoring
 - Perception = operators must perceive process changes based on information elements in the overview display
 - Comprehension = operators must understand process change by integrating potentially disjointed information elements within and across displays
 - Projection = operators must predict what process changes will happen in the future based on their knowledge and comprehension of the situation
- Operator situation awareness evolves while monitoring such that process changes are continuously perceived, comprehended, and projected throughout a typical shift

The Display Hierarchy – ASM ® Primer

- Hierarchy is typically made up of four levels:
 - Level 1 Overview
 - Dedicated display
 - Critical variables across span-of-control
 - Used for summarizing the “Big Picture”
 - Level 2 Summary
 - Display for each major process area (e.g., PFD level)
 - Level 3 Equipment
 - Display for each equipment with more detail information (P&ID level)
 - Level (4) Details
 - Selected details, help, or faceplate displays



Purpose of a Level 1 Overview

- Supports awareness of the “big picture”
 - Allowing for at-a-glance monitoring of critical variables across the span of control
 - Helping operators detect abnormal changes in the status of critical variables
 - Directing an operator’s attention to equipment areas that are starting to deviate or become abnormal
 - Providing a snap-shot summary of the health of the process
 - Giving early indication of impacts from upstream / downstream
- Display is on a dedicated screen
 - The “big picture” is always available
 - Operators can drill-in to details on other displays and continue to monitor the “big picture” as a situation evolves

Large Screen Display SA Challenges

- Design challenge:
 - minimize the total number of shapes / displays
 - maximize the amount of relevant information without making any given display too complex or cluttered
- Style has a significant impact on the speed and accuracy of operator's interactions
- Color schemes affect the ability of users to distinguish different types of objects, recognize important information, and orient to critical plant conditions
- Indiscriminate or arbitrarily use of color slows response times and contributes to errors in perception and comprehension

Phillips 66 Experiences

- Large Screen Technology in Phillips 66
 - First Use was in 2006 in a new Central Control Room
 - Large Screen technology was in early stages of infancy
- Key Findings on Effective Use
 - Applied at Three Sites with Central Control Rooms
 - Displays Proved Ineffective
 - Not having the correct information displayed
 - Information displayed poorly – or displayed in a way incompatible with monitoring and orienting activities
- Ineffective use prompted Phillips 66 participation in an ASM® research study

Impact of ASM® Research Study

- The ASM® Consortium conducted research on the use of qualitative display shapes for Level I displays
- Study was to identify visualization techniques to improve operators ability to detect important process changes
- Qualitative shapes were designed and tested for direct perception of changes in the state of process conditions
- Effects for improved situation awareness performance were statistically evaluated



ASM Consortium Technical Report
Assessing the Impact of Qualitative Display Shapes on
Operator Situation Awareness:
Visual Thesaurus Study V

Last Revision Date: 11 March 2010

Version: 2.00

Filename: 2009 Visual Thesaurus_DisplayShapesSitAwareness_v2.00

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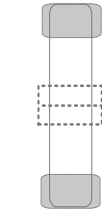
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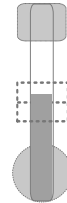
Contains Information Proprietary to the ASM Consortium

New Display Object Introduction

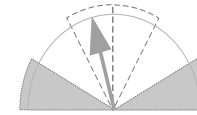
Gauge objects:



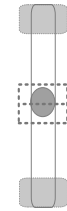
Level



Temperature



Flow



Pressure

Qualitative objects:



Deviation

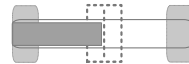


Quality



Trend

Controller objects :



