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Distributed Control System Alarm Prioritization and Standardization Guide

2018 TECHNICAL REPORT

Distributed Control System Alarm Prioritization and Standardization Guide

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ABSTRACT

This report provides information on best practices for uniform alarm management, taking into account different power generation plant types and the capabilities of several distributed control system (DCS) platforms. The alarm-related capabilities of several DCSs used in power generation are compared. Best practices for use of those capabilities are detailed and build upon prior Electric Power Research Institute (EPRI) reports identified in the References section.

This report is not intended to fully describe DCS alarm management or replace any concepts described in EPRI guidelines *Alarm Management Philosophy Document* (3002004840) or the *Updated EPRI Alarm Management Program Guideline* (3002005535). Instead, the specific Priority 1 and Priority 2 alarms identified in past alarm rationalization projects are listed for supercritical coal plants, subcritical drum coal plants, and combined-cycle power plants. This will provide a useful reference for generation plants that have not yet undergone alarm rationalization.

Keywords

Alarm analysis
Alarm management
Alarm rationalization
DCS alarms
DCS configuration
Distributed control system (DCS)

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PRIMARY AUDIENCE: Control room operators and DCS engineers/technicians

SECONDARY AUDIENCE: Operations and maintenance managers

KEY RESEARCH QUESTION

With the advent of digital alarms and the continued increase in plant automation controls, plant operators have been overwhelmed with digital control system alarms. Many of the existing systems have not been properly set up with alarm standards that are industry best practices, and many utilities have been unable to dedicate the resources to address this issue.

RESEARCH OVERVIEW

A research overview was performed with existing guidelines, past Electric Power Research Institute (EPRI) research, and power generation members' experiences. Power Generation and non-utility distributed control system (DCS) users were benchmarked to determine best practices. The alarming capabilities of the original equipment manufacturers for 10 DCSs were evaluated.

KEY FINDINGS

- Best practices for alarm summary screens
- Best practices for alarm tag names
- Priority 1 alarms for combined-cycle, supercritical, and drum units
- Priority 2 alarms for combined-cycle, supercritical, and drum units
- DCS configuration comparison for 10 different DCS types
- Best practices for process control graphics

WHY THIS MATTERS

Many power generating plants exceed industry guidelines for DCS alarm standards, and many utilities have been unable to dedicate the resources to address this issue. This research will provide an accelerated method to establish their respective DCS controls within the industry standard guidelines for human response.

HOW TO APPLY RESULTS

This report provides general standards and guidelines for DCS alarming and priorities that are relevant both in the control room and to the DCS controls engineer/technician. Application of the recommended alarm priorities for the specific unit types can accelerate the process of restoring industry guidelines on alarm response.

LEARNING AND ENGAGEMENT OPPORTUNITIES

- Alarm Management Philosophy Document (EPRI report 3002004840)
- Updated EPRI Alarm Management Program Guideline (EPRI report 3002005535)
- P108 Operations Conference
- Plant Managers Forum

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PROGRAM: Operations Management and Technology, P108

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INTRODUCTION

1.1 Background and Motivation

This is a report on best practices for uniform alarm management across power generation and several distributed control system (DCS) platforms.

The topic of alarm management has achieved high visibility in industry. The subject is extensively covered in such venues as trade journals and technical society meetings. The reason for this attention is that poorly performing alarm systems are a widespread problem throughout all the industries involved in process control, which include power generation and transmission.

Poorly performing alarm systems are often cited as significant contributing causes to process upsets, incidents, and major accidents. Significant alarm system improvement is needed in most industries that use modern computer-based distributed control systems (DCSs or energy management systems [EMSs]). These flexible and capable systems are used throughout various industries, including power generation, transmission, oil and gas, refining, chemical, petrochemical, pulp and paper, pharmaceuticals, minerals processing, discrete manufacturing, and others.

Those involved in owning, operating, designing, and modifying such facilities have a high interest in solving the alarm-related problems endemic to the use of these systems.

1.2 Project Objective and Scope

The alarm-related capabilities of several DCSs used in power generation are compared. Best practices for use of those capabilities are detailed, building upon prior Electric Power Research Institute (EPRI) reports identified in the References section.

Additionally, the specific Priority 1 and Priority 2 alarms identified in past alarm rationalization projects are listed for different power generation process types.

2
ALARM-RELATED CHARACTERISTICS OF DCS TYPES

This section summarizes the basic alarm-related capabilities of several DCS types and mentions the best practices associated with those capabilities. Additional details regarding the different DCS types are in Section 5.

In this document, an "alarm" is specifically defined as an audible and/or visible means of indicating to the operator an equipment malfunction, process deviation, or abnormal condition that requires a timely response.

2.1 Tag Names

A "tag" (sometimes called a "point") is a unique identifier assigned to a process measurement, calculation, software construct, or device within a control system. Alarms are configured on tags, and the indication of an alarm refers to the tag from which it is generated. An additional goal of this report is to put forth best practices for the configuration of tag names and tag descriptions and to compare those to common practices submitted via member survey.

Tag names and tag description fields are used to clearly identify an entity in a DCS. Typical field lengths are 16–32 characters. While the formatting varies (see Section 5), the combination of tag name and tag description field capabilities of all modern DCS types is adequate for clearly identifying a tag. The combination of tags, combined with a particular parameter of the tag, generates alarms and is used in other calculation expressions within the DCS.

Guidance for the effective use of tag names is as follows:

- **Length:** Tag names should be relatively short and easily understood. A 32-character tag name that differs only slightly from another 32-character tag name is not advisable.
- **Content:** It is a best practice for a tag name to clearly and consistently indicate the nature of the measurement.

The ISA document *ISA-5.1-1984 (R1992) - Instrumentation Symbols and Identification* provides one consistent method. Note that this document has not been updated since 1992, the dawn of the DCS era, and some of its concepts incorporate pre-DCS paradigms (for example, identifying things that are "behind the panel" and identifying pen-chart recorders.) Still, it is a helpful document, with tables that are often used for consistently identifying various measurement types.

Table 2-1 is a short and workable summary of the concepts in ISA-5.1.

Table 2-1
Examples of first character identification letter usage (Table 1 in ISA 5.1)

Table 1 — Identification Letters

	FIRST-LETTER (4)		SUCCEEDING-LETTERS (3)		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	Analysis (5,19)		Alarm		
B	Burner, Combustion		User's Choice (1)	User's Choice (1)	User's Choice (1)
C	User's Choice (1)			Control (13)	
D	User's Choice (1)	Differential (4)			
E	Voltage		Sensor (Primary Element)		
F	Flow Rate	Ratio (Fraction) (4)			
G	User's Choice (1)		Glass, Viewing Device (9)		
H	Hand				High (7, 15, 16)
I	Current (Electrical)		Indicate (10)		
J	Power	Scan (7)			
K	Time, Time Schedule	Time Rate of Change (4, 21)		Control Station (22)	
L	Level		Light (11)		Low (7, 15, 16)
M	User's Choice (1)	Momentary (4)			Middle, Intermediate (7,15)
N	User's Choice (1)		User's Choice (1)	User's Choice (1)	User's Choice (1)
O	User's Choice (1)		Orifice, Restriction		
P	Pressure, Vacuum		Point (Test) Connection		
Q	Quantity	Integrate, Totalize (4)			
R	Radiation		Record (17)		
S	Speed, Frequency	Safety (8)		Switch (13)	
T	Temperature			Transmit (18)	
U	Multivariable (6)		Multifunction (12)	Multifunction (12)	Multifunction (12)
V	Vibration, Mechanical Analysis (19)			Valve, Damper, Louver (13)	
W	Weight, Force		Well		
X	Unclassified (2)	X Axis	Unclassified (2)	Unclassified (2)	Unclassified (2)
Y	Event, State or Presence (20)	Y Axis		Relay, Compute, Convert (13, 14, 18)	
Z	Position, Dimension	Z Axis		Driver, Actuator, Unclassified Final Control Element	

Table 2-1 gives an example of a consistent usage of letters for the first character of a tag name, relating them to the type of process measurement. This is a highly desirable practice, but other letter choices could be made. The key is consistency and encoding some useful knowledge into the tag name itself. Tag names that seem to be a series of almost random letters and numbers should be avoided. Often tag names reflect some aspect of the engineering design coding, which may be no longer important in operation and irrelevant to the operator.

Consider these three example tag names. **P-MD1100-1** **T-MD1100-2** **FC-MD1100-3**

The leading character (two or three characters are allowed) indicates the type of measurement—in these cases: pressure, temperature, and flow. A table similar to Table 2-1 should be prepared for all possible measurement types and followed consistently. A single character is assumed to be a sensor element, not a controller construct. Since all inputs to a DCS can be "indicated," the old method of specifying "TI" (temperature 'indicator') is no longer necessary. The FC is a flow controller element, which is differentiated in the tag name from a simple sensor element. PC and TC would similarly be pressure controller and temperature controller.

The dash (or hyphen) "-" is" a desirable text separator element. Run-on tag names are difficult to read and comprehend. Some DCSs allow a dash; some do not, requiring an underscore or some other character. Most do not allow spaces to be used in a tag name, nor should they be used even if possible. (It is far too easy to have a typo involving two spaces.)

