Honeywell

Design Custom Displays

L5220

AG

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Figures and Tables

References

Publication Title	Publication Number	Binder Title	Binder Number
Picture Editor Reference Manual	SW09-450	Engineering Operations-2	TDC 3032-2

Introduction

Module Overview

About this module

This course module discusses the major categories of custom display conventions and the design techniques that are fundamental to building more sophisticated displays.

The displays used this course module are in directory DEMO on your cartridge disk.

Objectives

Given a Universal Station, design and build a custom display that is based on stated conventions and exhibits good design practices.

Sample test items

This course module's Criterion Test includes the following items:

Build a custom display that:

- contains at least five design conventions described in this course module,
- does not violate the "Don'ts of Display Design" described in this course module,
- exhibits at least five of the "Do's of Display Design" described in this course module.

Be able to describe to your course manager:

- your five design conventions,
- the five "Do's of Display Design" that you implemented.

Why Use Conventions

Why use conventions?

Using conventions is an important success factor in designing custom displays for operator assistance.

Logical and unambiguous conventions presented with clarity allow the operator's response to be consistent and repeatable.

Conventions, through pattern recognition, use human intuition in learning, thus minimizing the effort, cost, and time necessary for operator training.

Conventions are critical for other people to correctly interpret your designs. It is not important that you follow the exact conventions presented here—only that you have conventions.

Information processing

How people attend to, perceive, and process information from their environment has implications for the design of graphic displays.

To think that display design is nothing more than drawing graphics on CRT screens is to think that raising children is nothing more than providing them with food and shelter.

This course module discusses characteristics of human information processing that impact display design.

Location, Layout, and Orientation

Description

When the location, layout, and orientation of data and objects on a display are consistent and logical, the operator instinctively knows where on a display to find the information needed.