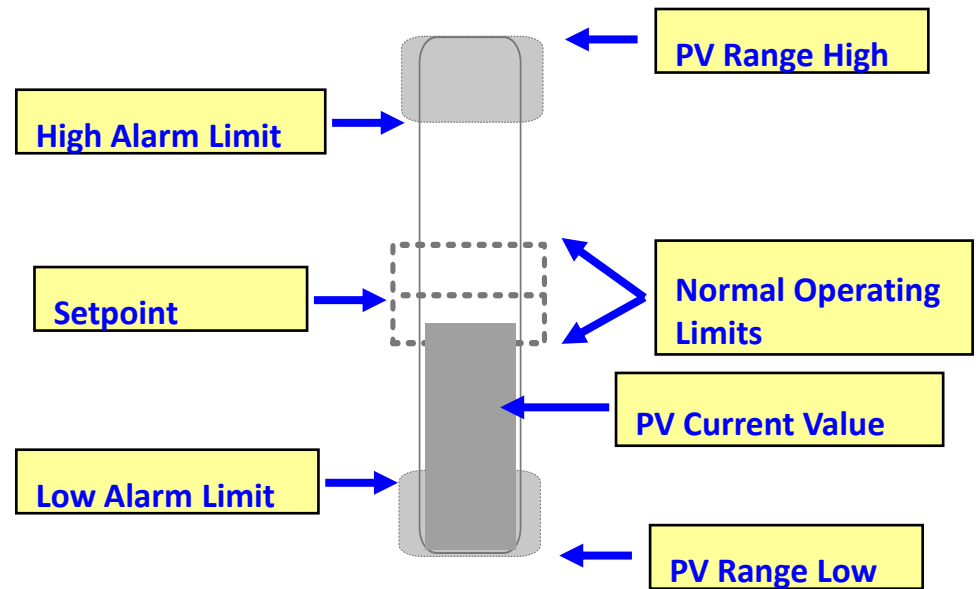
Controller
Output

Visual Thesaurus (VT) Display Objects Used for the Level 1 Functional Overview Display in the ASM® Study

New Display Object Introduction

Information in the new display objects is presented in such a way that operators can see:

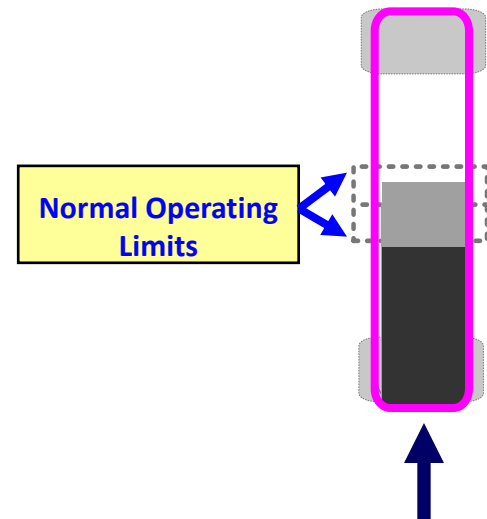
- Normal Operating Limits
- Alarm Limits
- How close the process is relative to the limits
- How quickly the process is moving towards / away from the limits



New Display Object Introduction

The new display objects can be configured to show when variables are outside a normal operating range and in an abnormal condition

- Useful when operators want to know that a variable has deviated more than expected
- When a variable exceeds a normal operating limit, the border surrounding the object is changed to a pink color
- NOTE: In some cases the shapes might indicate an abnormal state with the pink border, but the indicator may not appear to have crossed the normal operating range. If in doubt, believe the color rather than the indicator position.



Click *once* on the screen to see how the new display objects indicate abnormal conditions

ASM® RESEARCH RESULTS

- The study demonstrated the VT shapes were more effective for supporting operator situation awareness (SA) performance than the use of quantitative indicators showing the actual process values
- Operators had 17 percentage points better SA performance in terms of detecting process changes
- Operators monitoring the display had 6 percentage points better SA performance as measured in the accuracy of the operator's understanding of the abnormal plant condition

Operator Situation Awareness Measures	VT Level 1 Display Performance Benefits
Detecting significant process changes	<ul style="list-style-type: none">• 17 percentage pts. greater• 142% improvement
Accuracy of operator response in understanding the abnormal condition	<ul style="list-style-type: none">• 6 percentage pts. greater• 11% improvement