The next element, "MD1100," is an example of an alphanumeric equipment identifier, generally taken from a process piping and instrumentation diagram (P&ID). The naming conventions for such identifiers should also be consistent. The same kind of equipment should not be named MD1100 in one place and RF1101 in another. After that, the "-1, -2, -3, -4… etc.," identifies different loops (sensors or controllers) associated with that piece of equipment. Using two digits for the last element, a given piece of equipment could have 99 loops, numbered -1 through -99. Few equipment items have more than that, but there are no restrictions from going to three digits. Leading zeroes (-001, -002…) in the number are discouraged.

The order of the loops is not important. In some cases, closely related sensors might be identified as the same number with a suffix, as T-MD1100-14A, T-MD1100-14B, and T-MD1100-14C (three closely related temperature sensors).

Note that the letters "I" and "O" should not appear adjacent to or inside a numeric string. Equipment designations that are a combination of letters and numbers should not use "I" or "O" in the letter portion because they are easily read incorrectly as one or zero.

In some DCSs, the tag name itself incorporates some type of process area or equipment designation, sometimes in a prefix (GEN1, GEN2). In other cases, this is a separate field (for example, groups of tags are associated with a coded designation such as "UNIT" or "AREA"). Some such consistently used identifier set is desirable, as it enables a variety of sorting and filtering capabilities in searches.

The tag descriptions field should be useful to the operator and contain nomenclature relevant to that role. For example, the operator likely speaks of the "West Turbine" and not "K1107." It is common to find tag descriptions that are cryptic and unmeaningful to the operator.

Tag descriptions should use a standardized nomenclature and be consistent. For example, terms like LEVEL and LVL should not both be used. "EAST GEN OIL TEMP" and "W GEN OIL TEMP" and "GEN OIL TEMP NORTH" are inconsistent in terms and sequence.

A document detailing the proper way to designate all the customizable elements of the DCS should have been available and used when the DCS was configured. When such a document does not exist, the DCS structure will be inconsistent and more complicated to troubleshoot. Updates and additions are also likely to add more inconsistencies. Such a document should be created if one is unavailable. Note that in a good human-machine interface (HMI) design, an operator should never have to type in a tag name.

Table 2-2 shows some examples of tag names and tag descriptions provided via member survey for this report, with commentary.

Table 2-2
Example tag names and tag descriptions

Tag Name	Tag Description	Commentary
1L705	U1 SERVICE WATER TANK LVL	Straightforward and simple. L prefix means level, 705 identifies the loop number, with a clear description. However, the equipment ID is not incorporated into the tag name. Is this the 705th loop in the plant? Having no suffix might be a problem for equipment with multiple, complex loops. If TUI is the tank designator, 1TU1-705-1 might be an improvement.
3HDRLT_0004665	LP HTR DRAIN FLASH TANK 3C LEVEL	Confusing tag name, good tag description. If “LT” is for “level transmitter,” the “T” is not needed. There are unnecessary leading zeroes in the numeric identifier. The equipment designation is unclear.
1IDF:1PITBA102	1-1 IDF INLET PRESS	The 1IDF is likely a location or equipment prefix. 1PITBA102 looks needlessly complex. The use of PIT and BA seems cryptic for a simple pressure indicator.
2FW1P03.DACB	FEEDWATER FLOW	The tag name seems to possibly relate to the service, not the instrumentation function. 2FW1P could be referring to a particular feedwater pump. If so, there is nothing in the tag name indicating that it is a flow instrument rather than, for example, a pressure instrument.
C2SPLN02.DACA	N PRI SH OUTLET TEMP	A temperature instrument that, unusually, has no “T” in the confusing tag name.
1PC016AI	PRIMARY AIR DUCT PRESSURE	This was given as an example of an indicator element. PC should designate a pressure controller, not simply an indicator.
2PC015AI	COND HOTWELL LEVEL	Here, PC is being incongruously used to identify a level controller.
1G3214	Gen H2 Clr 1 Out Gas T	A temperature instrument that, unusually, has no “T” in the confusing tag name.
4FG1_ABS_LIMECT2.PIDA 4FG1_ABS_LIMEOX2.PIDA	LS Slurry Feed Ctrl SO2 Controller	Here is an example where significantly different controller elements differ in only two characters embedded in a lengthy string.
4AQ1_4PDIFF408.4PDIFF408 4AQ2_4TIBA126.4TIBA126	4A8 PJFF Diff Press 4A3A ID Fan Mtr Winding Temp	In this pair of lengthy tag names, these sensor-only tags have significant repetition, and the tag description begins with yet another cryptic 4-character string that is unlikely to be the manner in which the operator refers to that equipment.

Additional examples of tag names and tag descriptions received in this study are shown below. There is wide variation in these naming schemes. Often the relationship between the naming methodology and the nature of the instrument or measurement is not obvious. Many tag names seem unnecessarily cryptic.

2.1.1 Analog Points

```
C1LTGC00.DACA     GEN A1 MWS
2FW1P03.DACB      FEEDWATER FLOW
C2SPLN02.DACA     N PRI SH OUTLET TEMP
1E0392            1 GEN VARS
AI6628            1FF FEEDER SPEED
1T0479            1A ID FAN PT5 WDG TEMP
1F3115            LIP Htr 3 Level 1
1G3214            Gen H2 Clr 1 Out Gas T
1IDF:1PITBA102    1-1 IDF INLET PRESS
0LS13T:0PTLS008   0-1 HYDCL FD PRESS
1DAS:11MILLAIR    1-1 PRI AIR INLET TEMP
```

2.1.2 Controller Points

```
2MA1C03.PIDA      MILL A PRI AIR DMPR CONT
2AS1AC02.PIDA     PEGGING STM PRESS CNTR
1FFDRDMD          PUV F FEEDER DEMAND
1TURBVLVDMD       TURBINE VALVE DEMAND
1SPDSPCRIT        SPEED SET POINT IS CRITICAL
1HT11C27          LP Htr1 DP Drn HW Cnt Vl
1BM2C23           Coord Ctl Pr Ctrlr
1FC2C21           Fuel Master
1AH:B10           RECIRC AIR FAN DISCH CTRL
1M4:B16           MILL 1-4 PR AIR DAMPER
1GEN:B24          GENERATE RUNBACK SIGNAL
```

2.1.3 Other Points

```
F2DI1490.DIGACQA HOPPER 2A1 HI LEVEL
0D0682           2 DIESEL FAIL START
1LS4602ALM       U1 LSL STG TNK LVL DEV
1ANN-DI198       MAIN XFMR 1A COOLING MANUAL/OFF
1W0550           1A Ash Water Pump
1LMFT_17         MFT Trip Rly Input…BX17
2ILS195.DEVCTLA  A2 RG FAN
1ANN:I837        BRG WTR PMP TRIP
31ID:3ZSCBA03Y   3-1 IDF DSCHRG LVR DMPR CLSD
31_1CTF:B4A      COOLING TOWER FAN 3-1-1
1DI7873          1A IDF LO HDR/STBY PMP START
```

2.2 Available Alarm Types

All modern DCSs contain a plethora of standard alarm types that are available to be set on any signal; the most common examples are HI, HIHI, LO, and LOLO alarm settings on an analog signal. A DCS may have more than a dozen different alarm types available for an analog signal and even more on a controller. A discrete input (on-off, A-B switch position) may also have several alarm types available as standard features. "Logic points" or their equivalent are also available on DCSs to combine several different signals and alarm certain combinations and values.

An alarm philosophy document should govern the selection and use of all such alarm capabilities. For example, there should be criteria to follow as to when and if combinations such as HI-HH and LO-LL are allowed and for the relationship between such alarms and process shutdown trip values. Considerable guidance on the use and misuse of various alarm types can be found in EPRI document *EPRI Alarm Management and Annunciator Application Guidelines* (1014316), EPRI document *Updated EPRI Alarm Management Program Guideline* (3002005535), and *The Alarm Management Handbook* (Hollifield and Habibi 2010). See the References section.

2.3 Available Alarm Priorities

The ISA-18.2 definition of "alarm priority" is the relative importance assigned to an alarm within the alarm system to indicate the urgency of response (that is, the seriousness of consequences and the allowable response time).

Within this ISA definition, the effect of priority selection is to alter the appearance of an alarm when presented to the operator in such a way that the priority is easily distinguishable. This usually involves color, sound, and symbology differences.

This is the ideal use of priority; however, DCS vendors are widely inconsistent in nomenclature and even in the basic meaning of the word "priority" as implemented on a particular system. Alarm priority selection can be used to accomplish tasks having nothing to do with the word "priority" as used in international standards. For examples, see the following:

- Use of priority for turning alarm generation on or off
- Use of priority to include or exclude sound with visual annunciation
- Use of priority to make an alarm annunciate to the operator or simply (and invisibly) create a timestamped record (which, by definition, is no longer actually an alarm)
- Use of priority to route alarms to roles other than the operator
- Use of separate priorities to indicate the "type" of alarm (for example, environmental, production, quality, or even something as specific as voltage)

DCSs vary widely in the number of available alarm priorities. They can range from three choices to a thousand. In general, the remainder of this section discusses best practices in alarm priority.

In the context of the definition of priority at the start of this section, only three main priorities are used, referred to here as Priority 1 (highest), P2, and P3. Priority is based on a combination of:

- The nature and severity of the consequences that will occur if the operator does not respond to the alarm
- The time the operator has available to take the correct action

The desired distribution of priority is mentioned in the standards as ~5% P1, ~15% P2, and ~80% P3. Such a distribution aids in making the more important alarms stand out.

A grid-based system is commonly used to determine the priority for each alarm. The references mentioned above have considerable detail on alarm priority selection, including grid examples. A proper grid method will produce a distribution along the lines recommended in the standards.