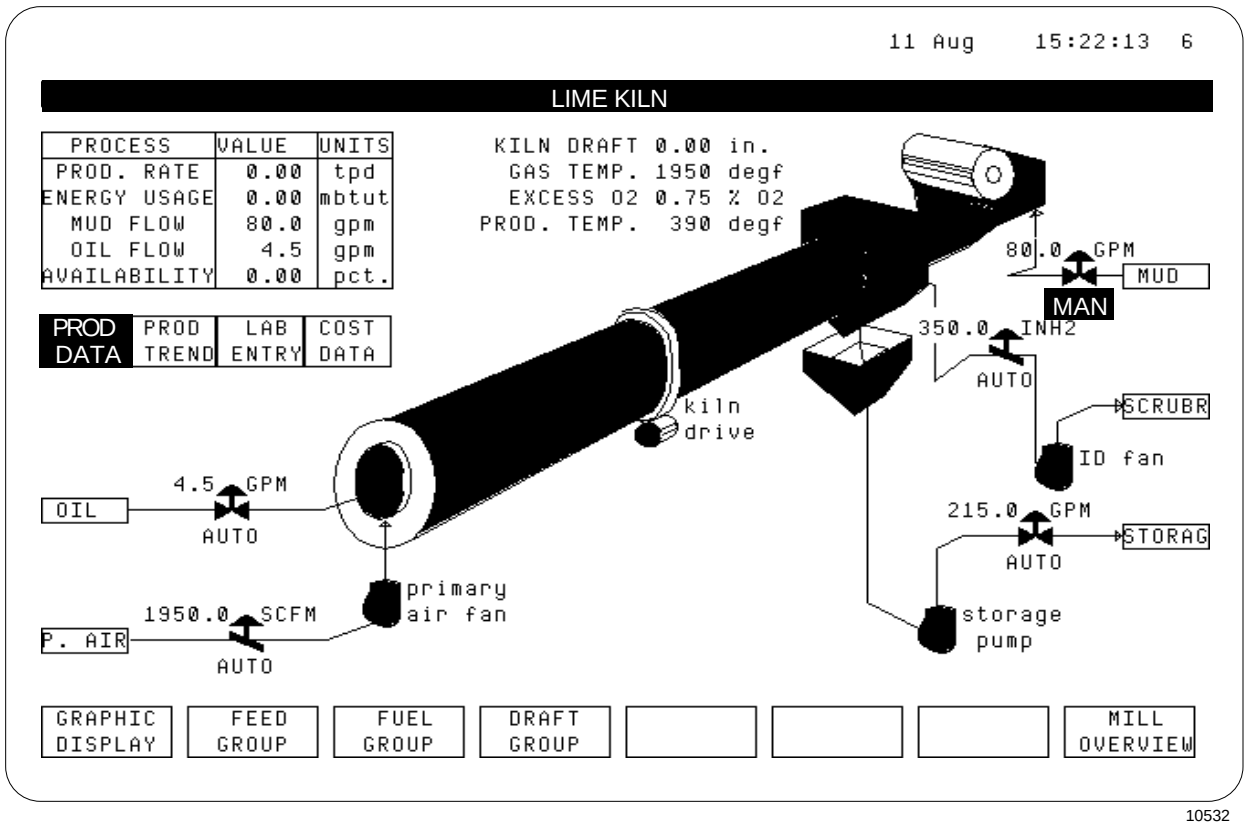
Example

The display in Figure 1 uses a convention in the design of the associated display targets. The targets appear in the same location as other unit level control detail displays (at bottom of display). The lower left target is always reserved for the Help Display.

Continued on next page

Examples, continued

Figure 1 Target Location Example—Lime Kiln Display (DEMO>KILN)



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Location and presentation

Table 1 describes examples of location and presentation conventions. These conventions show one way to present data. They can be easily modified to meet any specific criteria for your implementation.

Table 1 Location/Presentation Example Conventions

Item	Example
Targets	Several ideas for target conventions are • Associated displays (up to eight) at bottom of display. • Help display(s) on left, overview(s) on right. • Operator functions localized to bottom and right.
Values	Several ideas for value conventions are • Cyan if a system value. Example: **.**PV • White if operator changeable. Example: **.**SP • Yellow if a calculation product. Example: cost • Green for strings. Example: **.**NAME and **.**EUDESC
Modes	Several ideas for mode conventions are • Cyan if **.**MODE = **.**NMODE and **.**MODATTR = **.**NMODATTR • Yellow, reverse if .MODE = MAN and **.**MODE <> **.**NMODE • P- if **.**MODATTR = program • - C or blink if **.**RCASENB = ON and CASREQ = REQUEST
Colors	Several ideas for color conventions are • Red is used exclusively for alarm conditions. • Blinking red indicates unacknowledged alarms. • Blue for outlines, titles, and selected points. • Green, yellow, and white for process lines. • Magenta for abnormal conditions. Example: **.**PV = BADVAL

Data Presentation

Description

The use of color, reverse-video, blinking, and intensity can distinguish between types of data.

These distinctions of class, by color and text type, significantly reduce the amount of analysis required to understand the information displayed.

Most process operators prefer to handle the influx of data in a presentation format known as *by exception*. Color and blink, as well as size and text type, call attention to status changes in a quickly assimilated format.

Color Guidelines

Table 2 describes color usage guidelines you may want to follow.

Table 2 Color Guidelines

Guideline	Comment
In general, stay away from bright colors	Bright colors may look nice when the display is initially called up, but they are hard on the eyes when watching the screen for any length of time. Magenta is a bright color, especially if used as a fill color. One suggestion is to use magenta to highlight items on the display. Magenta is tiring on the eyes; use it sparingly.
Reserve red and yellow for alarm conditions	Red is usually assigned to high and emergency priority alarms and should be reserved so that as soon as red appears on a display, it gets the operator's immediate attention. If red is used for process equipment or process lines, it draws the attention away from alarm conditions. If yellow is required for secondary process lines, try using low intensity yellow so that it's not the same color as the alarms.
Use dark blue for background objects	Use dark blue for subtle identification of objects that you want to be in the background of the display. Text and values in blue can be difficult to read.
Avoid blinking colors	The blinking should be reserved for unacknowledged alarms. Flashing objects can wear on the operator's patience over time and draw attention away from unacknowledged process alarms. (Sorry, no flashing flames in process heaters!)

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Color coding

Table 3 lists graphic color coding standards that can be implemented.

Table 3 Color Coding Examples

Color	Example Convention
Red	Alarms (high and emergency priority) Safety Messages
Cyan	Live Data Values Major Process Lines Control Valves
Half Intensity Cyan	Fill Color For Major Process Equipment Instrument Lines
Blue	Outlines for display links Targets
White	Text Descriptors Page Title Outline of Minor Process Equipment Manually Operated Valves Equipment not Controlled by the DCS
Half Intensity White (gray)	Manual/Initialization and Off/Closed State
Green	Point Name Automatic/Cascade and On/Open State
Half Intensity Green	Engineering Units

Choosing colors

When choosing colors, it is important to consider those operators that may be color blind. The most common type of color blindness is yellow-green. A person afflicted cannot distinguish between yellow and green and may also have problems differentiating between cyan and white.

