The New High Performance HMI:

Contrasting traditional design techniques with recent innovations in HMI design

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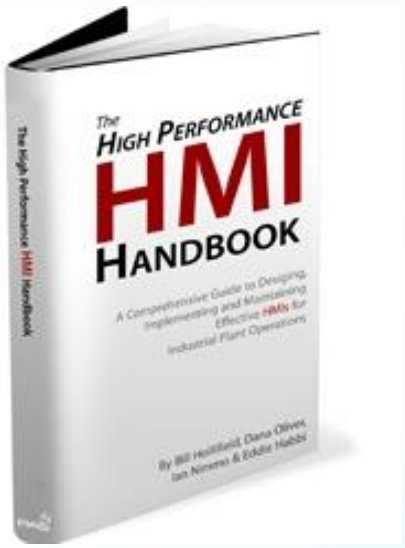
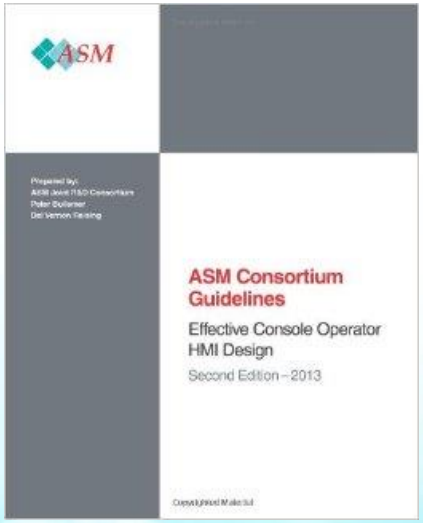
The New High Performance HMI

They wrote the book on it!



About PAS

- Published the High Performance HMI Handbook
- Written by Bill Hollifield, Dana Oliver, Ian Mimmo and Eddie Habibi



About ASM

- Abnormal Situation Management
- Consortium of leading Companies and Universities
- Written by Peter Bullemer and Dal Vernon Reising

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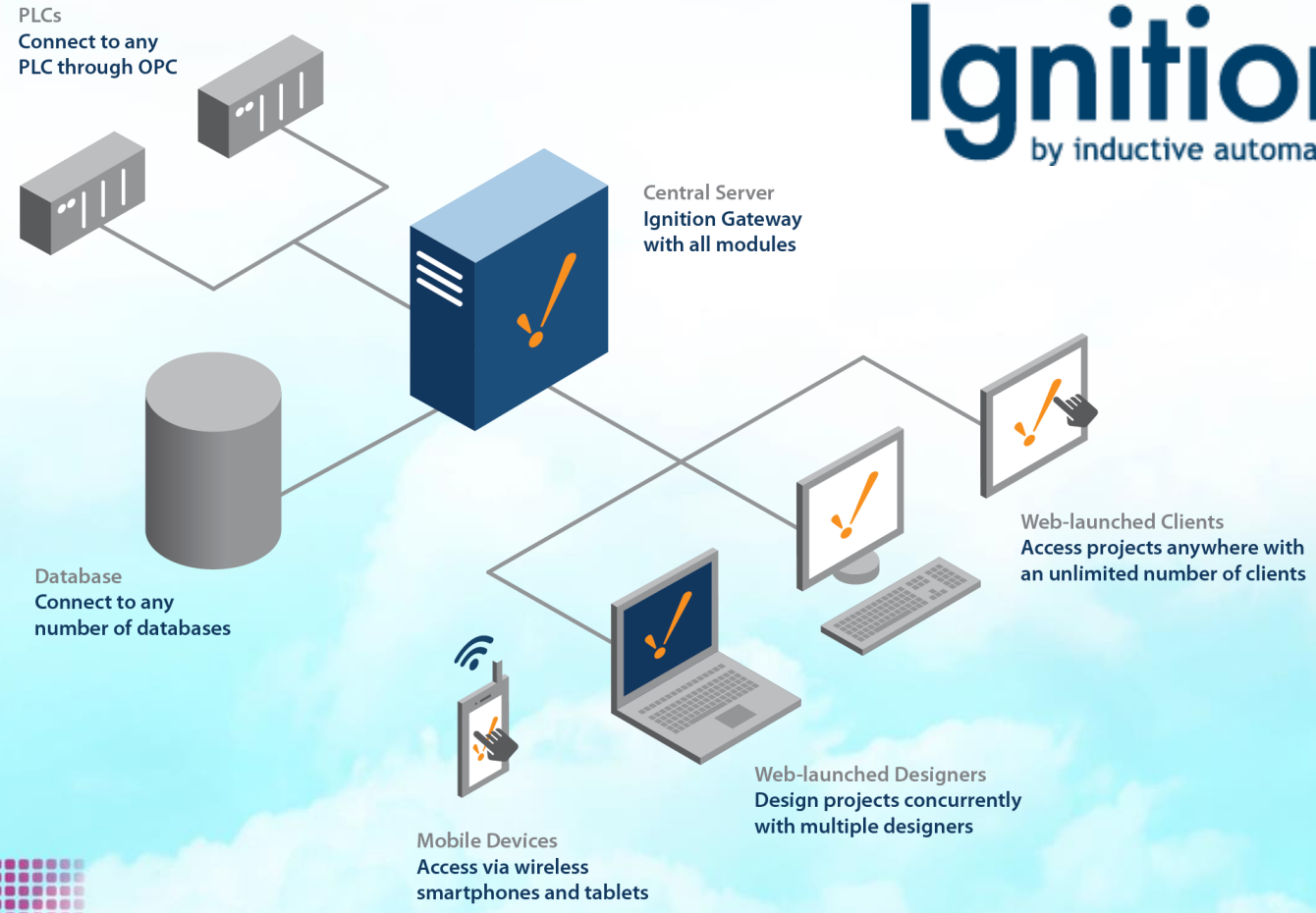
The New High Performance HMI

Standard lends itself toward Cloud hosted SCADA

Ignition by inductive automation™



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The New High Performance HMI

This Course will cover:

- HMIs Past and Present
- Common but Poor HMI Practices
- Justification for HMI Improvement – What Can You Gain?
- High Performance HMI Principals and Examples
- Depicting Information Rather Than Raw Data
- The Power of Analog
- Proper and Improper use of Color
- Depicting Alarm Conditions
- Trend Deficiencies and Improvements
- Display Hierarchy and the Big Picture