It is not unusual for two additional priorities to be used.

Diagnostic priority –This is the most common, which is used to indicate a sensor malfunction that is not repairable by the operator. The only operator action is the initiation of maintenance work. It is common to use this "4th" priority on alarms such as "Bad PV," "Bad-IO," or similarly named conditions on all analog signals.

"Critical" priority – This is a much less used case where all of the Priority 1 alarms are examined, and a dozen or so "most critical and important" alarms are chosen, often for a special display or special annunciation.

Other than these five examples, the use of additional priorities is not seen as a best practice. An exception is where, unlike the definition above, a "priority" is the means used in a particular DCS to accomplish some desired special handling of an alarm signal, such as routing or suppression.

2.4 Alarm Summary Displays

DCSs provide an alarm summary display as a standard feature. The display usually includes sorting and filtering capabilities and will typically be configurable as to the information fields shown for each alarm. An example of an alarm summary display is shown in Figure 2-1.

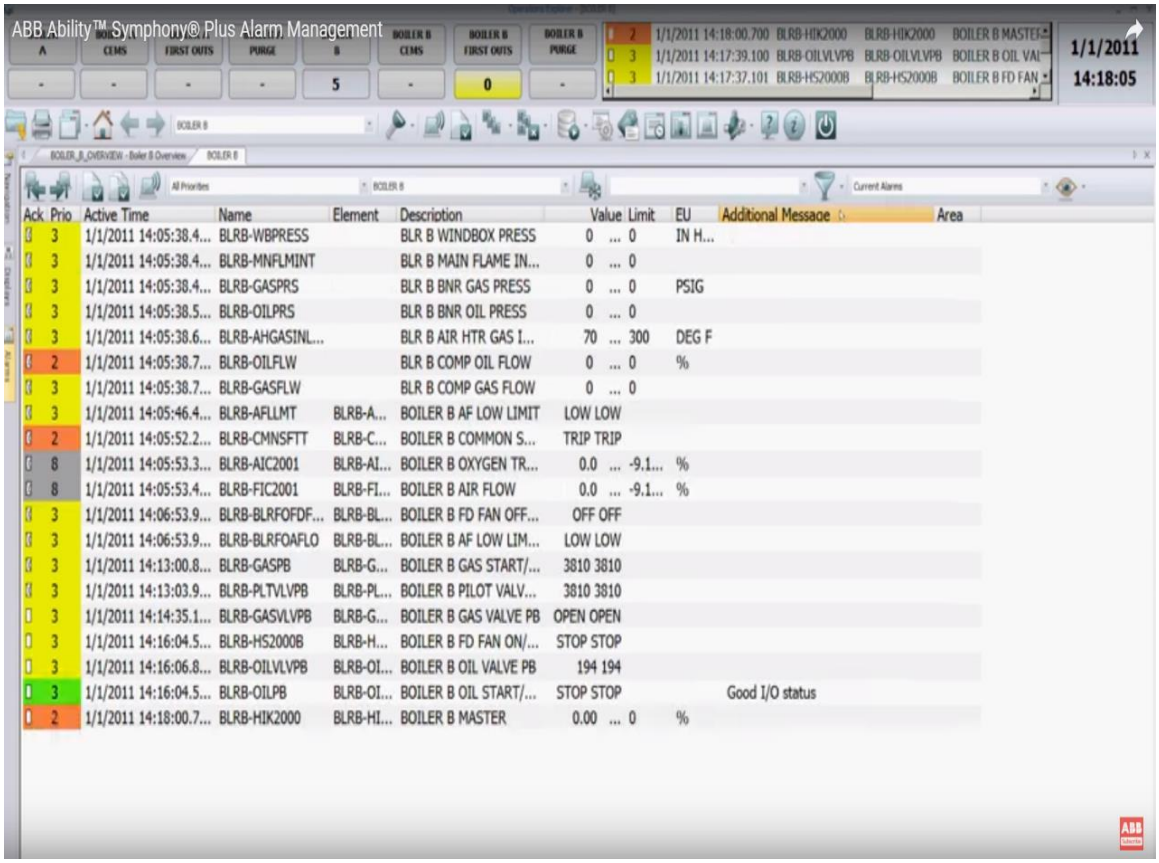

Figure 2-1
Typical alarm summary display

Survey examples of alarm summary screens were provided by members and were generally similar in their capabilities and appearance.

2.5 Best Practices for Alarm Summary Screens

The default view of the page should have alarms sorted by priority, with P1 as the first—and highest—priority. Within each priority band, the unacknowledged alarms should be at the top in order by most to least recent. Acknowledged alarms of the same priority follow, also sorted by most to least recent. Some DCSs use a page metaphor (Advance to the next page to see more alarms, a page at a time.); others use a scroll bar, such as in a spreadsheet.

2.6 Initial Alarm Presentation

Unacknowledged alarms should either blink or flash repeatedly. This behavior can be confined to a priority-based symbol associated with the alarm on the same line. The text of the alarm itself should be readable even when the blinking is occurring, for instance, by flashing the background color.

A priority-based sound should occur with each new unacknowledged alarm. The alarm line should show (as a minimum) time stamp, tag name, tag description, and alarm type. Some DCSs allow an additional alarm message (other than the tag description) to be configured and displayed. For analog alarms, it is common and desirable for the alarm setpoint value to be displayed and a continuously updating current process variable (PV) reading next to it.

2.7 Acknowledgment

Few industry sites ascribe a specific "meaning" to the operator's act of alarm acknowledgement. At a minimum, it indicates "I have seen and at least read this alarm."

Some DCSs allow the sound to be silenced without a full acknowledgement of the alarm, but the alarm continues blinking. Full acknowledgement stops both the sound and the blinking. The line displaying the alarm moves down into the list of acknowledged alarms of that priority. The DCS generates a time-stamped acknowledgement event into the alarm history log.

It should be possible for an operator to acknowledge a single alarm or all alarms shown on a page (or on a single screen) at one time.

2.8 Alarm Clearing

When the alarmed condition clears, there are two common choices for alarm summary behavior:

- The alarm automatically disappears from the summary screen without operator involvement.
- The alarm line has another change in appearance to indicate its cleared condition. The operator must then take some action to have it disappear from the screen.

Either method is acceptable. Part of the operator's responsibility in responding to an alarm is to verify that their alarm response action is effective and, in fact, clears the alarm condition.

2.9 Navigation and Additional Information

Many systems enable the pre-configuration of the "best" display graphic associated with an alarmed tag. With a one-step action, the operator can navigate to that screen to begin diagnosis of the alarm.

The operator should be able to access additional information about an alarm (such as causes, consequences, and corrective actions) from the Master Alarm Database, a repository of information required by alarm management standards.

2.10 Alarm Suppression/Shelving

The alarm summary screen may have an interface by which the operator can temporarily suppress an alarm. To be called "alarm shelving," the suppression method should meet several administrative requirements:

- Suppression is temporary in nature and expires. The ability to shelve at all may be disallowed based on priority or whether the alarm is part of a specific group.
- An accurate list of all currently shelved alarms is easily displayable (for example, at the beginning of a shift change). It is common that uncontrolled alarm suppression can result in important alarms being suppressed, sometimes for months, with no documentation. A paper-based list approach to tracking alarm suppression has usually been shown to be inaccurate and ineffective in other industries and at power plants where it has been audited.
- The time of shelving initiation (and, optionally, an operator-input reason) is captured.
- Approval by a second role for shelving of some alarms is possible and automatically documented when obtained.
- Ideally, the method of shelving should suppress an individual alarm on a tag without affecting the other alarms.

2.11 Alarm Depiction on Process Graphics

Several responders supplied over 40 process graphics showing alarms in effect. Depictions of alarms should stand out, attract the operator's attention, and be unmistakable. Most of the examples provided had a wide range of issues, including the following:

- Inconsistent use of color in alarm depiction, for example, using the same color to indicate both alarm and normal conditions
- Indication of an alarm condition solely by a slight or inconspicuous color change
- Failure to associate the priority with the depicted alarm condition
- Depiction of alarms in ways that are far less prominent and visible than items on the screen that are depicting their normal, or even static, condition
- Inconsistent depiction of alarm conditions from one graphic to the next (in the same unit)
- Depictions of alarms that are identical to depictions of simple non-alarm status conditions

Besides alarm depiction issues, other aspects of many graphics were problematic as well:

- Process values depicted without context as to whether the numbers are in a desirable range or are approaching alarm or trip conditions
- Confusing, "busy" depictions cluttered with extraneous detail
- Depictions of some abnormal conditions in subtle ways, in a manner overwhelmed by bright, vivid depictions of equipment and conditions that are normal
- A significant lack of trends, which are essential for operator situational awareness

These issues are common with graphics that were not designed in accordance with principles of human factors and human performance. Tables of numbers and P&ID representations covered in numbers are the most common forms of process graphics. Such designs make operator situational awareness and early detection of abnormal conditions much more difficult to achieve. The References section, including an EPRI case study, provides more detail on the design of graphics for successful performance. Such designs maximize an operator's capability for early detection and successful resolution of abnormal situations.

Examples of these issues are shown in the Appendix B attachment to this report titled: ***EPRI DCS Best Practices - Graphics Issues v1.0.***

3
SURVEY RESULTS

A survey was sent to member companies on a variety of DCS and alarm-related topics. Some of the responses were incorporated in the previous section of this report. Others are noted here.