This is not to say that these colors should not be used together, this would strictly limit the use of color in display building. But what is important is that there be careful consideration in designing displays and choosing colors where color identification is very important to the operator.

Color copier

Yellow does not reproduce well on some color copiers. If this is true for the color copier on your system, or if there is a potential for a color copier later on, do not use yellow for text or values.

Operator Actions and System Responses

Operation actions

Options for operator action should always be obvious. A simple convention of color can make it obvious.

You can make a clear distinction between actions affecting only the current display and an action that will call up another display, thus changing the current view of the process.

Other simple convention options include

- shape of the touch-target (pattern recognition), or
- position (location) in the custom display.

Guidelines

The biggest concern with targets is how to convey to the operator which areas of the screen are targets.

Targets should not attract attention away from the process and control information on the graphic.

Targets should be designed in a consistent manner from display to display.

The control system's responses to operator actions should be predictable and obvious. This translates into providing graphical feedback to the operator.

Example

Table 4 describes examples of target conventions.

Table 4 Action/Response Convention Examples

Item	Example Convention
Targets	White targets access other displays. Green targets change data or option on current display. Full intensity blue and white to identify targets.
Selected Targets	Blue outline box indicates a selected point. Green, reverse targets indicate selected option.

ATTENTION

ATTENTION—When adding targets to a display, two things are worth keeping in mind:

1. It is easiest to reach targets at the bottom of the screen, and
2. Targets on the right side of the screen do not require a right-handed person to obstruct their view of the screen while reaching for the target.

Progressive Exposure

Description

Progressive exposure is an important concept in designing graphics for large complex operations. Effective implementation of this concept can make the difference in operator response during crisis.

Progressive exposure is a methodology for logically allowing the operator to select (expose) more information about the process.

Hierarchy of displays

A graphical hierarchy for a large system can be designed by using a process area overview as a pinnacle, showing primarily production and quality data. The apparent simplicity in an overview display can be misleading.

Example

Figure 2 shows an example of a Paper Mill Overview display used to view an entire integrated pulp and paper mill. This seemingly uncomplicated display actually contains a lot of data. All of the important process control parameters from the mill are monitored from this one display for alarm conditions.

The upper half of the display can be used for abnormal condition messages and alarms. This design minimizes the "noise" an operator has to deal with; if there are no abnormal conditions; the only data of concern is quality and production.

The following sequence of exposure used in the display is logical, progressive, and uncomplicated:

IF you want to view this…	THEN do this…
Detailed process unit information that includes operator access to controls	Select that area of the screen.
Specific loop-level information	Select the desired control loop, perhaps designated as a valve symbol. (A change zone may provide data such as mode, setpoint, process value, and output.)
Detailed loop information	Select the loop's point name (usually shown in the change zone), then call up the system's standard Detail display.