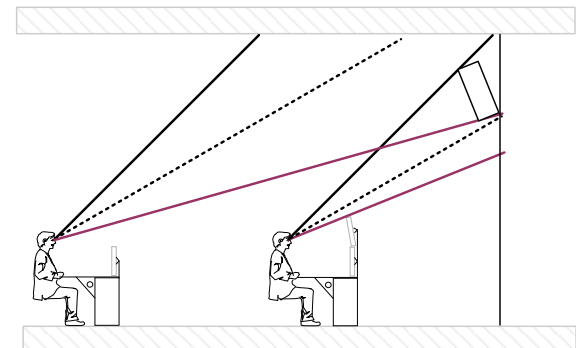
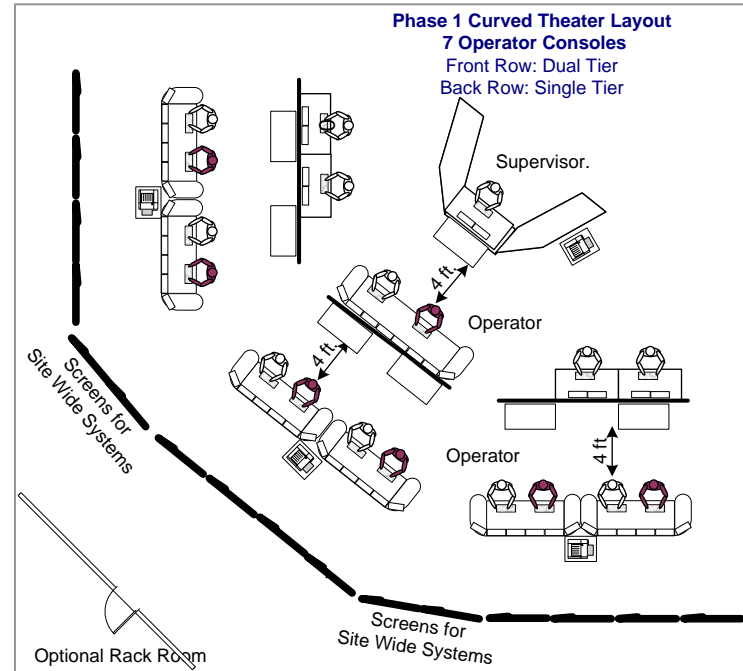
Phillips 66 Rodeo Site Information

- The Rodeo site is located near San Francisco, CA
- Originally built in 1896
- Initiated a control system modernization project in 2004
- Installed Experion Control System
- Designed and built a central control room
- New HMI Design



Support the Operator's Scope of Work

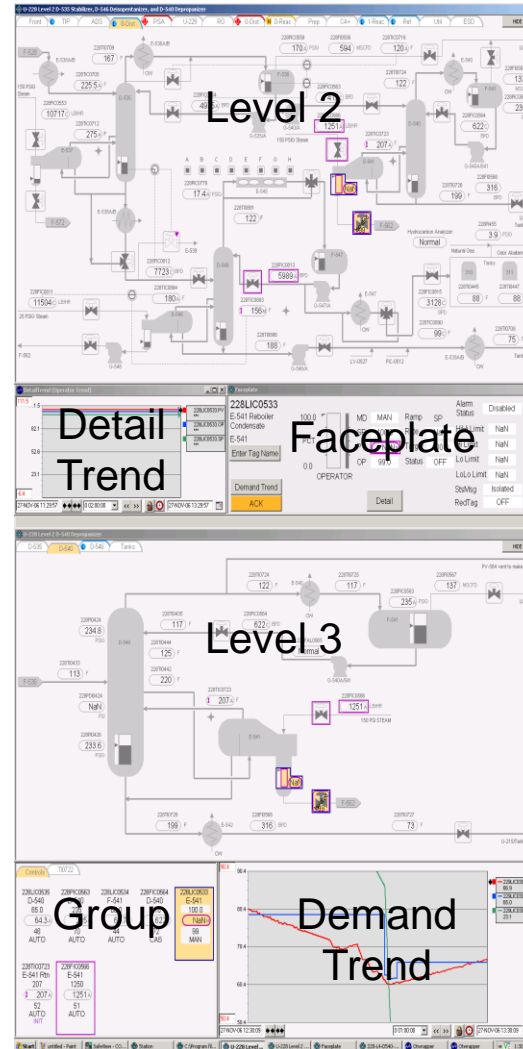
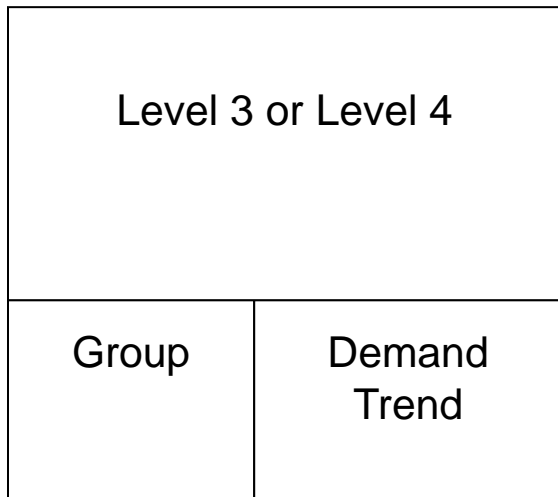
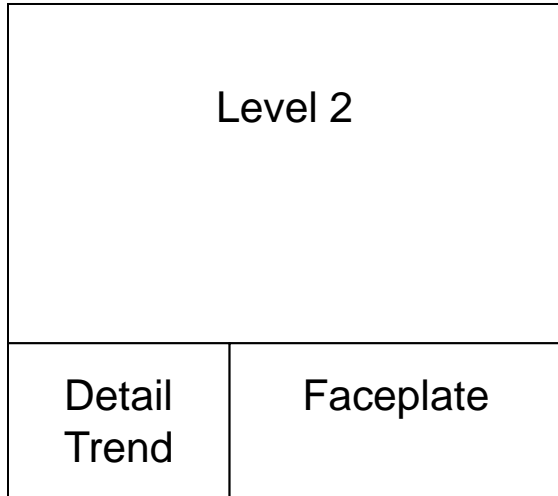
- Control Room Design
 - Number of console positions
 - Console arrangements
 - Support Staff
- Console Design
 - Equipment in the console
 - Number of screens
- Overview screens
 - View angles
 - Viewing Distance & Screen Character Size