3.1 Alarm Philosophy Document

Survey responders have alarm philosophy documents that range from 10 to 40+ pages in length. Effort spent in creating a comprehensive document is known to save considerable time and effort in later stages of alarm management, such as alarm rationalization.

3.2 Alarm Presentation and Information to Operators

Survey responders have configured their systems so that an operating position receives only the alarm relevant to that position. While this may seem to be an obvious practice, it is not uncommon to find industrial installations where this practice is not followed, resulting in an alarm system that is much less useful to the operator.

The systems are configured so that operators can distinguish priority, acknowledgement, and cleared status of an alarm on the alarm summary screen. The ability to see such conditions on the process graphics varied considerably.

In one survey response, the alarm summary screen was capable of and was configured to show detailed alarm response information to the operator. At the other end of the spectrum, responders indicated that operators had no access to such information or that the information did not exist.

3.3 Use of Alarm Priorities

The control system types surveyed all had the capability for using multiple alarm priorities, including up to 1,000 priority levels. Survey responders generally used three or four alarm priorities. Two responders indicated using only one and two priorities respectively. Most had methods available for assigning priority consistently, but some noted that work is incomplete.

3.4 Alarm Shelving

Shelving is the operator-initiated, temporary suppression of an alarm, using methods that provide safeguards against improper or untracked suppression. DCS systems vary in their ability to accomplish many of the safeguards, but comprehensive third-party solutions are available. Survey responders used a variety of methods to accomplish and track shelved alarms. In some cases, paper-based (“write it down on a list’) methods were mentioned. In other industries, such methods have been shown to be unreliable. Improperly suppressed alarms have contributed to significant accidents.

3.5 Status of the Alarm Management Effort

While responses varied, most survey responders had the following in place or started:

- Alarm analyses compared to the metrics in ISA-18.2
- Substantial progress in eliminating events from the alarm system that do not meet the definition of an alarm
- Substantial progress in consistent alarm prioritization
- Reasonable management of change of the alarm system
- Reasonable methods to control and monitor alarm suppression
- Various progress levels toward completing a program of alarm documentation and rationalization, creating a full Master Alarm Database, and making that alarm information available to the operators

4
POWER GENERATION HIGHEST-PRIORITY ALARMS

One aspect of alarm rationalization is to determine each alarm's priority. Priority 1 and 2 alarms are the most important, indicating alarms warning of significant consequences that will occur unless the operator takes action in a relatively short period of time.

In this section, the Priority 1 and 2 alarms that resulted from prioritization work processes are identified for each of three generation process types. These are Combined Cycle, Supercritical, and Drum Unit. The sources are a combination of PAS Alarm Rationalization projects for EPRI member companies in the last decade and survey responses. The nature of the alarm is from the tag description in the alarm databases.

4.1 Combined Cycle Gas Turbine – Priority 1

The Priority 1 alarms determined for CCGT generation are shown in Table 4-1.

Table 4-1
CCGT Unit Priority 1 Alarms

CCGT Unit Priority 1 Alarms			
EQUIPMENT	**ALARM - Priority 1**	**EQUIPMENT**	**ALARM - Priority 1**
BFW	HEADER HIGH HEADER PRESSURE	HP SUPERHEATER	OUTLET TEMP HH
BFW	PUMP LOW OIL PRESSURE	IP DRUM	LEVEL HH
BFW	PUMP VIBRATION ALARMS	IP DRUM	LEVEL LL
CONDENSER	CONDENSER DRAIN TANK LEVEL HH	IP DRUM	LEVEL LOW
CONDENSER	CONDENSER DRAIN TANK LEVEL HHH	IP DRUM	LEVEL TRANSMITTER DEVIATION
CONDENSER	CONDENSER HOTWELL LEVEL HH	IP DRUM	SUPERHEATER OUTLET HH
CONDENSER	CONDENSER PRESSURE HIGH	LP DRUM	DRUM LEVEL TRANSMITTER DEVIATIONS
CONDENSER	COOLING WATER PUMP OVERLOAD/TROUBLE/TRIP	LP DRUM	LEVEL HH
FUEL GAS	FUEL GAS HEADER PRESSURE LOW	LP DRUM	LEVEL LL
GTG	BOOST AND BUCK CAPABILITY	SCR	AMMONIA TRANSFER PUMP FAIL
GTG	BREAKER FAIL/MALFUNCTION	SCR	CEMS FAULT
GTG	FIRE SUPPRESSION INITIATED	SCR	DENOX REACTOR INLET GAS TEMP DEVIATIONS
GTG	FUEL GAS PRESSURE LL	SCR	DENOX REACTOR INLET GAS TEMP HIGH
GTG	FUEL GAS PRESSURE LOW	SCR	DENOX REACTOR INLET GAS TEMP LOW
GTG	GAS TURBINE RUNBACK	STG	HOT REHEAT DRIPLEG TEMP HI
GTG	GAS TURBNE TRIP	STG	HOT REHEAT DRIPLEG TEMP LOW
GTG	LCI COOLING WATER FLOW LOW	STG	IP TURB DRIP LVL HIHIHI
HP DRUM	DRUM LEVEL HH	STG	REHEAT STEAM HEADER TEMP HI
HP DRUM	DRUM LEVEL LL	STG	REHEAT STEAM HEADER TEMP LOW
HP DRUM	DRUM LEVEL XMITTER DEVIATIONS	STG	STEAM TURBINE TRIPPED
HP DRUM	STEAM FLOW TO HEADER HH	STG	STG GENERATOR TEMP HIGH

4.2 Combined Cycle Gas Turbine – Priority 2

The Priority 2 alarms determined for CCGT generation are shown in Table 4-2.

Table 4-2
CCGT Unit Priority 2 Alarms

CCGT Unit Priority 2 Alarms			
EQUIPMENT	**ALARM - Priority 2**	**EQUIPMENT**	**ALARM - Priority 2**
BFW	PUMP LOW DISCHARGE FLOW	IP DRUM	IP STEAM BYPASS TO COND PRESS HI
BFW	PUMP LOW OIL SUMP LEVEL	IP DRUM	IP STEAM HEADER FLOW HI
BFW	PUMP MOTOR OVERLOAD/TROUBLE/TRIP	IP DRUM	IP STEAM HEADER PRESSURE HI
BFW	SUPPLY WATER PRESSURE LOW	IP DRUM	IP STEAM HEADER PRESSURE LO
BFW	SUPPLY WATER TANK LEVEL LOW	IP DRUM	IP STEAM HEADER TEMP HI
CONDENSER	AUX STEAM HEADER PRESSURE HI	IP DRUM	LEVEL HI
CONDENSER	AUX STEAM HEADER PRESSURE LO	IP DRUM	LEVEL LOW
CONDENSER	CONDENSATE PUMP FAIL	IP DRUM	SH ATTEMP BLOCK VALVE
CONDENSER	CONDENSATE TEMPERATURE HI	IP DRUM	STM DMP DESUPERHEATER TEMP HI
CONDENSER	CONDENSER DRAIN TANK LEVEL HI	IP DRUM	SUPERHEATER OUTLET HI
CONDENSER	CONDENSER HOTWELL LEVEL HI	LP DRUM	LEVEL HIGH
CONDENSER	CONDENSER HOTWELL LEVEL LOW	LP DRUM	LEVEL LOW
CONDENSER	CONDENSER TEMPERATURE HI	LP DRUM	LP STEAM HEADER TEMP HI
CONDENSER	COOLING TOWER BASIN LOW	SCR	DENOX REACTOR NOX OUT HIGH
CONDENSER	COOLING WATER MOV/VALVE FAILURE	SCR	DENOX REACTOR NOX OUT PINGE
CONDENSER	COOLING WATER SUPPLY FLOW LOW	SCR	NH3 TANK LEVEL LOW
FUEL GAS	FUEL GAS HEADER PRESSURE HIGH	SCR	SCR DILUTION AIR FLOW RATIO
GTG	BEARING VIBRATION HH	SCR	SCR SKID INST AIR PRS LO
GTG	FUEL GAS PRESSURE HH	STG	GLAND EXHAUSTER BLOWER FAIL
GTG	FUEL GAS PRESSURE HI	STG	HP TURB DRP LEG LVL HIHI
GTG	H2 TO GTG PRESS LOW LOW	STG	STEAM TURBINE TRIP LOGIC
GTG	LCI PWR XFER DISC	STG	STG #1 CND VAC BREAKER FAIL
GTG	LCI/EXCITER HI-HI SUMP LVL	STG	STG #1 TUNNING GEAR ALARM
HP DRUM	BLOWDOWN TANK LEVEL HI	STG	STG #2 CND VAC BREAKER FAIL
HP DRUM	DRUM LEVEL HIGH	STG	STG #2 TUNNING GEAR ALARM
HP DRUM	DRUM LEVEL LOW	STG	STG #3 CND VAC BREAKER FAIL
HP DRUM	STEAM HEADER FLOW HI	STG	STG #3 TUNNING GEAR ALARM
HP DRUM	STEAM HEADER PRESSURE HI	STG	STG1 L OIL PMP 1C DCMS LOCKOUT
HP DRUM	STEAM HEADER TEMP LOW	STG	STG2 L OIL PMP 2C DCMS LOCKOUT
HP DRUM	STEAM TO BYPASS PRESSURE HI	STG	STG3 L OIL PMP 3C DCMS LOCKOUT
HP SUPERHEATER	ATTEMPERATOR VALVE FAIL	UPS	BATTERIES SUPPLYING LOAD
HP SUPERHEATER	OUTLET TEMP HI	UPS	BATTERY CHARGER LOW/BAD VOLTAGE
HP SUPERHEATER	STEAM DUMP DESUPERHEAT TEMP HI	UPS	BATTERY GROUND
		UPS	GENERAL FAULT OR TROUBLE ALARM
		UPS	LOSS OF AC

4.3 Supercritical Units – Priority 1

The Priority 1 alarms determined for supercritical units are in Table 4-3.

