# Efficient Operations Using Advanced Operator Graphics

## Abstract

The Operator interface to your control system is an important part of the Operator's ability to control the plant processes. A well-designed graphic that encourages situational awareness allows for a more accurate and timely Operator response.

By using leading indicators, deviating process values can be easily identified and corrected before they alarm or trip. Alarms and other abnormal events should clearly stand out on the graphics by using specific colors and shapes allowing for easy identification of a process change.

High performance shapes can enhance the performance of the Operators by giving them visual references of the state of the process, allowing for issues to be detected in earlier stages.

The navigation bar organizes the displays into an intuitive hierarchy, and provides the Operator with the ability to move from any display to any other display. Various high performance shapes have been developed to provide at glance monitoring, where deviations from normal patterns in the shapes will stand out.

Task oriented displays, for example startup/ shutdown, provide the information necessary for control during these known situations. The use of permissive and shutdown graphics show the Operator specifically what is keeping the plant from starting up or what exactly caused the plant to shutdown.

## Graphics Layout

**Preventing Overcrowding and Providing Ease of Navigation**

More information does not always mean better when it comes to advanced Operator graphics. Displays with a high information density can be hard to read and do not provide good diagnostics, control, or situational awareness.

There needs to be a balance between the necessary information and overcrowding. As suggested by ISA 101.01, a way to prevent high information density is to have multiple layers of displays.

See Table 1 for information on the different display levels.

The different levels of displays should be organized into a hierarchical structure for organization with the detailed displays being placed under their associated overview displays.

Once organized into a hierarchy, an intuitive navigation should be implemented to assist in the efficient operations of the plant. Being able to quickly navigate from one graphic to another is critical for effective operations and diagnostics.

To assist with the navigation between the different layers of displays, Emerson has developed the Navigation Bar which allows the user to navigate from any display to any other display. The Navigation Bar is configurable which allows for display organizational changes to be made to provide a more intuitive display structure for the Operator.

| Graphic Layer | Description | Where Emerson Products and Services Can Help |
|---|---|---|
| **1. Diagnostic Overview** | Provides overall process information without the ability to control. This level should be strictly diagnostic and show information that allows for deviations in the system to be detected early. | Emerson can provide Consulting Services for the development of these displays. The tags and shapes chosen for these displays can play a big role in the early detection and prevention of process upsets.<br>The Emerson team brings process knowledge and experience to the analysis in order to identify the most critical variables to monitor.<br>Emerson can also provide shapes to help in the monitoring of the critical variables including the shapes that are shown in Figure 2. |
| **2. Controls Overview** | Provides the necessary handles for common tasks and diagnostics. This level of graphics should be used most of the time while everything is running normal.<br>They should also provide the proper tags that promote situational awareness. Changes in the process should also be easily identifiable from the variables on these graphics. | As a part of an advanced HMI design, Emerson looks at many factors to make sure necessary handles for daily operation are covered.<br>Operator event logs are collected to determine the most used variables over a period of time. This helps to determine tasks routine to Operations and can help prevent the changing of screens to do a daily task.<br>The Emerson team also ensures complete coverage of the mass and energy balances of a system on this level of graphic. Being able to monitor these balances can help pinpoint potential areas of concern. |
| **3. Detailed Process** | This layer includes detailed process graphics, where the graphics are similar in detail to the P&ID. All necessary control handles should be present on this layer including complex control loops and alternate line ups. | Emerson can assist in the development of these displays. Using a combination of engineers and graphic designers, Emerson develops graphics from P&IDs that are both accurate and easy to follow. Where possible, controllers are lined up in a grid like pattern for ease of monitoring and control.<br>Emerson also provides a shape, the Navigation Bar, for easy navigation between displays. Emerson can develop a hierarchical organization of the graphics for intuitive navigation from display to display. With the Navigation Bar, users can navigate from a display on any level to any other display.<br>The Navigation Bar can be seen in Figure 3. |
| **4. Other** | The remainder of the system information should be present in this layer. Information may include interlocks and permissives, and this information could be shown on a popup type display. | The Emerson team references startup and shutdown logic documentation to develop these specialized graphics.<br>This type of information on a graphic can provide a quick reference to diagnose what is preventing something from starting up or what has caused something to shutdown. |

*Table 1: Levels of Graphics.*

## Alarm Identification

**Enhance Alarm Identification as well as Promote Alarm Prevention**

Some general rules exist when it comes to alarm identification on graphics. Alarms should be easily identifiable on a graphic, and different priorities should also be easily differentiable.