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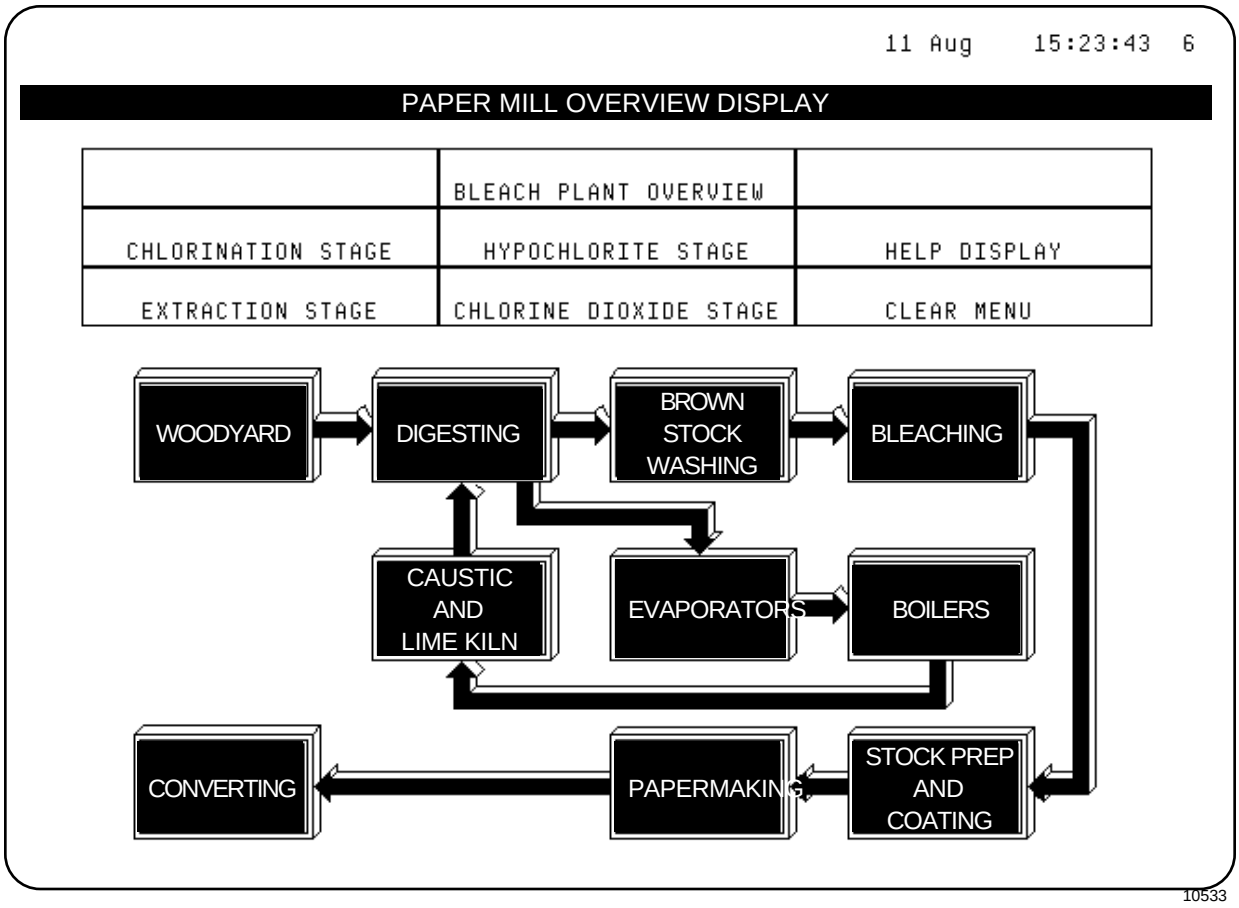
Example, continued

Figure 2 Example of Progressive Exposure—Paper Mill (DEMO>MILL)



Selective Disclosure

Description

Selective disclosure, often implemented as *windowing*, is less structured than progressive disclosure. It allows the operator to select from disparate, even disassociated, groups of data.

To aid in the understanding of the process, design display overlays that lay over the existing display and contain additional information. There are ways to hide detailed information and display it only at the operator's request.

Change zone

The change zone is an example of providing only the information (and control) selected.

Trends

The trend window is also an example of the selective disclosure concept; it does not have to clutter the screen when no point is selected.

NOTE: Operators like trends. If there is available room on a graphic display, try adding a trend of the most important process variables to the display (Honeywell-supplied subpictures TREND and TREND_AX).

Example

Figure 3 shows a variation on the concept of selective disclosure.

A window is provided for the operator to choose among several options, including maintaining a minimalist overview of the process area in the upper-left corner.

In this way the operator has both an "overview" and a "detail" display. The operator decides which window is important: the display is not crowded with the "noise" of all the data all the time.