Table 4-3
Supercritical Unit Priority 1 Alarms

Supercritical Unit Priority 1 Alarms - Table 1 of 4			
EQUIPMENT	**ALARM - Priority 1**	**EQUIPMENT**	**ALARM - Priority 1**
AIR PREHEATER	AIR PREHEATER AIR OUTLET TEMP HI	GENERATOR	EMERGENCY BEARING OIL PUMP DC POWER FAILURE
AIR PREHEATER	AIR PREHEATER GUIDE BRG OIL PMP FAIL ST	GENERATOR	EMERGENCY LUBE OIL PUMP RUNNING
AIR PREHEATER	AIR PREHEATER GUIDE BRG OIL PMP PWR FAIL	GENERATOR	EMERGENCY OVERSPEED TRIP
AIR PREHEATER	AIR PREHEATER GUIDE BRG TEMP HH	GENERATOR	Emergency Seal Oil Pump Locked Out \ Off Stndby
AIR PREHEATER	AIR PREHEATER SUP BRG OIL PMP FAIL ST	GENERATOR	EMERGENCY TRIP HEADER TRIPPED
AIR PREHEATER	AIR PREHEATER SUP BRG OIL PMP PWR FAIL	GENERATOR	EXH HOOD A GEN END TMP HI TRIP
BFP	BFP BALANCING DRUM DIFF PRS HHH	GENERATOR	GEN AIR SIDE SO PMP TRIP
BFP	BFP BEARING TEMP HHH	GENERATOR	GEN COIL TEMP HI
BFP	BFP BEARING TEMP HI	GENERATOR	GEN COIL WTR FLOW LOW
BFP	BFP BEARING VIB. HHH	GENERATOR	GEN COIL WTR FLOW VERY LOW
BFP	BFP CNTRL OIL TER DIFF HIGH	GENERATOR	GEN COIL WTR PRESS DROP HIGH
BFP	BFP DISCHARGE FLOW DPT HI	GENERATOR	GEN COOL SYS LOSS
BFP	BFP DISCHARGE HDR PRES #1/2 CNTL DEV	GENERATOR	GEN COOL WTR DIFF PRESS HI
BFP	BFP DISCHARGE HDR PRESS HIGH	GENERATOR	GEN CORE MONITOR OUTPUT LOW
BFP	BFP DISCHARGE PRESS HI	GENERATOR	GEN CURRENT PHASE A HI
BFP	BFP INJ H2O FLOW BFR COOLERS HI	GENERATOR	GEN CURRENT PHASE B HI
BFP	BFP INJ H2O PRESS AFT STRNRS LO	GENERATOR	GEN CURRENT PHASE C HI
BFP	BFP LUBE OIL PRES LOW	GENERATOR	GEN DC SEAL OIL PMP ON
BFP	BFP LUBE OIL PUMP TRIPPED ALARM	GENERATOR	GEN DEFMG TANK LEVEL HIGH
BFP	BFP PRESS HI	GENERATOR	GEN FIELD CURRENT HIGH
BFP	BFP RECIRC VALVE TEMP HI	GENERATOR	GEN FIELD GROUND RELAY
BFP	BFP RECIRC VALVE TROUBLE	GENERATOR	GEN H2 GAS TEMP HI
BFP	BFP RECIRC VLV FAIL TO RESPND	GENERATOR	GEN H2/WTR DIFF PRESS HIGH
BFP	BFP RUNBACK REQD	GENERATOR	GEN INLET WTR TEMP HIGH
BFP	BFP SPEED CHANGER CONTROL DEV	GENERATOR	GEN LEADS CLG FAN TRIP
BFP	BFP SPEED SET POINT HI	GENERATOR	GEN OUTLET WTR TEMP HIGH
BFP	BFP SUCT FLOW LO	GENERATOR	GEN SEAL OIL PRESS LOW
BFP	BFP SUCT PRESS ALARM DEV	GENERATOR	GEN SO TURB BACKUP PRESS LOW
BFP	BFP SUCT PRESS CONTROL DEV	GENERATOR	GEN VARS HI
BFP	BFP SUCT PRESS LO	GENERATOR	GEN VOLTS HI
BFP	BFP SUCT TEMP ALARM DEV	GENERATOR	GENERATOR BREAKER TRIPPED
BFP	BFP SUCT TEMP CONTROL DEV	GENERATOR	GENERATOR CORE MONITOR-ALARM
BFP	BFP THRUST BRG TEMP HI	GENERATOR	GENERATOR DIFFERENTAL TRIP
BFP	BFP TRIP	GENERATOR	GENERATOR DIST RELAY TRIP
BFP	BFP TRIP OIL PRES LO TRIP	GENERATOR	GENERATOR FIELD
BFP	BFP TURBINE TRIP OIL PRESS LOW	GENERATOR	GENERATOR GROUND
BFP	BFP TURBINE AUX OIL PMP ON	GENERATOR	GENERATOR GROUND TRIP
BFP	BFP TURBINE AUX OIL PMP TRIP	GENERATOR	GENERATOR H2 PURITY LO
BFP	BFP TURBINE AUX OIL PRESS LOW	GENERATOR	GENERATOR LOSS OF FIELD
BFP	BFP TURBINE CONTROL DEVIATION	GENERATOR	GENERATOR NEGATIVE SEQ TRP
BFP	BFP TURBINE CONTROL OIL PRESS LO	GENERATOR	GENERATOR NEGATIVE SEQUENCE ALM
BFP	BFP TURBINE DC PMP ON	GENERATOR	GENERATOR NUETRAL GROUND
BFP	BFP TURBINE EHC PMP 1 TRIP OVRD	GENERATOR	GENERATOR OVERALL DIFF TRP
BFP	BFP TURBINE EHC PMP 1 TRIPPED	GENERATOR	GENERATOR REVER POWER TRIP
BFP	BFP TURBINE EHC SYSTEM PRESS LLL	GENERATOR	GENERATOR RF MONITOR IN ALARM
BFP	BFP TURBINE EMER OIL PMP DC CONTROL POWER LOST	GENERATOR	GENERATOR TRANS RELAY 86GT
BFP	BFP TURBINE EMER OIL PMP DC PWR LOST	GENERATOR	GENERATOR VOLTZ/HERTZ HI
BFP	BFP TURBINE EMER OIL PMP PRESS LOW	GENERATOR	GENERATOR VOLTZ/HERTZ HIHI
BFP	BFP TURBINE EMRG TRIP PB LOCAL PANEL	GENERATOR	GOV LOAD CHNGR MTR POS ALM DEV
BFP	BFP TURBINE EXH CAS HI TEMP	GENERATOR	GOV LOAD CHNGR MTR POS CNT DEV
BFP	BFP TURBINE EXHAUST PRESS HI	GENERATOR	H20 FRM HP GENERATOR STATOR C4 HI
BFP	BFP TURBINE EXHST TEMP HI	GENERATOR	H20 FRM LP GENERATOR STATOR C3 HI
BFP	BFP TURBINE EXTR TRIP	GENERATOR	H20 IN TO HP&LP GEN STATORS C1 HI
BFP	BFP TURBINE GOVNR OIL PRESS LOW	GENERATOR	H20 TO HP&LP GEN STATORS C5 HI
BFP	BFP TURBINE HEAT EXR TRIPPED	GENERATOR	HP #1 EXTR PRESS HI
BFP	BFP TURBINE HOOD HIGH TEMP	GENERATOR	HP EXCITER DC AMPS HI
BFP	BFP TURBINE HP JNL BRG OIL DRN TEMP HI	GENERATOR	HP EXCITER DC VOLTS HI
BFP	BFP TURBINE I/H CONTROL OIL PRESSURE HI	GENERATOR	HP EXCTR JRNL BRG TEMP HI
BFP	BFP TURBINE I/H CONTROL OIL PRESSURE LO	GENERATOR	HP EXCTR STDY BRG TEMP HI
BFP	BFP TURBINE KDNY PMP TRIP OVRD	GENERATOR	HP GEN CALCULATED FIELD TEMP HI
BFP	BFP TURBINE KDNY PMP TRIPPED	GENERATOR	HP GEN H2 COMN COLD GAS TEMP HI
BFP	BFP TURBINE LO OTLT TMP FROM COOLER HI	GENERATOR	HP GEN H2 COOLER 1 COLD GAS HI
BFP	BFP TURBINE LP JNL BRG OIL DRN TEMP HI	GENERATOR	HP GEN H2 COOLER 1 HOT GAS HI
BFP	BFP TURBINE LUBE OIL PRESS LO	GENERATOR	HP GENERATOR HYDROGEN PRESS HI
BFP	BFP TURBINE MAIN OIL PRESS LOW	GENERATOR	HP GENERATOR HYDROGEN PRESS LO
BFP	BFP TURBINE MISSING SIGNAL TRIP	GENERATOR	HP GENERATOR LOAD HI
BFP	BFP TURBINE O/S PROT TROUBLE	GENERATOR	HYDROGEN PURITY LLL
BFP	BFP TURBINE OIL TANK FIRE	GENERATOR	LOSS OF GEN COOL WTR RUNBACK
BFP	BFP TURBINE OIL TANK FIRE SYS TROUB	GENERATOR	LP EXCITER DC AMPS HI
BFP	BFP TURBINE OIL TANK FIRE SYS WAT FL	GENERATOR	LP EXCITER DC VOLTS HI
BFP	BFP TURBINE OVERSPEED TRIP	GENERATOR	LP EXCTR JRNL BRG TEMP HI
BFP	BFP TURBINE RESERVOIR TEMP HI	GENERATOR	LP GEN CALCULATED FIELD TEMP HI