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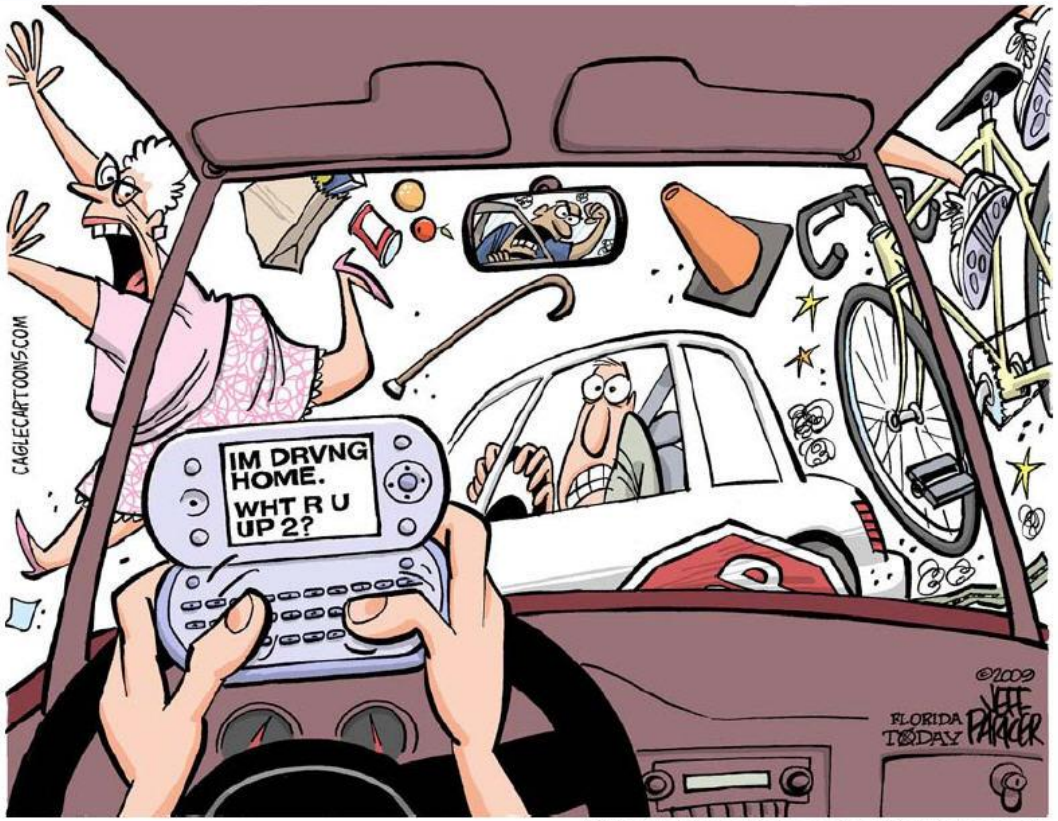
HMIs Past and Present

What information is really helpful?

Distraction?



Jeff Parker / Florida Today, courtesy CagleCartoons.com

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HMIs Past and Present

- Example of a Control Wall
- Gauges, chart recorders, lights, buttons and switches audible alarms
- Analog gauges provide quick information “at a glance”
- Most important alarms and control immediately accessible
- Difficult to modify!
- No data analysis

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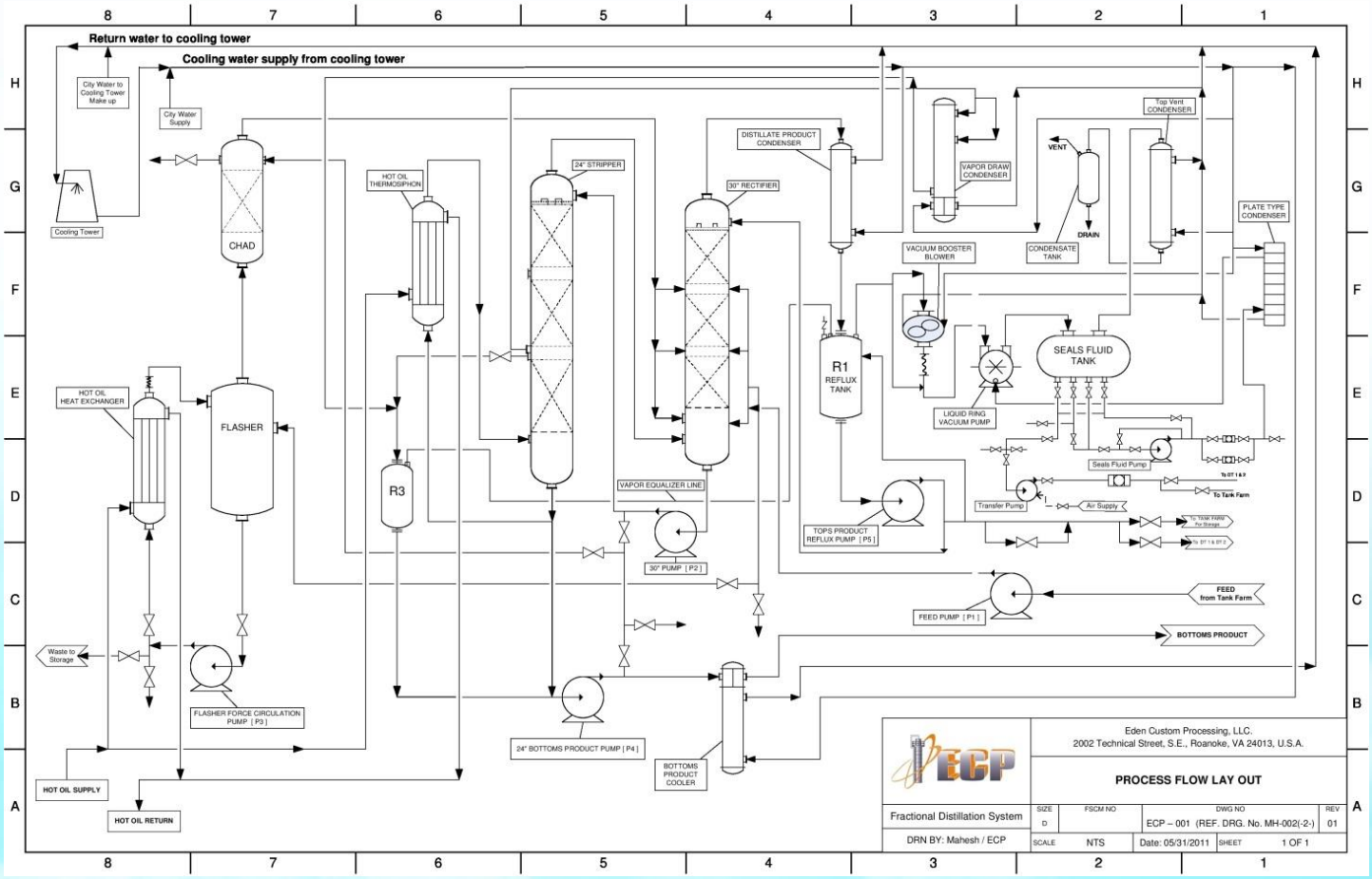
HMIs Past and Present