SF Rodeo Central Control Room

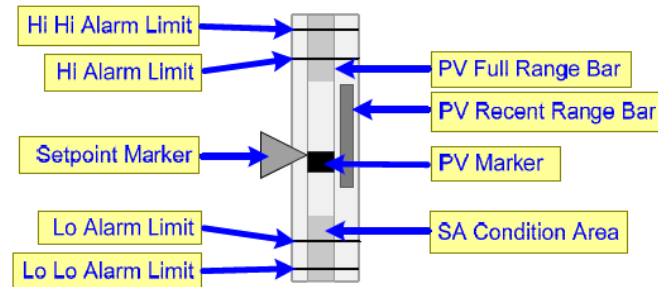
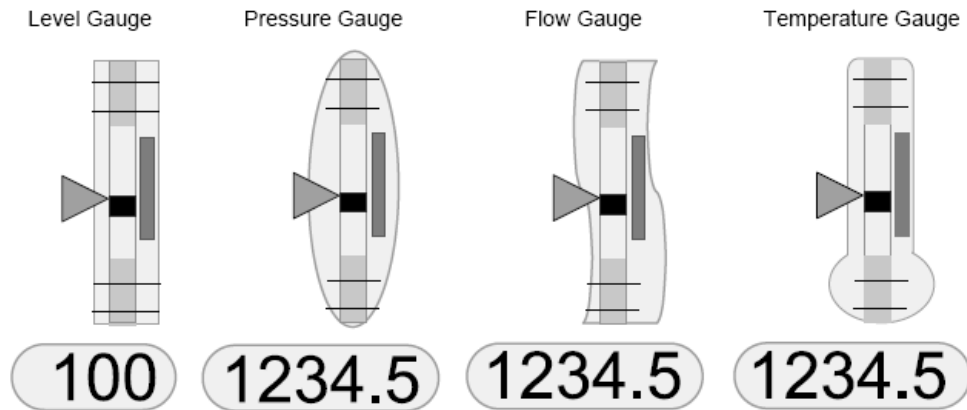