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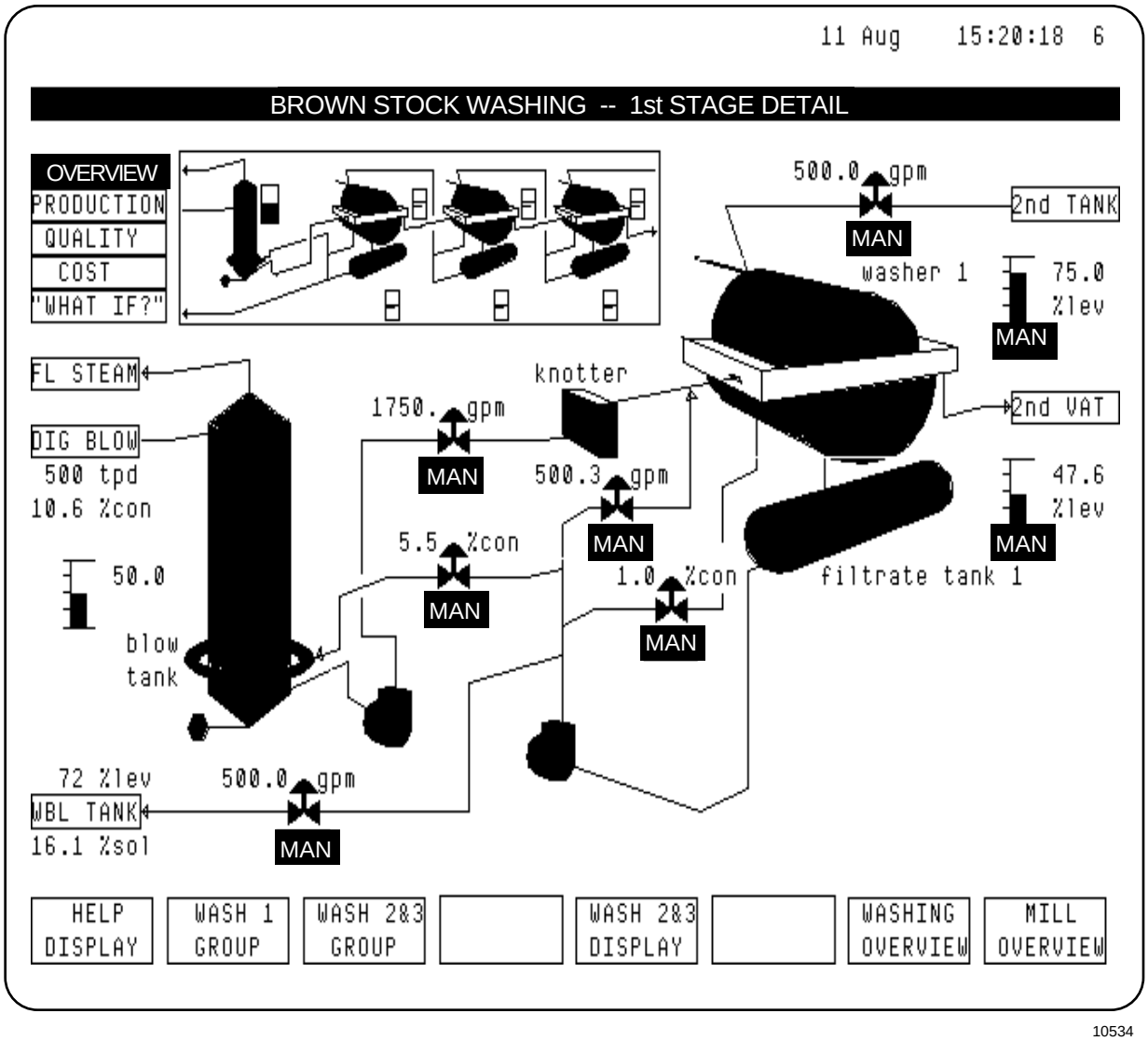
Example, continued

Figure 3 Example of Selective Disclosure—Brown Stock Washing (DEMO>BSW2)



Programmed Action

Description

Programmed action, often referred to as *smart targets*, is the ability within the operator interface to interpret a process condition and base the system's action on that condition.

The Picture Editor provides you with variants, conditions, actor mathematics, and actor comparisons to effect "smart action."

Example 1

An example of programmed action is when the display offers a PROG mode target only if the engineer has specified that "program" is a normal mode condition.

A conditional target actor checks the point's normal mode attribute (**.**NMODATTR) for PROGRAM before setting the mode attribute (**.**MODATTR) to program. Conditional behavior on a target turns the target black whenever .NMODATTR <> program.

Example 2

Another example can be illustrated in an application that assists the operator in dealing with process alarms.

In the Mill Overview display shown in Figure 2, if any point has an alarm, the appropriate block changes color to red (and possibly blinks).

The "smart target" function now takes over. Instead of calling the selected process area overview when the operator selects the red area, a menu of all the available displays is called to the top of the display.

This menu further aids the operator by indicating which displays have active alarms—"smart alarming"!

The Information "Chunking" Principle

"Chunking" principle

A chunk is any meaningful cluster of data (an information chunk).

Seven chunks of data, plus or minus two, is the amount of data that the human short term memory can hold.[1]

The overriding principle in display design is this inherent limitation in the human short term memory system.

Remember this! It is the most important principle in display design!