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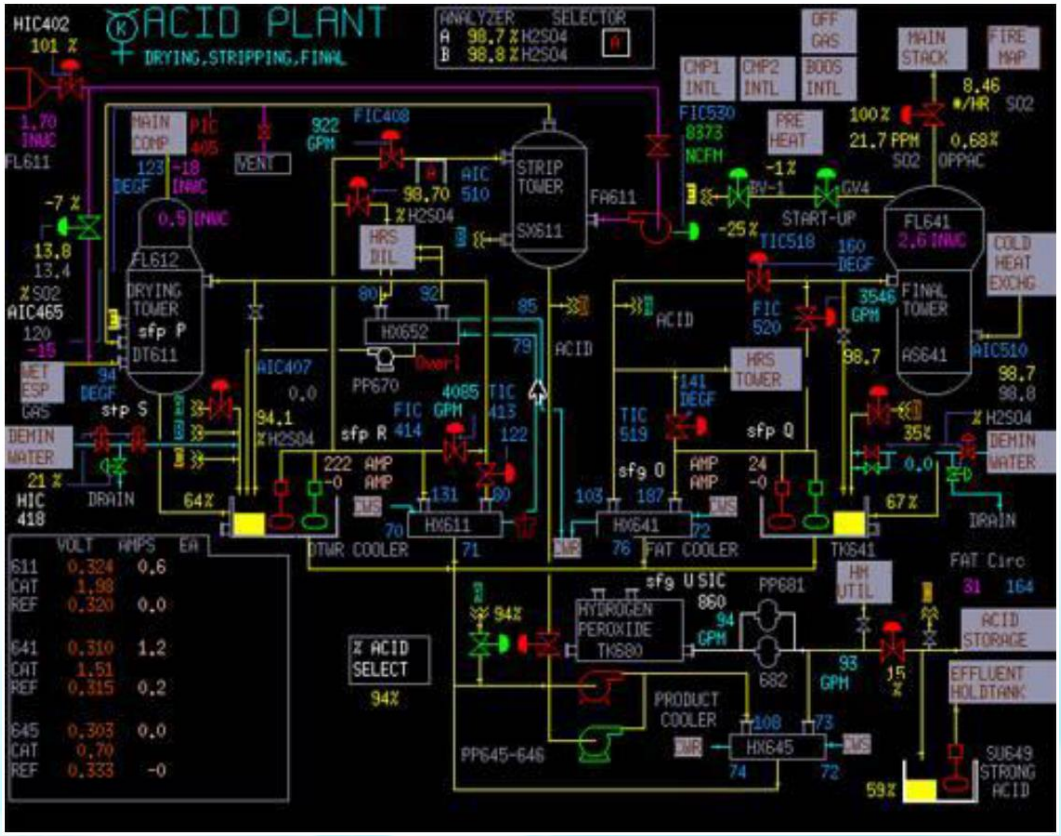
HMIs Past and Present

- Early SCADA / DCS graphical display
- Crowded, mimic schematic drawings, convenient but not necessarily optimal
- Operators become accustomed, resistant to change
- Still seen after 20 years even in large operations



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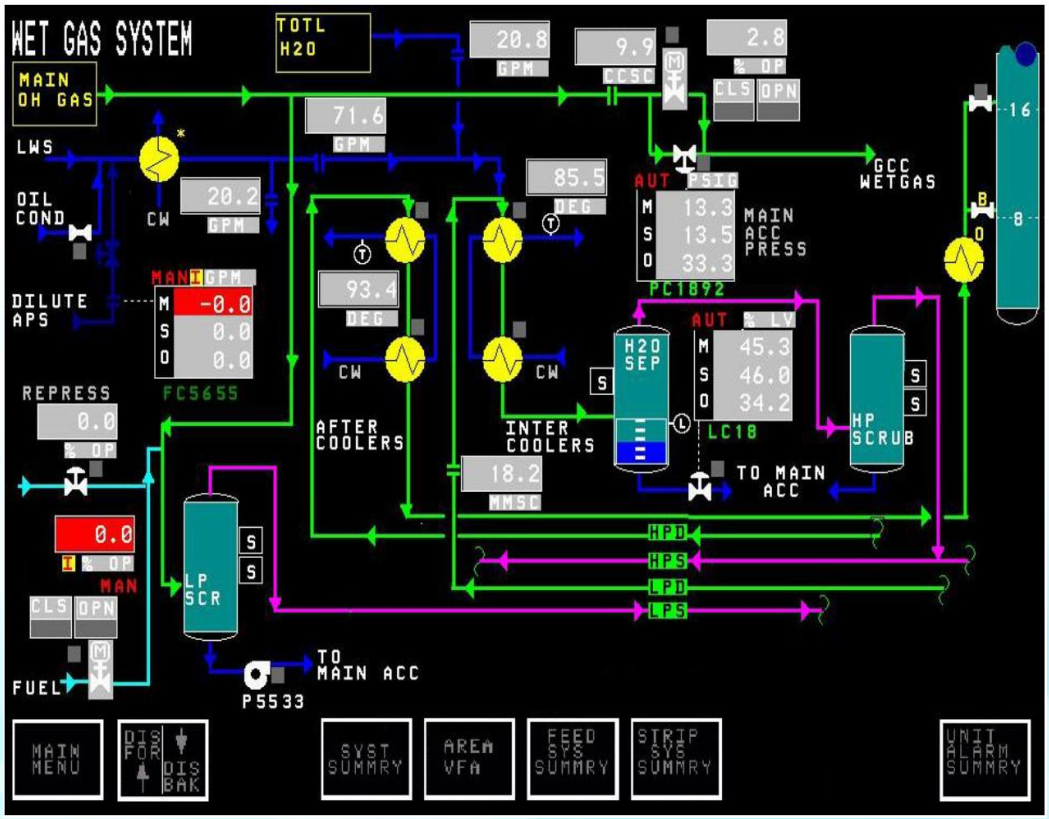
HMIs Past and Present

- Became flashy, colorful designs, a lot of graphics
- Minimal and poorly depicted numeric data
- No obvious correlation between graphics and data
- 10% information, 90% pictures



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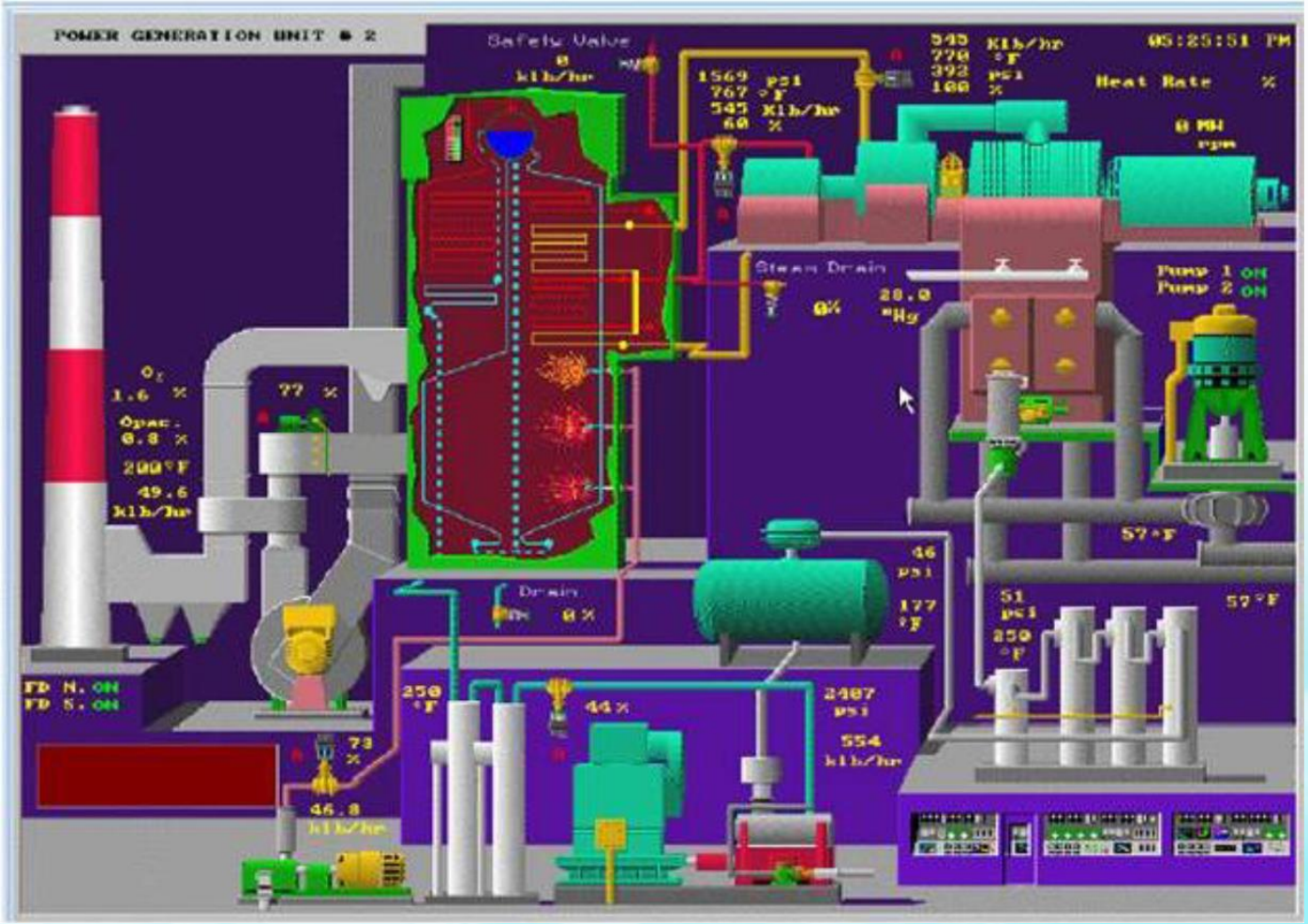
Graphics Principals