Window Layout



Level 1 Overview Shapes HCS Advanced Operator Interface™

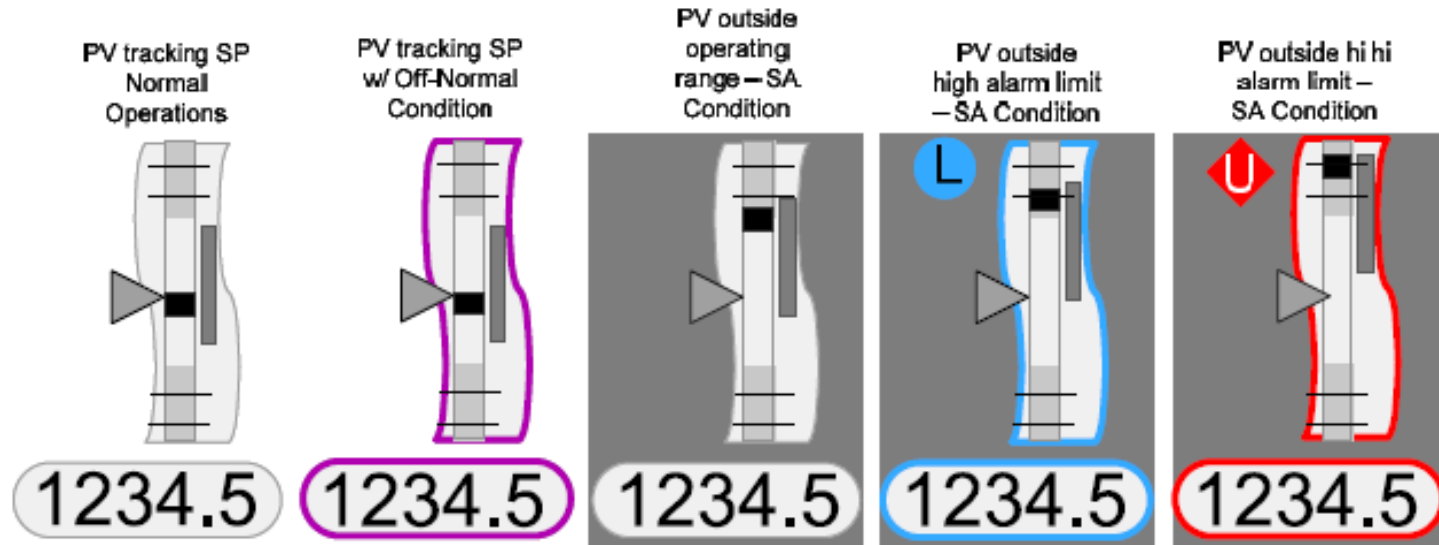
- PV Gauges



Shape design from the HCS Advanced Operator Interface™

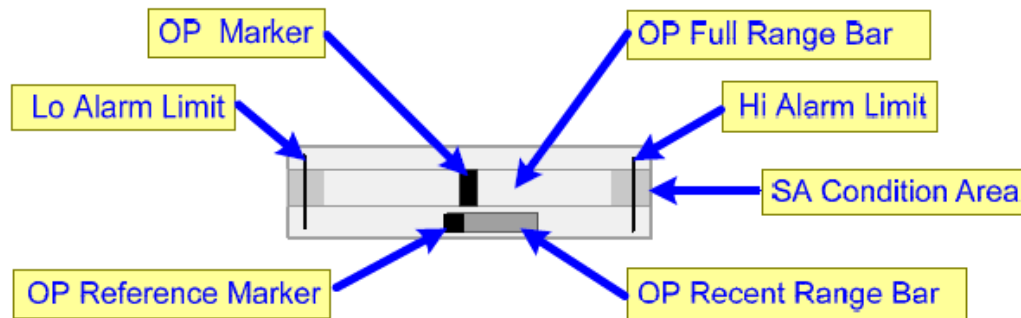
Level 1 Overview Shapes HCS Advanced Operator Interface™

- PV Gauges



Level 1 Overview Shapes HCS Advanced Operator Interface™

- OP Gauge and OP Reference Marker Reset

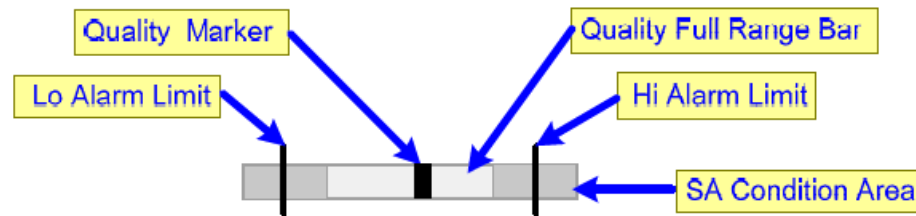
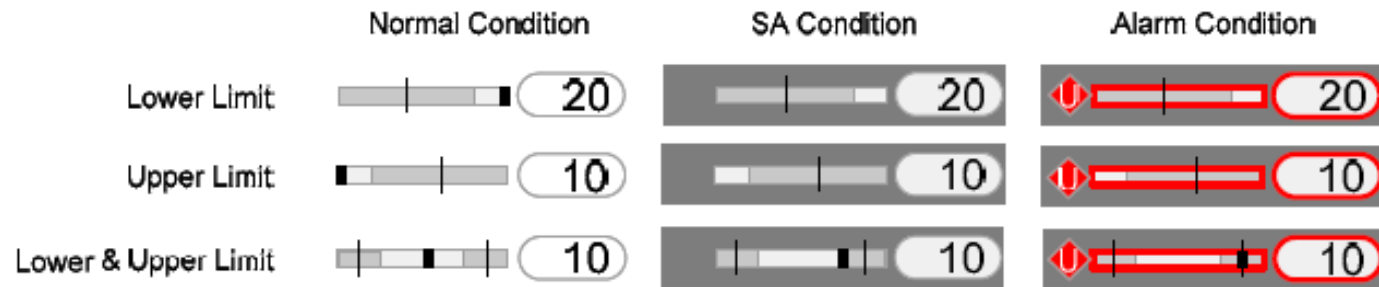