Table 4-3 (continued)
Supercritical Unit Priority 1 Alarms

Supercritical Unit Priority 1 Alarms - Table 2 of 4			
EQUIPMENT	**ALARM - Priority 1**	**EQUIPMENT**	**ALARM - Priority 1**
BFP	BFP TURBINE RSVR LVL LO-LO	GENERATOR	LP GEN H2 COMN COLD GAS TEMP HI
BFP	BFP TURBINE RUNBACK	GENERATOR	LP GEN H2 PRESS HI
BFP	BFP TURBINE SPEED HI	GENERATOR	LP GEN H2 PRESS LO
BFP	BFP TURBINE STEAM PRESS HI	GENERATOR	LP GEN STATOR COOL EXIT TEMP HI
BFP	BFP TURBINE TACH O/S TRIP	GENERATOR	LP GENERATOR LOAD HI
BFP	BFP TURBINE TACH PACK OVRSPD TRIP	GENERATOR	MANUAL EMERGENCY TRIP
BFP	BFP TURBINE TACH SPEED HI	GENERATOR	PC 4KV BKR TRIP
BFP	BFP TURBINE THR BRG TEMP - ACTIVE HI	GENERATOR	Seal Oil DC Emergency Pump TOC
BFP	BFP TURBINE THR BRG TEMP - INACTV HI	GENERATOR	Seal Oil Emergency Pump DC Failure
BFP	BFP TURBINE THRUST BEARING	GENERATOR	UNIT UPS FUSE BLOW/CKR BKR TRP
BFP	BFP TURBINE THRUST BRG OIL DRN TEMP HI	GENERATOR	VOLT REG FIELD VOLTAGE HI
BFP	BFP TURBINE TRIP	GENERATOR	VOLTAGE REG DECS & PLC FAILED
BFP	BFP TURBINE TRIP BLOCKED	GENERATOR	VOLTAGE REG DECS FAILED
BFP	BFP TURBINE TRIP DC FAILURE	GENERATOR	VOLTAGE REG FIELD CURRENT HI
BFP	BFP TURBINE VACUUM LOW	GENERATOR	VOLTAGE REG REF ADJUST @ MIN
BFP	BFP TURBINE VIBRATION-INBD HI	GENERATOR	VOLTAGE REG SYS CRITICAL ALARM
BFP	BFP TURBINE VIBRATION-OTBD HI	GENERATOR	VOLTAGE REG TRANSFER TO B-UP
BFP	BFP UNBALANCED FLOW A-B	GENERATOR	VOLTAGE REG VOLTS/HZ ALARM
BFP	BFP VACUUM PRES LO TRIP	GENERATOR	VOLTAGE REG VOLTS/HZ TRIP
BFP	BFP VIBRATION -INBD HI	GENERATOR	VOLTAGE REG VOLTS/HZ TROUBLE
BFP	BFP VIBRATION -OUTBD HI	GENERATOR	VOLTAGE REGULATOR SYSTEM TRIPPED
BFP	BFW BYPASS FLOW DPT HI	GENERATOR	XCESS V/HZ FLD BKR TRIP
BFP	SELECTED BFP DIS HDR PRESS HI	LIME SILO	LIME SILO BLOWERDIS TEMP HIHI
BFP	SELECTED BFP TRIP OIL PRES LOW	LIME SILO	LIME SILO CONV CMP MTR TROUBLE
BOILER	"L" VALVE BYPASS TEMP HI	LIME SILO	LIME SILO CONV CMP PRESSURE
BOILER	12 ECN LKS TO BLR MX CH-FRN HI	LIME SILO	LIME SILO CONV CMP TEMP HIHI
BOILER	12 SH SCW IN LKS-FRN HI	LIME SILO	LIME SILO CONV CMP TRIP ALARM
BOILER	AIR HEATER ELECTRIC DRIVE TRIPPED ALARM	LIME SILO	LIME SILO CONV IB BRG TEMP HI
BOILER	AIR HEATER FAIL TO STOP	LIME SILO	LIME SILO CONV OB BRG TEMP HI
BOILER	BFW TO FURN CNTL DEV	LIME SILO	LIME SILO ROT FDR SPD ERROR
BOILER	BLR FRONT FIRE ALARM	LIME SILO	LIME SILO ROT FDR SPD LO
BOILER	BLR IGNITION GAS FLOW HI	LIME SILO	LIME SILO ROT FDR VFD FAIL
BOILER	BLR IGNITION GAS U FLOW HI	LIME SILO	LIME SILO STORAGE SILO LEVEL LO
BOILER	BNR F1/F4 SLV DMPR NOT OPN ALM	LIME SILO	LIME SILO UNLDG BLOWER DIS PRESSURE
BOILER	BOILER LOW SH TEMP	PULVERIZER	MILL A (TRIP)
BOILER	BOILER MASTER FORCED TO MANUAL	PULVERIZER	MILL LUBE OIL PRESSURE LO
BOILER	BOILER MFT	PULVERIZER	MILL MOTOR AMPS HI
BOILER	BSTRFAN TRIP AFURN PRESS LO	PULVERIZER	MILL MOTOR AMPS LO
BOILER	DEA INLET DISSOLVED OXYGEN LLL	PULVERIZER	MILL PRESSURE HI
BOILER	ECONZ INLET DISOLVED OXYGEN LLL	PULVERIZER	PULV AMPS HIGH
BOILER	FLASH TANK PRESS HI	PULVERIZER	PULV DRV GEAR LUB OIL TEMP HI
BOILER	FLASH TANK PRESS/TO COMP HI	PULVERIZER	PULV EXHSTR BRG TEMP -EXH HI
BOILER	FURN AIR FLOW BQ TRIP	PULVERIZER	PULV EXHSTR BRG TEMP -RNR HI
BOILER	FURN BRNR CNTL RLY VOLT FAIL	PULVERIZER	PULV MTR BRG TEMP - EXH HI
BOILER	FURN COAL MSTR AT MAX/RUNDWN	PULVERIZER	PULV MTR BRG TEMP - PULV HI
BOILER	FURN HI PRESS TRIP	PULVERIZER	PULV OUTLET TEMP HI
BOILER	FURN HIGH WW PRESS	PULVERIZER	PULV PA MASS DP HIGH
BOILER	FURN HIGH WW TEMP	PULVERIZER	PULV V SHFT RAD BRG TEMP HI
BOILER	FURN LO PRESS TRIP	PULVERIZER	PULV V SHFT THR BRG TEMP HI
BOILER	FURN LOSS OF FLAME	PULVERIZER	PULV WRM SHFT BRG TEMP -MTR HI
BOILER	FURN LOSS OF FUEL	PULVERIZER	PULV WRM SHFT BRG TEMP -OUT HI
BOILER	FURN NO SCAN CLG FANS RUN'G	PULVERIZER	PULV BNR PAIR A1,A4 TRIP
BOILER	FURN PRESS HIGH	PULVERIZER	PULV BNR PAIR A2,A3 TRIP
BOILER	FURN PRESS LL	PULVERIZER	PULV CLS AIR TEMP HI
BOILER	FURN PRESS LO	PULVERIZER	PULV COAL/AIR TEMP > 200 F
BOILER	FURN PRESS LS ALRM DEV	PULVERIZER	PULV COAL/AIR TEMP HI
BOILER	FURN SCANNER AIR COOL FLOW LO	PULVERIZER	PULV COAL/AIR TEMP SEL
BOILER	FURN SCANNER CAB 1 HIGH TEMP	PULVERIZER	PULV EMERGENCY TRIP
BOILER	FURN SCANNER CAB 2 HIGH TEMP	PULVERIZER	PULV FAIL TO STOP
BOILER	FURN SCANNER COOL FLOW ABNORMAL	PULVERIZER	PULV GEAR BOX TEMP HI
BOILER	FURN WW OUT PRESS HIGH	PULVERIZER	PULV LEVEL HI
BOILER	FURNACE PRESS BOILER BLOCKING	PULVERIZER	PULV LEVEL LO
BOILER	HIGHEST SH TUBE TEMPS	PULVERIZER	PULV MILL LVL LOW GT 5 MIN
BOILER	LOAD < 25% OR MFT	PULVERIZER	PULV OIL TROUB
BOILER	LP HTR DRAIN FLASH TANK LEVEL HIGH	PULVERIZER	PULV TMP > 175 DEG HI
BOILER	MAIN STEAM TEMP HI/LO	REHEATER	RH EXT OUT LINK - A1 #1 TEMP HI
BOILER	MAIN STEAM TEMP HIGH HI	TRANSFORMER	MAIN XMFR 1A BUCHOLZ RLY ALM
BOILER	MFT	TRANSFORMER	MAIN XMFR 1A OIL LEVEL ALRM
BOILER	MN TURB GOV (BLR IN CTL)	TRANSFORMER	MAIN XMFR 1A PROTECTION TRIP
BOILER	PASS 4 TO 5 TEMP HIGH HI	TRANSFORMER	MAIN XMFR 1A SUDDEN PRESS ALM
BOILER	PASS 4 TO PASS 5 TEMP HI	TRANSFORMER	MN XFMR 1A PRI WNDG TMP HI
BOILER	PLACE REHEAT MASTER IN AUTO	TRANSFORMER	MN XFMR 1A SEC WNDG TMP HI