ISA 18.2 states that alarm colors cannot be used for anything else on the graphics. Also, according to ISA 101.01, colors used should be easy to tell apart from each other, as well as used in a way as to not take away the meaning of an alarm color. Background colors should be neutral in order to enhance the readability of a display, and colors used to highlight changing conditions should be easily seen on the background.

Emerson has created color themes for graphics that are pre-configured color combinations to help with this. Colors in a theme are from the same color palette and do not contain an excessive number of colors.

The theme colors can be seen in Figure 1.


*Figure 1: Color Themes.*

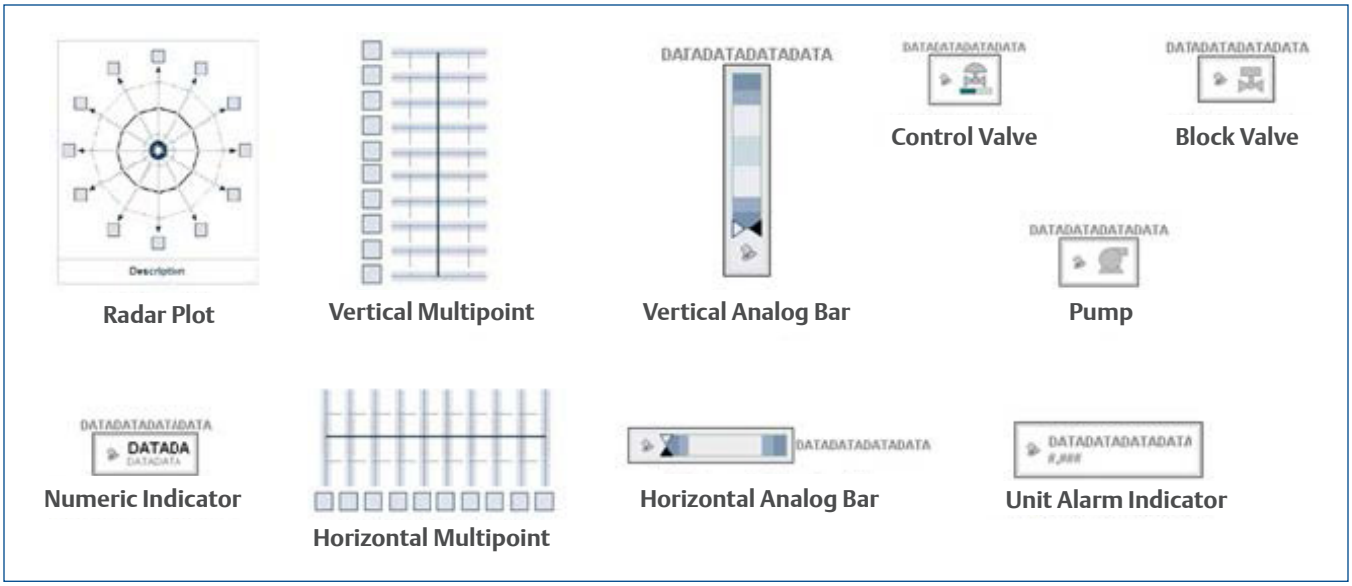


*Figure 2: High Performance Shapes.*

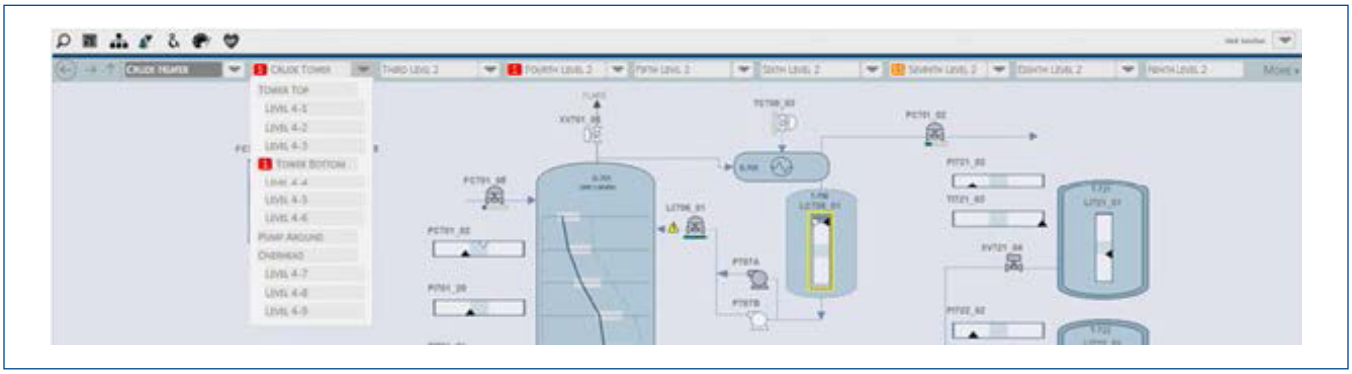

*Figure 3: Navigation Bar.*

## Special Modes of Operation

**Reduce Graphics Changes During Known Alternative Process Conditions**

According to ISA 101.01, displays should be designed for all common modes of operation including known abnormal running conditions. Separate displays may need to be created to support these abnormal modes in order to maintain proper information density on the graphics. Different types of displays are helpful for specific tasks and known abnormal conditions.

Displays specific for startup and shutdown, including process type, startup permissives, and shutdown logic can be utilized. These displays allow for Operations to have all necessary information for these situations without having to navigate through as many screens. While starting up a unit, there are often different permissives that must be met before moving on to the next main step.