Problematic



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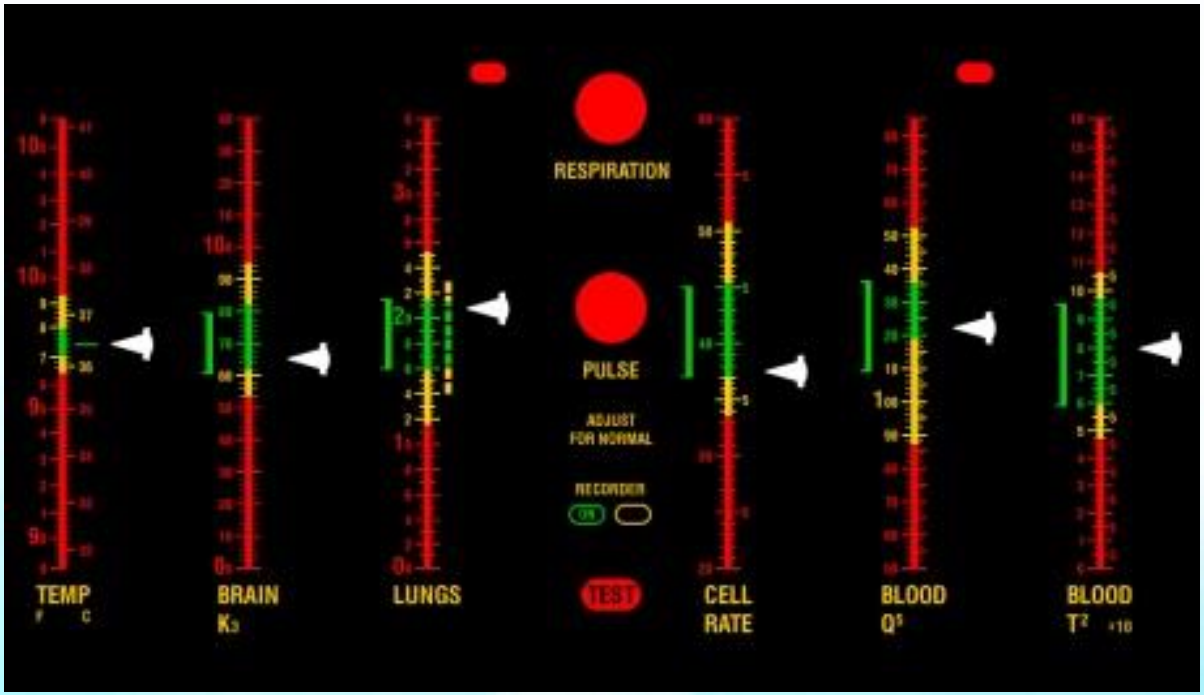
Graphics Principals

High Performance HMI



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Graphics Principals

High Performance HMI

- Avionics gets it right
- “Situation Awareness”
- Information at a glance
- Heading, altitude, time, engine diagnostics, fuel level, fuel consumption rate, real-time weather, location, GPS mapping, route, terrain, wing flap and trim positioning
- Now standard on even small aircraft

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Graphics Principals

High Performance HMI

- Non schematic depiction
- Limited use of color
- Gray backgrounds to minimize glare
- No animation except for alarm related
- Embedded trends for important parameters
- Analog representation with value relative to normal, abnormal and alarm
- A hierarchical display of screens and sub screens
- Low-contrast depictions in 2D, not 3D
- Consistent navigation

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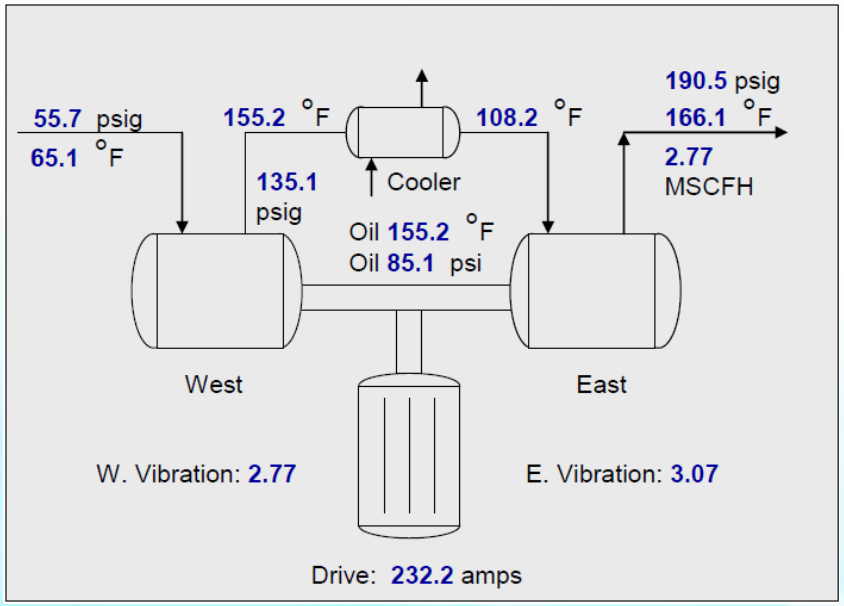
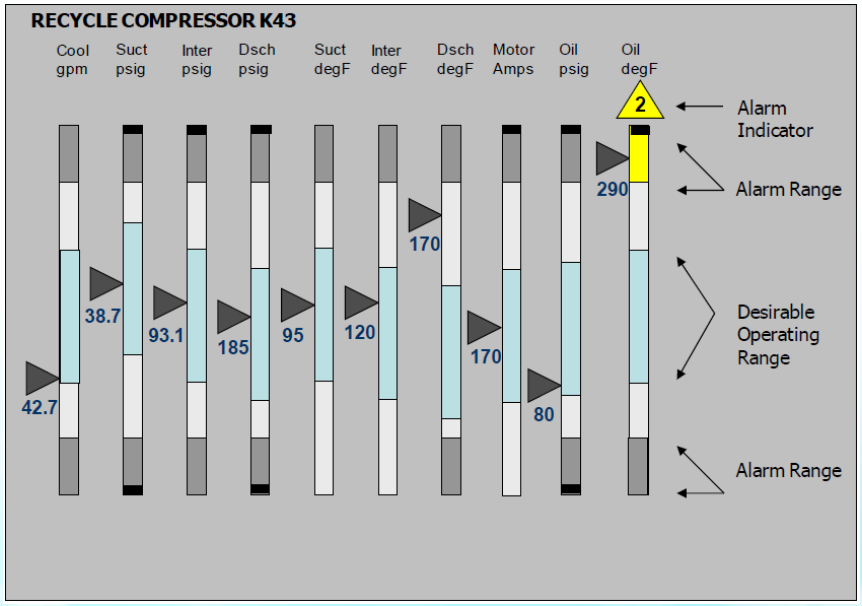
Graphics Principals

Data or Information?