Example

A telephone number is an example of chunking to bypass short term memory limitations. This string of numbers is very difficult to remember:

5134341093

Providing structure to the string of numbers decreases the number of chunks of information to three:

(513) 434-1093

Humans process the structured string of numbers faster and with better recall.

Chunking techniques

These techniques can be used to chunk information on a graphic display:

- Demarcate related groups of information to facilitate processing of those elements as a chunk (putting a box around them).
- Use closure to facilitate chunking of information (put values inside figures).
- Use relative spacing of items in a display, rather than using an equally spaced array.
- Break down a process unit into its major systems, subsystems, and parameters. From this logical break down, you can create the structures (chunks of information) needed by the operators.

Continued on next page

[1] Miller, G.A. (1956). The magical number seven, plus or minus two; some limits on our capacity for processing information. Psychological Review, 63, 81-97.

The Information "Chunking" Principle, Continued

Chunking guidelines

Follow these guidelines when chunking display information:

- Use techniques that allow the operator to treat numerous points or controllers as one chunk! (Do not interpret the short term memory limitations to mean that only seven, plus or minus two points or controllers should be on a display page.)
- If an operator has to compare information on two different displays, the operator has higher short term memory requirements than if the same information were on the same display. Short term memory limitations argue for minimal displays with well chunked data.

Signal to Noise Ratio

Description

Displays should not contain nonfunctional elements or features, as they represent *visual noise* .

As more items are added to a display, it becomes increasingly difficult to locate a target or other “signal” in the display.

Signal = Information
Visual Noise = Anything that is not a signal

Guideline

Examine each element in a display with respect to how it impacts operator behavior. If you cannot say why a feature is in the display, it should not be there.

The adage that “it can’t hurt” for low use items is wrong; it hurts because it makes it more difficult to find the important items.

With this exception, all of the other design principles indicate that as much information as possible should be put on each screen.

User Capability

Description

A key assumption that must be made in display design is what the user or operator brings with him to the display system.

How much can be assumed that the user knows and therefore not displayed on the screen?

If displays are designed for the trainee or the casual user (an engineer or supervisor), it makes use of them by the operator more difficult.

Guideline

Do not include information in operating displays that is not needed by the operator of the system.

If the casual user or trainee has a hard time using the system, provide an instruction manual and develop separate displays.

The Do's of Display Design

Audience

Design for the normal user. Don't develop primary operating displays for training purposes, for engineers, or for superintendents. Concentrate on what the normal operator's needs are.

Planning

Save room for advanced control information, messages, and targets.

Shapes

Put site glasses inside vessels.

Do try to allow patterns to emerge in the data by using graphic rather than numeric representations.

Do put boxes around related information.

Do put data inside the figures to which they pertain. If hollow vessels are used, data can be displayed within the display, thus providing more space on the display as well as providing association between the data and piece of equipment. If you do decide to fill vessels, try to minimize the size of the vessel on the display to allow room for live data. When filling vessels or process equipment we recommend using half intensity cyan. It provides good definition without being too bold on the display. Remember that the process lines and equipment are not the main focus of the display. They are background information used only for reference. The most important information on the display is control and measurement data.

Lines

Try to minimize line crosses and bends.

Use control lines to show cascades and complex instrument configurations.

Approximate, don't duplicate piping. When designing the graphic, don't feel compelled to duplicate the piping in the field or on the P&ID. The operators using the system are trained and know how the process operates. Graphics should be made as simple as possible while still representing what is occurring in the field.

Use minimal process line color coding. Don't overuse color coding of process lines. Too many color codes on a display for the process lines distract from the real data.

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The Do's of Display Design, Continued

Text	**Use small size text.** **Put a title in the top center or upper left of the custom display.** This is particularly important for similar displays for similar process equipment. The operator needs to know what is being working on. Use the large text size for the title or use the Honeywell text library symbols (LIBE). These library symbols can be scaled as large as desired. Try highlighting the title with a magenta underline, by using reverse video text, or putting a blue solid under the white text. A blue box with white text allows you to put a hidden target over the title to display the actual file name of the graphic.
Targets	**Require two touches to change process data or the status of a piece of equipment.** A sequence of two or more touches or button pushes should be required to change process data or the status of a piece of process equipment such as a valve or motor. This constitutes a confirmation by the operator that the request is truly wanted. The [ENTER] key counts as one of the two button pushes.