Table 4-3 (continued)
Supercritical Unit Priority 1 Alarms

Supercritical Unit Priority 1 Alarms - Table 3 of 4			
EQUIPMENT	**ALARM - Priority 1**	**EQUIPMENT**	**ALARM - Priority 1**
BOILER	PULV BNR PAIR A1,A4 TRIP	TRANSFORMER	MN XFMR 1A TERT WNDG TMP HI
BOILER	PULV BNR PAIR A2,A3 TRIP	TURBINE	5TH STAGE AT IP TURB WTR INDUCT.
BOILER	REHEAT TEMP MASTER FORCED TO MAN	TURBINE	6TH STAGE AT IP TURB WTR INDUCT.
BOILER	SERVICE AIR HEATER A OUTLET GAS TEMP 3	TURBINE	80V TURB MCC TRIP
BOILER	SOOT BLOWERS ARE NOT BLOWING	TURBINE	AX TURB 1A INACT THBRG MTL TMP HHH
BOILER	STM TEMP LOW STOP VLV	TURBINE	AX TURB 1B OUTBD JRNL BRG TEMP HHH
BOILER	TFSO - LINK A1 #1 HI	TURBINE	BFP TURBINE TRIP
BOILER	TFSO-LINK A1 ALARM DEVIATION	TURBINE	DIFFERENTIAL EXPANSION #2 LONG TRIP
BOILER	TFSO-LINK A1 CNTL DEVIATION	TURBINE	Emer. Brg. Oil Pmp 1 DC Fail
BOILER	UNIT END WALL IP WTR INDUCT	TURBINE	EMERGENCY BEARING OIL PUMP RUNNING
BOILER	WATE WALL OUTLET TEMP HIGH	TURBINE	EMERGENCY OVERSPEED TRIP
BFW BOOST	BOILER FEED BOOSTER PUMP BRG TEMP HI	TURBINE	GEN SO TURB BACKUP PRESS LOW
BOOSTER FAN	BOOSTER FAN BRKR FAIL TO OPEN	TURBINE	GENERATOR BREAKER TRIPPED
BOOSTER FAN	BOOSTER FAN DRV BRG TMP HH	TURBINE	GENERATOR LOSS OF FIELD
BOOSTER FAN	BOOSTER FAN IDL BRG TMP HH	TURBINE	GENERATOR NEGATIVE SEQUENCE ALM
BOOSTER FAN	BOOSTER FAN INBD BRG VIB HH	TURBINE	GENERATOR NUETRAL GROUND
BOOSTER FAN	BOOSTER FAN INL PRESS LO	TURBINE	GENERATOR VOLTZ/HERTZ HI
BOOSTER FAN	BOOSTER FAN INL PRESS LO-LO	TURBINE	GENERATOR VOLTZ/HERTZ HIHI
BOOSTER FAN	BOOSTER FAN MTR DRV BRG TMP HH	TURBINE	HP BEARING VIBRATION 1 HI
BOOSTER FAN	BOOSTER FAN MTR IDL BRG TMP HH	TURBINE	HP BOOSTER DISCH OIL PRESS LO
BOOSTER FAN	BOOSTER FAN OIL CLR B PWR FAIL	TURBINE	HP BOOSTER NOZZLE OIL PRESS LO
BOOSTER FAN	BOOSTER FAN OIL CLR PWR FAIL	TURBINE	HP BRG OIL HEADER PRESS LO
BOOSTER FAN	BOOSTER FAN OIL PMP B PWR FAIL	TURBINE	HP DIFF EXPANSION HI
BOOSTER FAN	BOOSTER FAN OIL PMP PWR FAIL	TURBINE	HP DIFF EXPANSION LO
BOOSTER FAN	BOOSTER FAN OUTBD BRG VIB HH	TURBINE	HP GEN STATOR COOL EXIT TEMP HI
BOOSTER FAN	BOOSTER FAN PWR FAIL	TURBINE	HP HYDR OIL HDR PRESS LO
BOOSTER FAN	BOOSTER FAN VFD TRIPPED	TURBINE	HP THRST BRG OIL DRN-FRNT TEMP HI
BOOSTER FAN	BSTRFAN TRIP AECON PRESS LO	TURBINE	HP THRST BRG OIL DRN-REAR TEMP HI
BOOSTER FAN	BSTRFAN TRIP BECON PRESS LO	TURBINE	HP THRST BRG TEMP-FNT UP L HI
BOOSTER FAN	BSTRFAN TRIP VIA MFT FO	TURBINE	HP THRST BRG TEMP-FNT UP R HI
CONDENSER	CBP PMP BRG TEMP - CPL HI	TURBINE	HP THRST BRG TEMP-REAR UP L HI
CONDENSER	CBP PMP BRG TEMP - OTBD HI	TURBINE	HP THRST BRG TEMP-REAR UP R HI
CONDENSER	CONDENSER ABSORBER PRESS HI	TURBINE	HP TURB BRG 1 OIL DRAIN TEMP HI
CONDENSER	Exhaust Hd Spray Temp Ctrl in Man Mode	TURBINE	HRH WTR INDUCTION AT IP TURB
CONDENSER	EXHAUST VACUUM TRIP	TURBINE	Hydraulic Fluid Pump 1A TOC
CONDENSER	HIGH EXHAUST TEMPERATURE TRIP	TURBINE	IP BRG 3X HI
CONDENSER	HOTWELL LEVEL HI	TURBINE	IP BRG 3X SHAFT HI
CONDENSER	HIGH EXHAUST TEMPERATURE TRIP	TURBINE	IP BRG 3Y HI
CONDENSER	CONDENSATE FLOW TO DEAERATOR LO	TURBINE	IP BRG 3Y SHAFT HI
CONDENSER	CONDENSATE PMP DISCH FLOW LO	TURBINE	IP BRG 4X HI
CONDENSER	CONDENSATE PMP PRESS HI	TURBINE	IP BRG 4X SHAFT HI
CONDENSER	CONDENSATE PMP PRESS LO	TURBINE	IP BRG 4Y HI
CONDENSER	CONDENSATE PMP TRIP	TURBINE	IP BRG 4Y SHAFT HI
CONDENSER	CONDENSATE POL OUT PRESS HI	TURBINE	IP CASE EXP LEFT HI
CONDENSER	CONDENSATE POL SYS DIFF PRESS HI	TURBINE	IP CASE EXP LEFT LO
CONDENSER	CONDENSATE PUMP DISCH U FLOW LO	TURBINE	IP CASE EXP LEFT POSITION HI
CONDENSER	CONDENSATE RECIR FLOW LO	TURBINE	IP CASE EXP LEFT POSITION LO
CONDENSER	CONDENSATE TO DEAER FLOW HI	TURBINE	IP CASE EXP RIGHT HI
CONDENSER	CONDENSATE TO DEAER FLOW LO	TURBINE	IP CASE EXP RIGHT LO
CONDENSER	CONDENSATE TO DEAR U FLOW HI	TURBINE	IP CASE EXP RIGHT POSITION HI
CONDENSER	CONDENSATE TO DEAR U FLOW LO	TURBINE	IP CASE EXP RIGHT POSITION LO
CONDENSER	CONDENSATE VAC PMP TRIP	TURBINE	IP DIFF EXPANSION A HI
CONDENSER	CONDENSER HOTWELL TEMP HI	TURBINE	IP DIFF EXPANSION A LO
CONDENSER	CONDENSER VACUUM LOW	TURBINE	IP THRUST A HI
CONDENSER	DEA DRN TO CONDENSERR NOT CLSD	TURBINE	IP THRUST A LO
CONDENSER	HP CONDENSER BACKPRESSURE HI	TURBINE	IP TURBINE CROSSOVER PRESS HI
CONDENSER	HP CONDENSER CIRC WTR OUT TEMP HI	TURBINE	IP TURBINE EXHAUST PRESS HI
CONDENSER	LP CONDENSER CIRC WTR IN TEMP HI	TURBINE	IP TURBINE SPEED (BENTLY) HI
CONDENSER	LP CONDENSER CIRC WTR OUT TEMP HI	TURBINE	LP BOOSTER DISCH OIL PRESS LO
CONDENSER	LP CONDENSER VACUUM HI	TURBINE	LP BOOSTER NOZZLE OIL PRESS LO
CONDENSER	TURB CONDENSER VACUUM ALARM	TURBINE	LP BRG 1 VIBRATION HI
CONDENSER	TURB CONDENSER VACUUM TRIP	TURBINE	LP BRG OIL HDR PRESS LO
CONDENSER	TURB LOW CONDENSER VACUUM TRIP	TURBINE	LP HYDR OIL HDR PRESS LO
CONDENSER	TURB SYSTEM CONDENSER VACUUM HI	TURBINE	LP ROTOR EXPANSION A HI
ENVIRONMENTAL	#CEM UPS	TURBINE	LP ROTOR EXPANSION A LO
ENVIRONMENTAL	ABSORBER 1 OUTLET SO2 HIGH	TURBINE	LP THRST BRG OIL DRN-FRNT TEMP HI
ENVIRONMENTAL	ABSORBER ARS LO FLOW	TURBINE	LP THRST BRG OIL DRN-REAR TEMP HI
ENVIRONMENTAL	ABSORBER ARS LO LEVEL	TURBINE	LP THRST BRG TEMP-FRNT UP L HI
ENVIRONMENTAL	ABSORBER ARS LO PRESS LO	TURBINE	LP THRST BRG TEMP-FRNT UP R HI
ENVIRONMENTAL	ABSORBER ARS LOLO FLOW	TURBINE	LP THRST BRG TEMP-REAR UP L HI
ENVIRONMENTAL	ABSORBER ARS LUBE OIL TEMP HI	TURBINE	LP THRST BRG TEMP-REAR UP R HI
ENVIRONMENTAL	ABSORBER ARS LUBE OIL TEMP HIHI	TURBINE	LP TURB BRG 1 METAL TEMP HI
ENVIRONMENTAL	ABSORBER ARS MTR IB BRG TEMP HI	TURBINE	LP TURB BRG 5 OIL DRAIN TEMP HI