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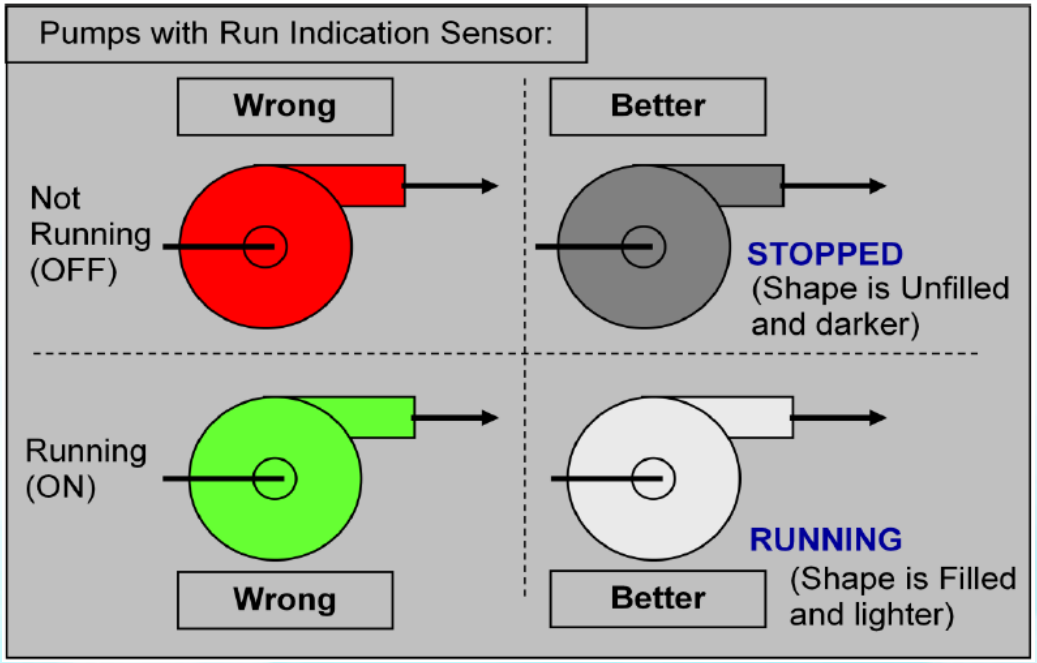
Graphics Principals

Using Color

- Must be used consistently
- Use for abnormal conditions
- Relative brightness and text for redundancy
- Bright indicates “on” – think of a light bulb



Color is not used as the sole differentiator of an important condition or status

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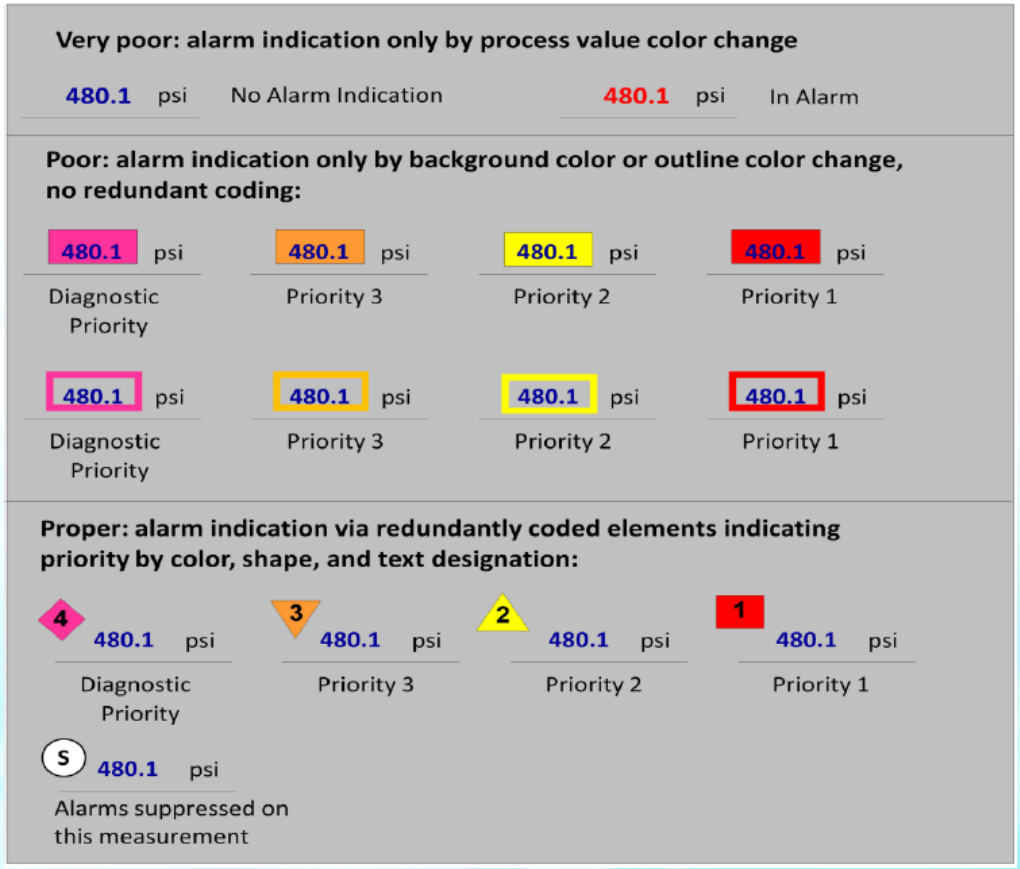
Graphics Principals

Using Color and Shapes

- Alarms should be redundantly coded
- There should be multiple alarm priorities
- Colors for alarms used only for alarms
- Indicators only appear in the event of an alarm
- Alarms flash until acknowledged and remain on until resolved



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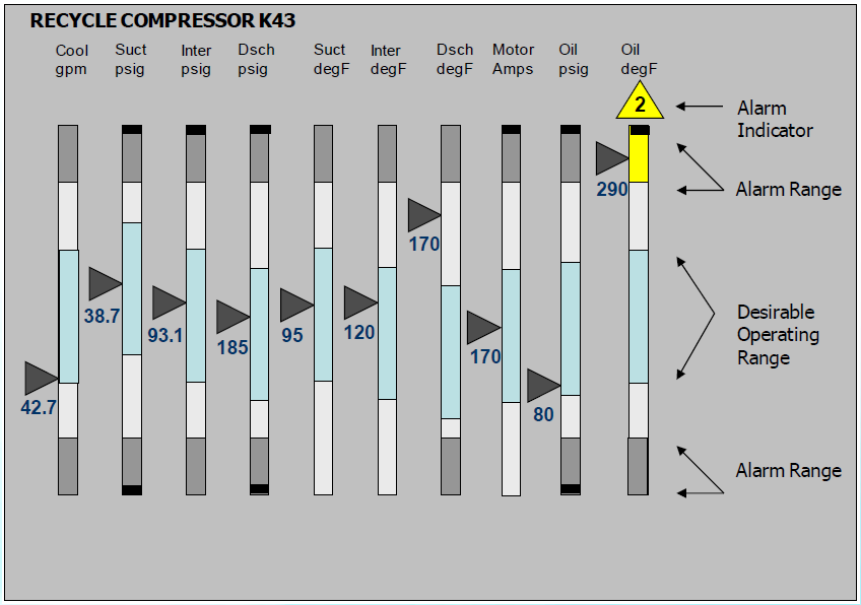
Graphics Principals