OP Reference Time

08:00 15 Jan

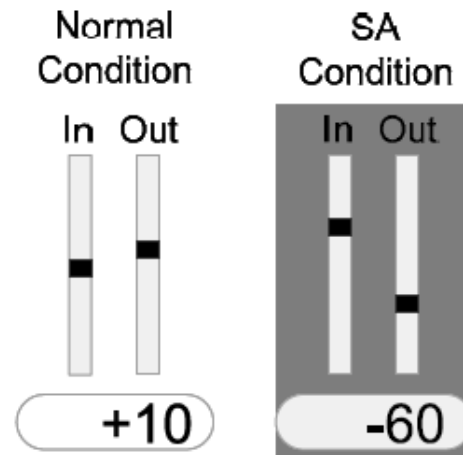
Level 1 Overview Shapes HCS Advanced Operator Interface™

- Quality Limits Gauge



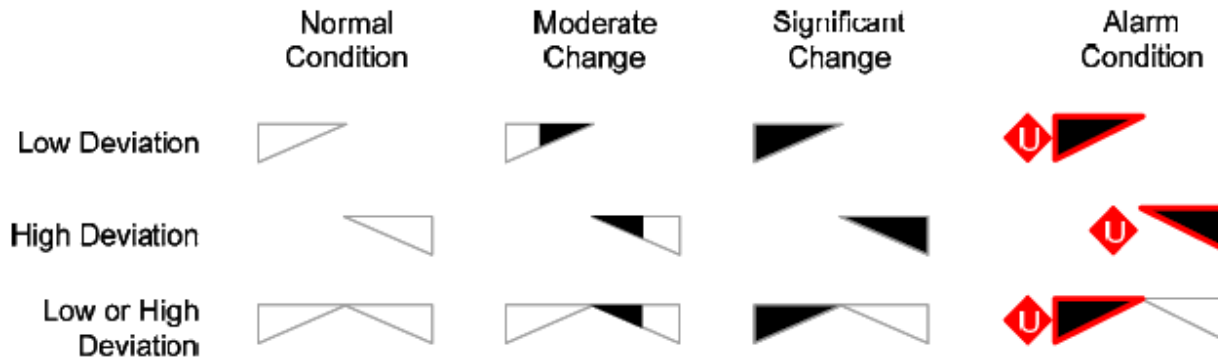
Level 1 Overview Shapes HCS Advanced Operator Interface™

- Material Balance Gauge



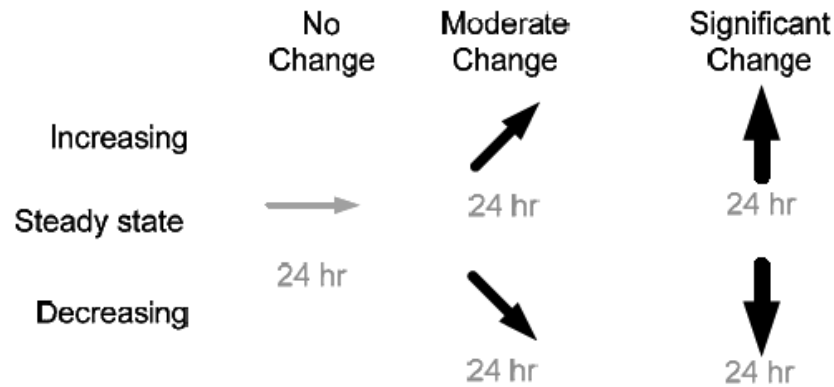
Level 1 Overview Shapes HCS Advanced Operator Interface™