For example, lighting pilot gas burners before introducing fuel gas. Permissive displays allow for a clear visual of what conditions have been met, and what conditions still need to be satisfied. This helps to focus the operator on what is holding him/her up on moving on to the next step (See Figure 4).

Shutdown logic displays allow the Operator to identify what caused a shutdown condition to be met (See Figure 5). Operations can quickly investigate the cause by knowing the shutdown condition.

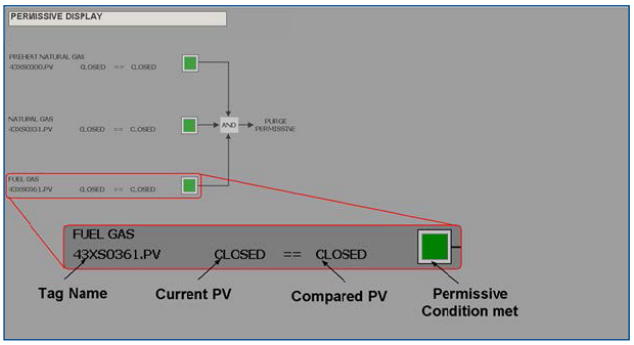


*Figure 4: Permissive Display.*

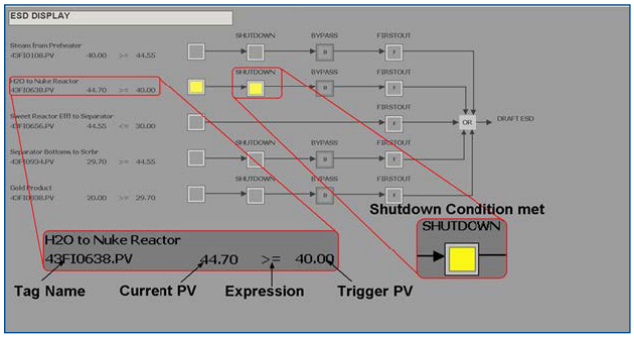


*Figure 5: ESD Logic Display.*

## Conclusion

There are many things to consider when developing Advanced Operator Graphics. Various levels of graphics can be used to enhance usability and situational awareness. The high performance shapes can be used to enhance alarm identification and promote alarm prevention.

Displays can be developed for known abnormal conditions which can reduce the number of graphics changes and diagnostic time during these operational conditions. In conclusion, well designed Advanced Operator Graphics can promote efficient operations, and Emerson has the tools and experience needed to create them.

## References

1. ANSI/ISA 18.2-2016, Management of Alarm Systems for the Process Industries, ISA, Research Triangle Park, North Carolina (2016).
2. ANSI/ISA 101.01-2015, Human Machine Interfaces for Process Automation Systems, ISA, Research Triangle Park, North Carolina (2015).

# Efficient Operations Using Advanced Operator Graphics

**White Paper**
October 2018

Emerson
North America, Latin America:
+1 800 833 8314 or
+1 512 832 3774

**Asia Pacific:**
+65 6777 8211

**Europe, Middle East:**
+41 41 768 6111

**www.emerson.com**