Hierarchically Linked Alarm Information

- Alarm indicated by multiple differentiators



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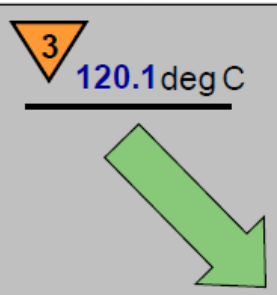
Graphics Principals

Hierarchically Linked Alarm Information

- Clicking on alarm icon takes operator directly to specifics
- Consequences, causes and corrective actions



TI-468-02 Column Overhead Temperature		
Alarm: PVHI	**Setting: 120 deg C**	**Priority: 3**
Class: Minor Financial	**Response Time: <15 min**	
Alarm Consequences:	**Alarm Causes:**	**Corrective Actions:**
Off-spec Production	Excess steam	Adjust base steam rate
Lowered efficiency	Pressure excursion	Check pressure and feed parameters vs. ***SOP 468-1***
	Insufficient reflux	Adjust reflux per computation; check controller for cascade mode
	Feed composition variance	Check feed composition

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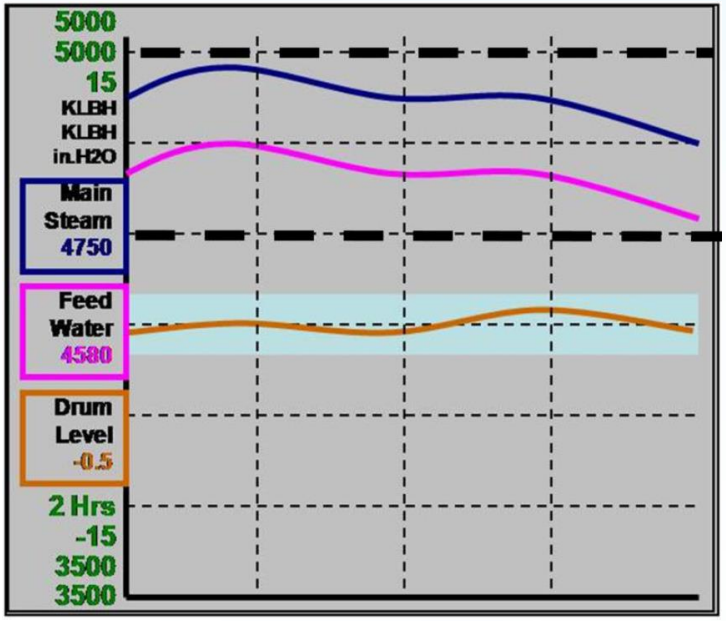
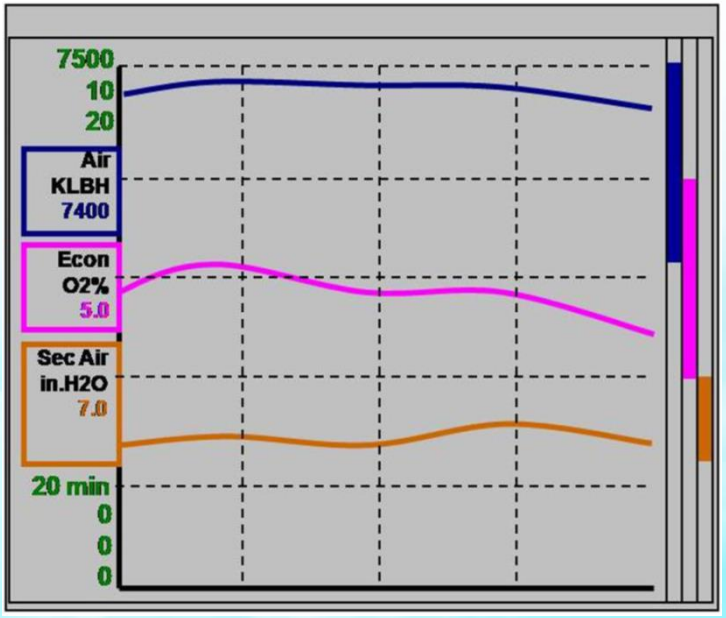
Graphics Principals

Trends

- Graphics rarely incorporate trends
- Trends best for continuously changing values
- Should show relevant history and should depict normal and abnormal ranges
- Great example of situation awareness!





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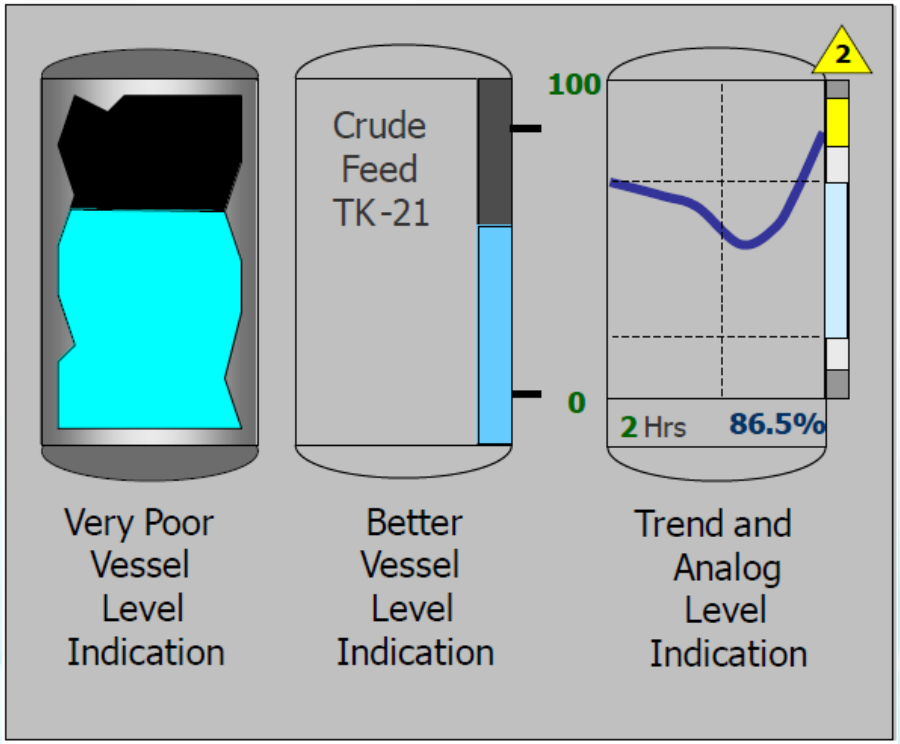
Graphics Principals

Level Indication

- Vessel levels should have more than just a rendition of liquid
- Scaled level indication is a minimum requirement
- High performance HMI gives situation awareness to include trend, trend duration, scaled level and alarm information
- Another great example of situation awareness!