- Qualitative Deviation
 - Compared to assigned “normal” value



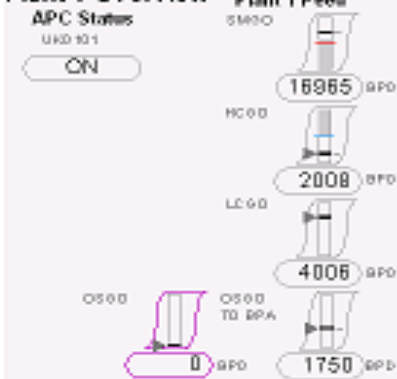
Level 1 Overview Shapes HCS Advanced Operator Interface™

- Qualitative Trend
 - Over specified time period

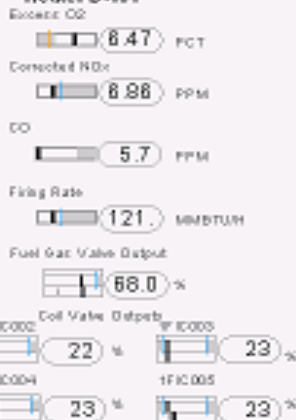


Level 1 Displays

Plant 1 Overview



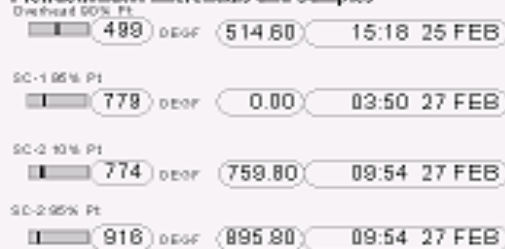
Heater B-101



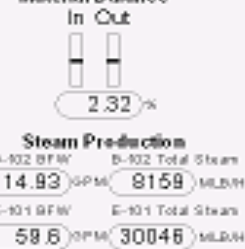
Prefractionator Yields



Prefractionator Inferentials and Samples



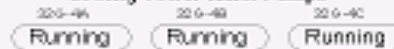
Material Balance



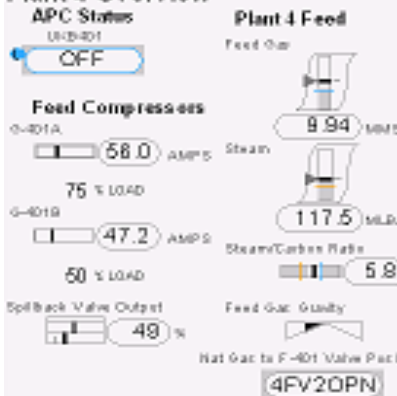
Plant 1 Status



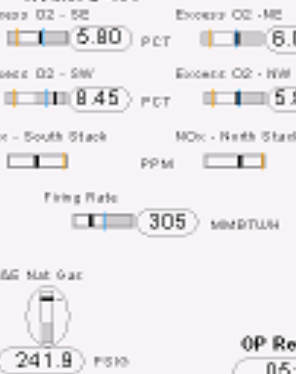
Cooling Tower Water Pumps



Plant 4 Overview



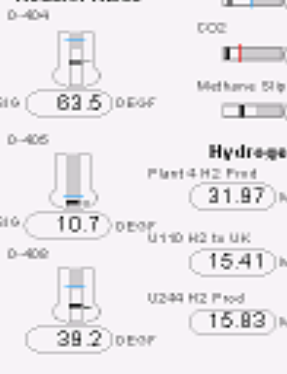
Heater B-401



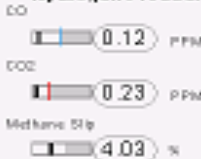
B-401 Fuel Gas



Reactor Risers



Hydrogen Product



Hydrogen Plant



Hydrogen Production



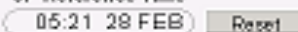
Steam Production



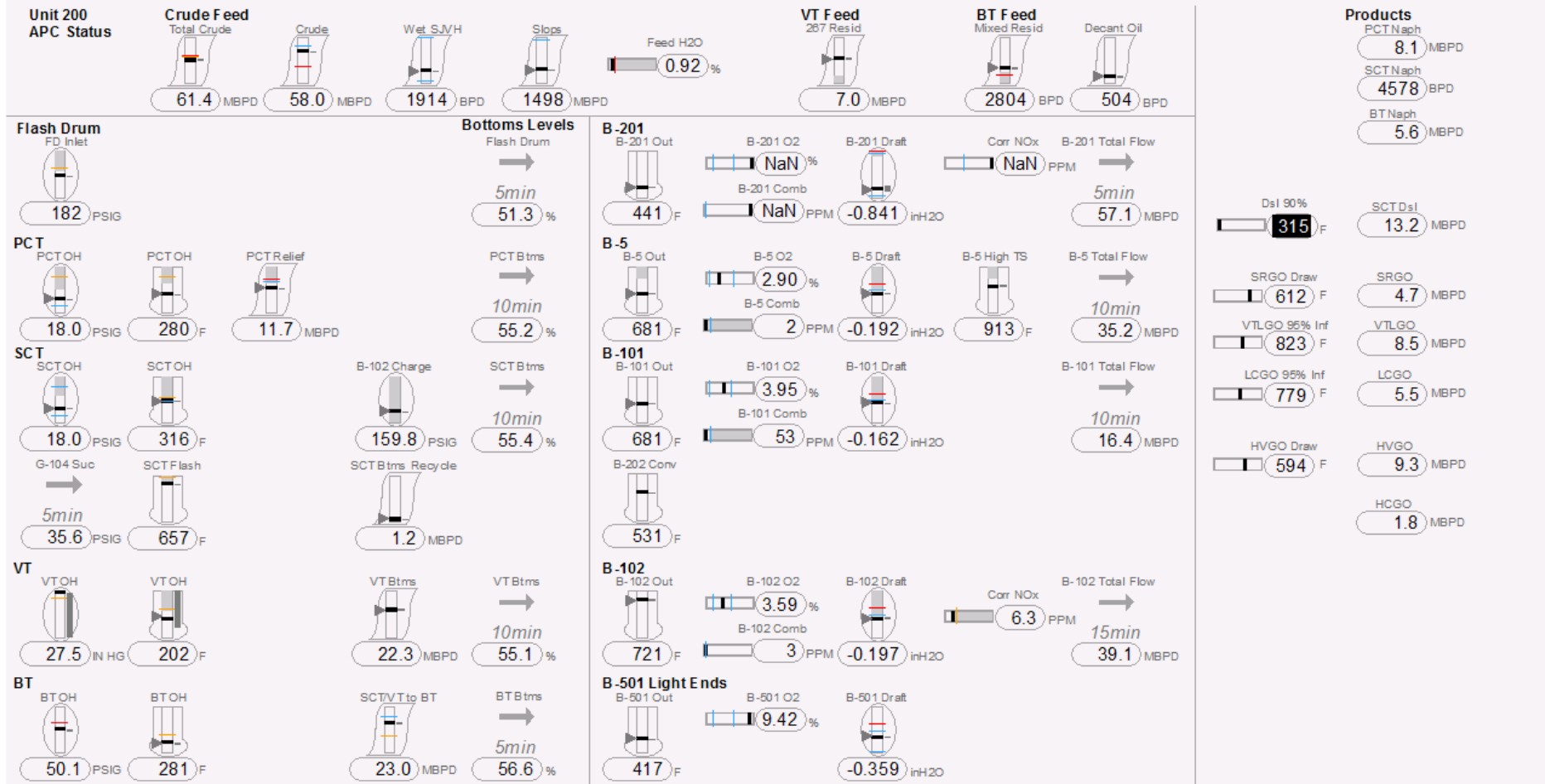
Plant 4 Status



OP Reference Time



Level 1 Displays



Shape design from the HCS Advanced Operator Interface™

Human Factor Consideration Summary

- Improve Situation Awareness
 - Close attention to the operator interface will enhance the operator's effectiveness and response accuracy
- Human-Centered design concepts are key to success
 - Understand operator monitoring and decision making requirements in overview design
 - 2/3 benefit from display presentation
 - 1/3 benefit from operator requirements analysis
 - Use visualization techniques to provide a clear overview of the information needed to detect qualitative process changes
 - Use enhanced navigation methods to reduce operator workload and improve display usability

Acknowledgements

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Additional Resources

To learn more about the ASM and its guidelines:

<http://www.asmconsortium.net>

The Human Factors and Ergonomics Society:

<http://www.hfes.org/>

Reference Material on Human Factors:

- The Human Factors – by Kim Vicente
- The Design of Everyday Things – by Donald Norman
- Set Phasers on Stun: And Other True Tales of Design, Technology, and Human Error – by Steven Casey



HUG