The Don'ts of Display Design

Conventions	**Don't destroy the color conventions just to "brighten up" a display.**
Shapes	**Don't show vessel internals unless it provides needed information to the operator.** **Don't put excessive detail in the graphics** (such as tower trays that have no bearing on flows). **Don't show hand valves or valves not controlled by the DCS or whose status does not come to the DCS.**
Lines	**Don't show sensing points or instrument leads unless it is hard to understand on the display.** You may choose to use dashed lines for instrument lines. Dashed lines are best drawn using text objects (dashes [-] and bars [|]) and then using the line command to build the corners.
Extra space	**Don't use space just because its available.** Don't be tempted to put nonessential information on a display even if you have room. If after all the displays are created all have space available, something probably went wrong. Go back and try to combine information.

Display Integration

Do the pieces fit?

Although display design is a holistic process, it eventually becomes a multitude of individual displays. The displays have the correct content for the intended use and the data are presented in a manner compatible with the human information processing system; however, do the pieces fit together?

Although how the pieces fit together should be continually evaluated, it is important, at least at the end, to examine the entire system. If the pieces don't fit, don't force them. Go back and rework the system until they do.

What to look for

There are some general characteristics to look at first. Most of the indications will show in the lack of correspondence or consistency between displays, a lack of symmetry in the system, and/or "exceptions."

Consistency

Correspondence or consistency violations are space related or involve axis shifts.

Space-Related

To much or too little space often causes designers to violate conventions early on in the design process. "I don't have room to show the output as I do everywhere else," or "I had room to show the Honeywell van."

Don't let space drive display design. Combine the display with another if there is too much extra space, or just leave the space open.

Axis Shifts

Axis shifts are subtle changes in orientation: going left to right on most displays, and switching top to bottom on another. While an axis shift is not always bad, if one exists the question should be asked as to whether it is necessary.

Symmetry

Lack of symmetry shows up primarily in array-type displays or in the keypad. If there is one display too many for the rows or columns in the array, the extra display gets pushed to the next one. The symmetry is then broken and the question should be asked, can that subset of displays be reworked?

Continued on next page

Display Integration, Continued

Exceptions

Exceptions point to integration problems. If, in describing the system, you often state that "it always works this way, except...," the displays probably need to be reworked.

Too many exceptions means more than one or two, and is relative to the total size of the display system.

If it seems that there are a lot of exceptions, there probably are too many.

Exceptions become little traps or annoyances because, as creatures of habit, we get familiar with "always" and forget "except."

Lab Exercise

Overview

Introduction

This lab exercise has two parts:

- in Part 1, you will look at the conventions and design guidelines implemented on several custom displays, and
- in Part 2, you will build or modify a custom display that follows stated conventions and recommended design guidelines.

NOTE:
Displays referenced in Part 1 of this exercise are on your cartridge disk in the DEMO directory.

Duration

Part 1—30 minutes

Part 2—1 hour

Part 1—Display Examples

Location, layout and orientation

Design Guideline

When the location, layout, and orientation of data and objects on a display are consistent and logical, the operator instinctively knows where on a display to find the information needed.

Instructions

1. Select APPLICATIONS on MOOSE.
2. Call up the KILN display.
3. Check out the display's conventions for location, layout, and orientation:

Display	Example Conventions
KILN	Associated display targets appear at bottom of display. The lower-left target is always reserved for the Help Display. Targets in upper-left corner access additional information. Targets at the end of each flow line, call up the upstream or downstream display. Flow value appears beside valve that controls the flow.

4. Return to the Application Menu, then call up the Brown Stock Washing display (BSW1).
5. Observe that BSW1 implements the same conventions as KILN.

Continued on next page

Data presentation

Design Guideline

To reduce the amount of analysis required to understand the display and to call attention to status changes in a quickly assimilated format, use color, text size/type, reverse-video, blinking, and intensity to distinguish between types of data.

Instructions

1. Return to the Application Menu, then call up the displays KILN and Brown Stock Washing 3, BSW3.

2. Check out the displays' conventions for data presentation:

Display	Example Conventions
KILN	Cyan—Live data values Green—Targets that change data or option on current display. White—Targets that access other displays. Red—Indicates alarm conditions, blinking for unacknowledged. Select a valve, then cause the point to go into alarm using the change zone.
BSW3	Cyan—Live data values. White—Targets that access other displays. Red—Indicates alarm conditions, blinking for unacknowledged. Select a site glass, then change the output to 15% using the change zone to see the alarm condition.

Operator actions and system responses

Design Guideline

Options for operator action should

- be obvious, predictable, and consistent,
- provide graphical feedback to the operator, and
- clearly indicate when they call up another display, thus changing view of the process.