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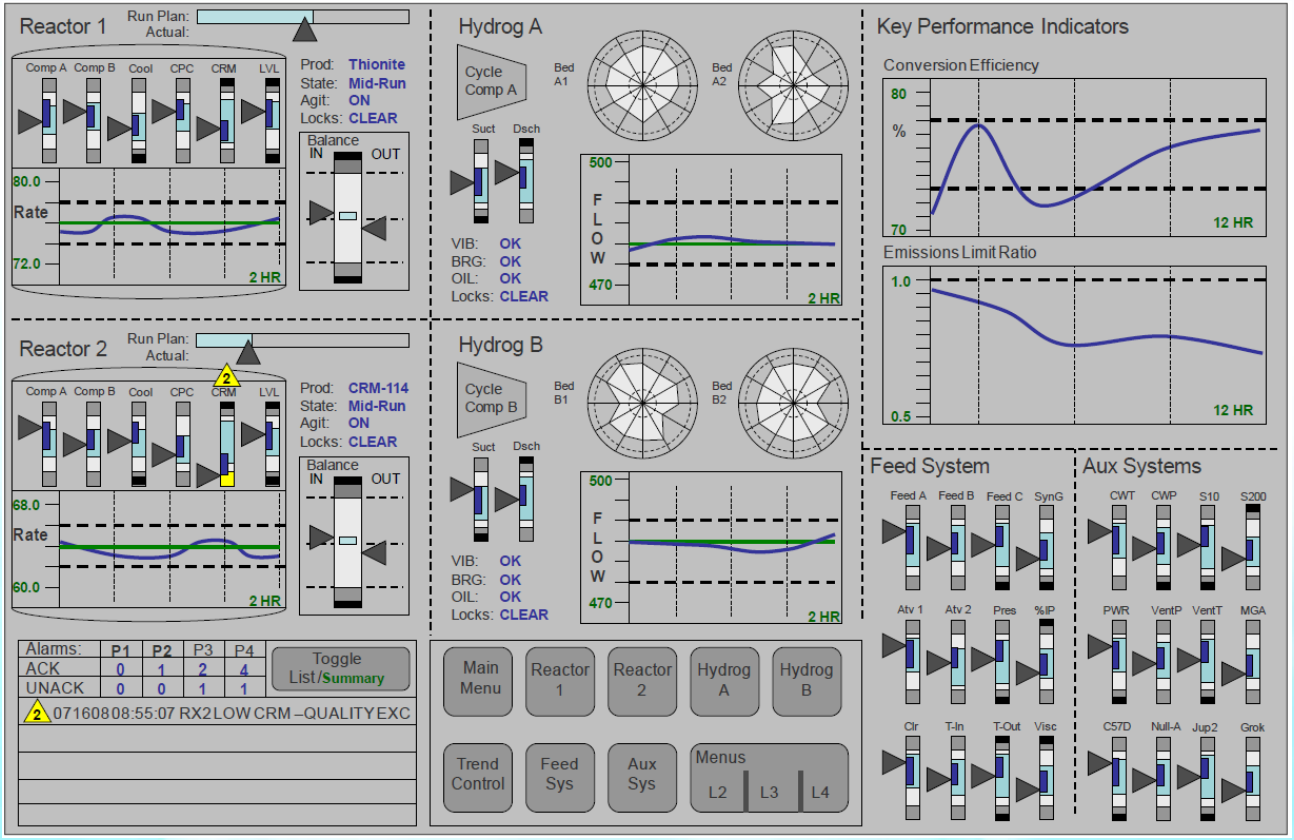
Graphics Principals

Display Hierarchy: Level One Display



Control Interactions are not made from the level one screen.
Menu buttons (bottom center) take to level two

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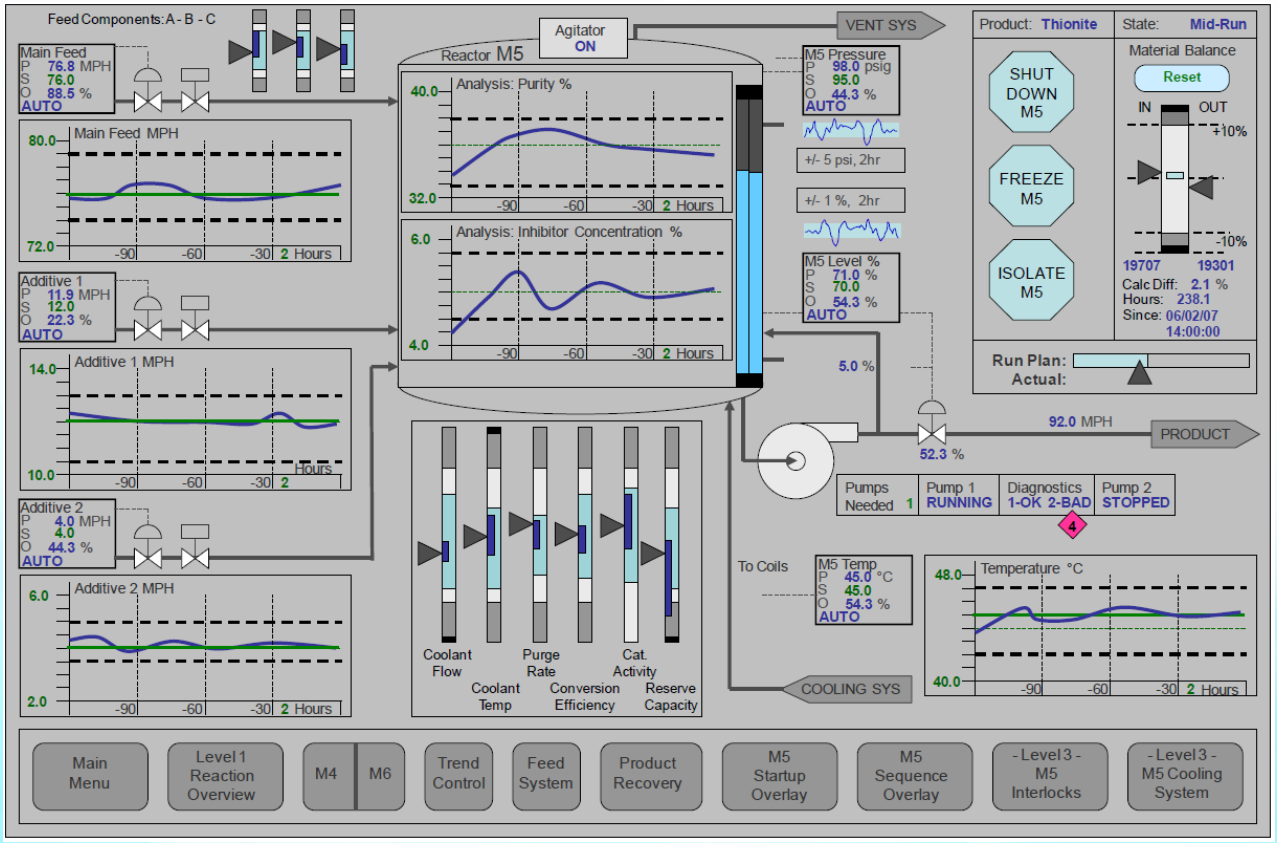
Graphics Principals

Display Hierarchy: Level Two Display - Reactor



A level two graphic exists for each separate major unit operation. Buttons at bottom of screen take to level three for finer control

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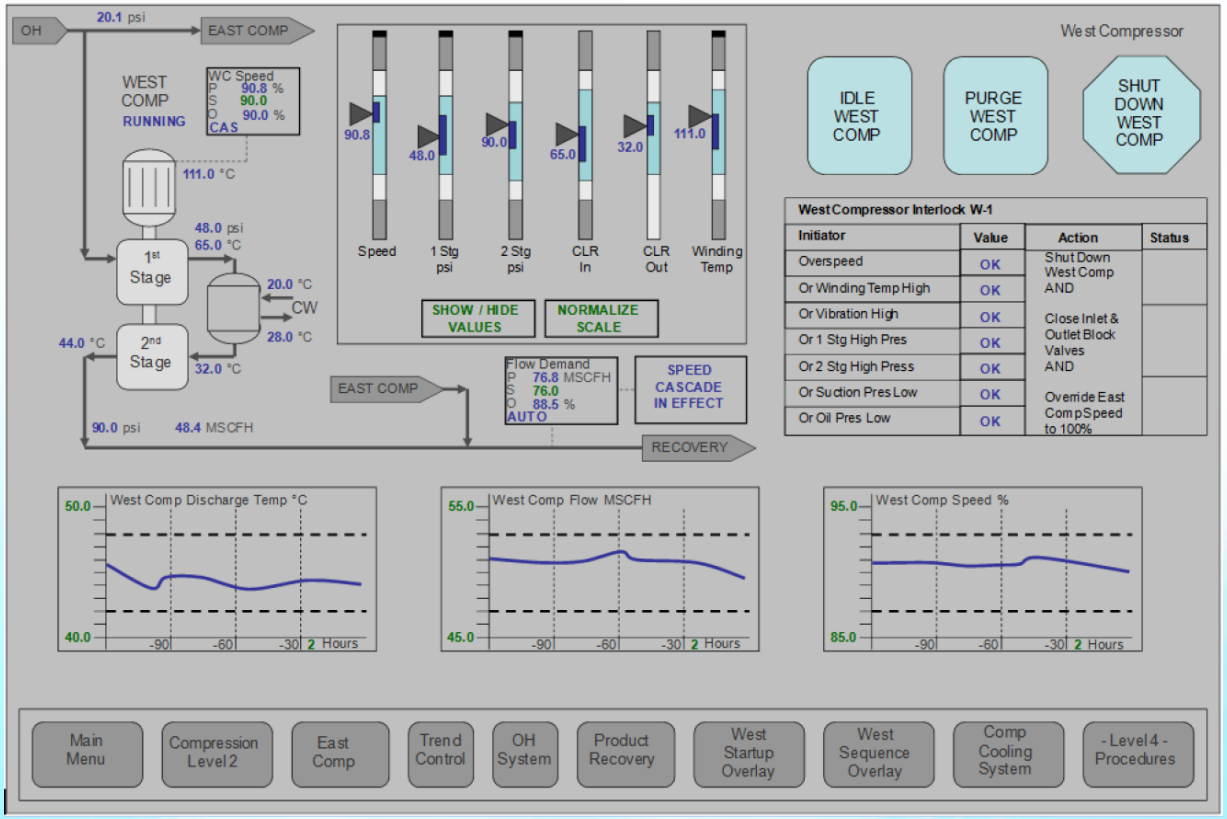
Graphics Principals

Display Hierarchy: Level Three Display - Compressor



A level three graphic exists for systems supporting major unit operation. Buttons at bottom of screen take to level four procedures

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Graphics Principals

Process Overview Displays

1930's universally adopted graphic rendition for subway depiction. The key is depiction of topography, not geography

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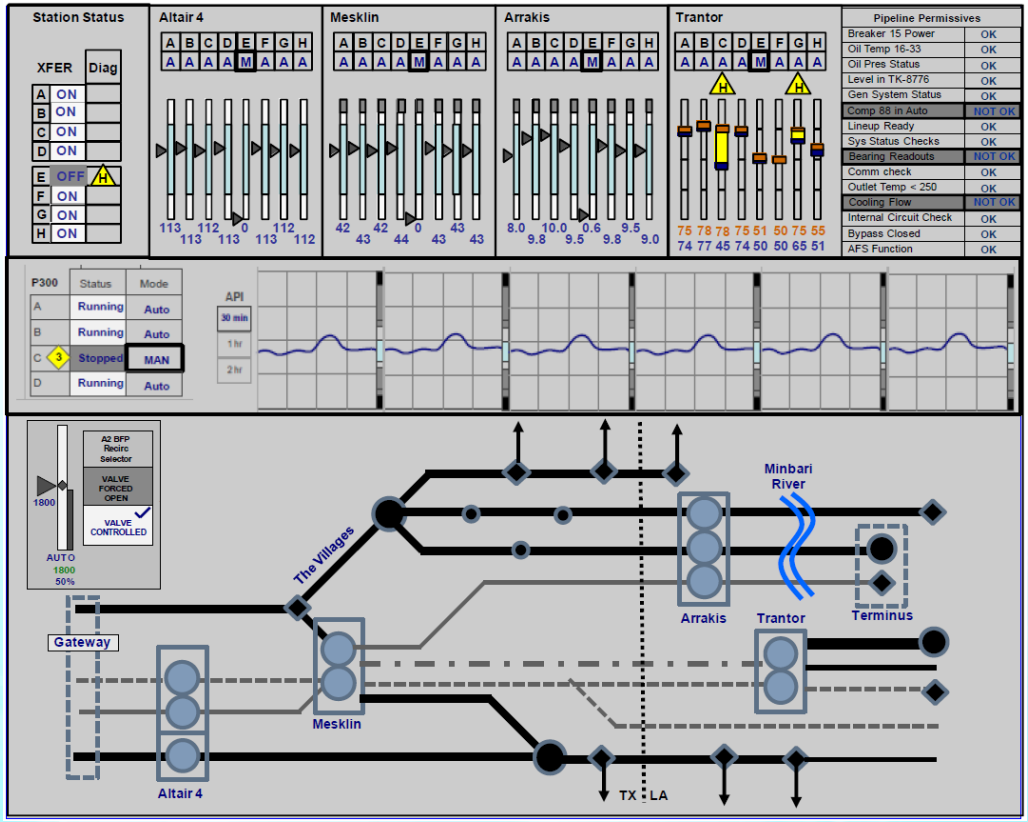
Graphics Principals

Process Overview Displays



Conceptual High Performance HMI rendition of the London Tube discussed earlier

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High Performance HMI Evaluation

- Based on principals of High Performance HMI handbook
- Takes subjectivity out of the equation, systematic approach
- All screens are evaluated for each respective HMI
- Each screen receives a score based on six criteria
  - Ease to keep track of processes under normal conditions
  - Effectively monitors and informs of abnormal conditions
  - Abnormalities can be handled entirely from within the HMI
  - In event of abnormality HMI operator is not distracted
  - During abnormality HMI only prompts relate to problem resolution
  - Holistic adherence to High Performance HMI “good practices” regarding graphics, navigation, workstation, environmental, and alarm management factors (described earlier)

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Conclusion

Sophisticated, capable, computer-based control systems are currently operated via ineffective and problematic HMIs, which were designed without adequate knowledge. In many cases, guidelines did not exist at the time of graphic creation and the resistance to change has kept those graphics in commission for two or more decades.

The functionality and effectiveness of these systems can be greatly enhanced if redesigned in accordance with proper principles. A High Performance HMI is practical and achievable.

Thank You!

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