Continued on next page

Instructions

1. Return to the Application Menu, then call up the display KILN and look at the conventions for operator actions and system responses:

Display	Example Conventions
KILN	Green/Reverse background a. Option target selected Blue Outline a. Point selected

Progressive exposure

Design Guideline

To help make a difference in operator response during a crisis, you should logically allow the operator to expose more information about the process.

Instructions

1. Check out the progressive exposure in display BSW2 and MILL:

Display	Example Progressive Exposure
BSW2	Alarms a. Call up the Detail of point LF06S07. b. Put it in manual and and change its output until a deviation alarm occurs. c. Return to BSW2 and select the flashing red alarm target.
MILL	Alarms a. Call up the Detail of point 57FC651. b. Put it in manual and change its output until a deviation alarm occurs. c. Return to MILL and select the flashing red Caustic and Lime Kiln target.

Programmed Action

Design Guideline

Create *smart targets* that interpret a process condition and base the system's action on that condition.

Continued on next page

Instructions

1. Check out the programmed action in display MILL:

Display	Example Programmed Action
MILL	If there is an alarm condition, the smart alarm target displays a menu of the affected process areas at the top of the screen. a. Select the BLEACHING target. b. Select the CHLORINATION STAGE target to display the selected process area overview display. c. Call up the Detail of point 57FC651. d. Change the output until the deviatin alarm returns to normal. e. Return to the display MILL. f. Select the BLEACHING target. g. Notice now that the BLEACH PLANT OVERVIEW DISPLAY appears.

Selective disclosure

Design Guideline

Allows the operator to select from disparate, even disassociated, groups of data.

Instructions

1. Check out the selective disclosure in displays KILN and BSW2:

Display	Example Selective Disclosure
KILN	Change zone a. Select a valve Trend a. Select a valve
BSW2	Overview graphic of other units a. Select the OVERVIEW target.

2. Locate all the targets in BSW2. Are the targets obvious?

3. Can you locate the revision date of BSW2?

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The information "chunking" principle

Design Guideline

You should "chunk" the information on a graphic display:

- demarcate related groups of information (put a box around them),
- use closure to chunk information (put values inside figures),
- use relative spacing, rather than using an equally spaced array,
- break down a process unit into its major systems, subsystems, and parameters, then from this logical break down, create the structures (chunks of information) needed by the operators,

Instructions

1. Call up the displays in the DEMO directory and list the chunking methods you find used in these displays:

Display	Chunking Method

Part 2—Designing A Custom Display

Instructions

Modify an existing custom display, or build your own custom display that

- contains at least five design conventions described in this course module,
- does not violate the "Don'ts of Display Design" described in this course module,
- exhibits at least five of the "Do's of Display Design" described in this course module.

Modifying an existing display

If you choose to modify an existing display, copy it to your cartridge disk and rename it.

Any displays in the following directories are available for you to copy and modify. Listed on the right is one of the displays available in the directory.

Directory	Display
$Fn>DIST	DT
$Fn>MPTH (multi-path reactors)	REACT_OV
$Fn>DEMO	KILN
$Fn>DEMO	MILL
$Fn>DEMO	BLEACH2

Database points

If you want to compile your completed display, use the AM points listed on your partition sheet to support your display so that it can be compiled on the Training System.

You do not have to compile your display to meet the requirements of this course module.

Directions

DIRECTIONS—This is the end of the study material for this module. Discuss questions concerning the study material or the lab activities with a colleague or a course manager

If you are satisfied that you have achieved the objectives of this module, continue with the next section, the Student Proficiency Evaluation.

Student Proficiency Evaluation

Criterion Test

Instructions

Completion of the lab exercise satisfies the majority of the test requirement for this course module.

Your display should not violate the "Don'ts of Display Design" described in this course module,

Using the display you modified or built in the lab exercise, describe to your course manager

- your five design conventions (listed below), and
- the five "Do's of Display Design" that you implemented (listed below).

Conventions

List your five design conventions here:

1. _____
2. _____
3. _____
4. _____
5. _____

Do's

List your five Do's of display design here:

1. _____
2. _____
3. _____
4. _____
5. _____

Self-Evaluation

Solutions

Directions

DIRECTIONS—This is the end of this module.

Use your course map to

- Get your course manager to sign off this module.
- Choose your next eligible module.

If you have a question

- Ask your course manager.

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