Table 4-3 (continued)
Supercritical Unit Priority 1 Alarms

Supercritical Unit Priority 1 Alarms - Table 4 of 4			
EQUIPMENT	**ALARM - Priority 1**	**EQUIPMENT**	**ALARM - Priority 1**
ENVIRONMENTAL	ABSORBER ARS MTR OB BRG TEMP HI	TURBINE	LP TURBINE 1A EXHAUST PRESSURE HH
ENVIRONMENTAL	ABSORBER ARS MTR WIND TEMP HI	TURBINE	LP TURBINE 1A EXHAUST PRESSURE HHH
ENVIRONMENTAL	ABSORBER EFF PH LO	TURBINE	LP TURBINE 1A EXHAUST PRESSURE HI
ENVIRONMENTAL	ABSORBER EFFLUENT PRCNT SOLIDS LO	TURBINE	Main OIL Suction Pump Running
ENVIRONMENTAL	ABSORBER INLET TEMP HI & ME FLW LO	TURBINE	MAIN SHAFT OIL PUMP SUCTION PRESSURE LOW
ENVIRONMENTAL	ABSORBER OUT DUCT TEMP HI	TURBINE	MN TURB GOV (BLR IN CTL)
ENVIRONMENTAL	ABSORBER RECIRC PUMP CTRL TRIP	TURBINE	MN TURB GOV (DECR)
ENVIRONMENTAL	ABSORBER RECIRC PUMP GBOX IB HS TEMP HI	TURBINE	MN TURB GOV (INCR)
ENVIRONMENTAL	ABSORBER RECIRC PUMP GBOX IB LS TEMP HI	TURBINE	MN TURBINE JOURNAL BNG 10 TEMP HHH
ENVIRONMENTAL	ABSORBER RECIRC PUMP GBOX OB HS TEMP HI	TURBINE	North TLO TCV Not Following Demand
ENVIRONMENTAL	ABSORBER RECIRC PUMP GBOX OB LS TEMP HI	TURBINE	PRIMARY OVERSPEED TRIP
ENVIRONMENTAL	ABSORBER RECIRC PUMP GBOX OIL TEMP HI	TURBINE	ROTOR EXPANSION #1 LONG TRIP
ENVIRONMENTAL	ABSORBER RECIRC PUMP IB BRG TEMP HI	TURBINE	ROTOR EXPANSION #1 SHORT TRIP
ENVIRONMENTAL	ABSORBER RECIRC PUMP MANUAL REJECT	TURBINE	ROTOR EXPANSION TRIP FROM B/N
ENVIRONMENTAL	ABSORBER RECIRC PUMP MTR IB BRG TMP HI	TURBINE	SEAL OIL TURB B-UP PRESS LOW
ENVIRONMENTAL	ABSORBER RECIRC PUMP MTR OB BRG TMP HI	TURBINE	SHAFT PUMP DISCH PRESS LOW LOW - PULSE PUMP
ENVIRONMENTAL	ABSORBER RECIRC PUMP OB BRG TEMP HI	TURBINE	SHUTDOWN TRIP
ENVIRONMENTAL	ABSORBER SUMP LVL LO2	TURBINE	SOE TURB TRIP
ENVIRONMENTAL	ABSORBER TK LVL LO	TURBINE	THROTTLE PRESS #1/2 CNTL DEV
ENVIRONMENTAL	ABSORBER TK LVL LO LO	TURBINE	TSI Bearing Vibration Cabinet Alarm
ENVIRONMENTAL	ARS OX AIR INL TEMP HI	TURBINE	TURB AUTO STOP SOL ACTUATED
ENVIRONMENTAL	CEMS FLUE GAS DESULFUR INLET TROUBLE ALARM	TURBINE	TURB AUTOSTOP OIL PRESS LOW
ENVIRONMENTAL	CEMS FLUE GAS DESULFUR STACK TROUBLE ALARM	TURBINE	TURB BEARING OIL PRESS 1 LO
ENVIRONMENTAL	FLUE GAS DESULFUR ABSORBER INLDUCT OPACITY TO UCR HI	TURBINE	TURB BRG FIRE
ENVIRONMENTAL	FLUE GAS DESULFUR DET BASIN HIHI	TURBINE	TURB BRG FIRE SYS TROUB
ENVIRONMENTAL	FLUE GAS DESULFUR STK NOX EMISSION LB/MMBTU HI	TURBINE	TURB BRG FIRE SYS WAT FLOW
ENVIRONMENTAL	FLUE GAS DESULFUR STK NOX LB/MMBTU PH UCR HI	TURBINE	TURB BRG OIL PRESS LOW ALARM
ENVIRONMENTAL	LIQ NH3 LINE ISO VLV PWR FAIL	TURBINE	TURB BRG OIL PRESS LOW TRIP
ENVIRONMENTAL	LIQ NH3 PUMP ISO VLV PWR FAIL	TURBINE	TURB BRG OIL PRESS TRIP
ENVIRONMENTAL	LS FDR SHUTDOWN	TURBINE	TURB CONDENSER VACUUM ALARM
ENVIRONMENTAL	MMBTU SO2 HIGH	TURBINE	TURB CONDENSER VACUUM TRIP
ENVIRONMENTAL	NH3 HIGH ALARM - COMP AREA	TURBINE	TURB CONTROL OIL PRESS LO
ENVIRONMENTAL	NH3 HIGH ALARM - STORAGE AREA	TURBINE	TURB EHC PUMP DISCH PRESS LO
ENVIRONMENTAL	NH3 HIGH CONCENTRATION LEVEL	TURBINE	TURB EHC PUMP TER DIFF HI HI
ENVIRONMENTAL	NH3 STRG FOG SYS TROUBLE ALARM	TURBINE	TURB EHC SYSTEM PRESS
ENVIRONMENTAL	NOX 3 HOURLY RLG EMMISSION HIGH	TURBINE	TURB EHC SYSTEM PRESS LO
ENVIRONMENTAL	NOX HOURLY EMMISSION HIGH	TURBINE	TURB GEN END DIFF TEMP LO
ENVIRONMENTAL	OUTLET NOX HIGH	TURBINE	TURB GOV END TEMP DIFF LO
ENVIRONMENTAL	OXIDATION BLOWER IB BRG TEMP	TURBINE	TURB LOW CONDENSER VACUUM TRIP
ENVIRONMENTAL	OXIDATION BLOWER IB BRG VIBRATION	TURBINE	TURB LPT MANIFOLD PRESS LO
ENVIRONMENTAL	OXIDATION BLOWER MTR IB BRG TEMP	TURBINE	TURB LUBE OIL PRESS LO
ENVIRONMENTAL	OXIDATION BLOWER MTR IB BRG VIB	TURBINE	TURB LUBE OIL TEMP (CONTROL) HI
ENVIRONMENTAL	OXIDATION BLOWER MTR OB BRG TEMP	TURBINE	TURB LUBE OIL TEMP (CONTROL) LO
ENVIRONMENTAL	OXIDATION BLOWER MTR OB BRG VIB	TURBINE	TURB NO BRG OIL TEMP HI
ENVIRONMENTAL	OXIDATION BLOWER OB BRG TEMP	TURBINE	TURB OIL REVS FIRE
ENVIRONMENTAL	OXIDATION BLOWER OB BRG VIBRATION	TURBINE	TURB OIL REVS FIRE SYS TROUB
ENVIRONMENTAL	SCR OUT NOX LBMBTU HI	TURBINE	TURB OIL REVS FIRE SYS WAT FL
ENVIRONMENTAL	SCR OUT NOX LBMBTU LO	TURBINE	TURB PUMP 2 TER DIFF HI HI
ENVIRONMENTAL	SCR OUT NOX LO	TURBINE	TURB SYSTEM BRG OIL PRESS LO
ENVIRONMENTAL	SCRA DIL AIR TO MXR FLOW LL	TURBINE	TURB SYSTEM CONDENSER VACUUM HI
ENVIRONMENTAL	SCRA OUT NOX RATIO PATH 1 HI	TURBINE	TURB SYSTEM THR BRG OIL PRESS HI
ENVIRONMENTAL	SO2 #/HR BIASED 12HR AVG #1 HI	TURBINE	TURB THR BRG OIL PRESS TRIP
ENVIRONMENTAL	SO2 3 HOURLY RLG EMMISSION HIGH	TURBINE	TURB THR BRG OIL TRIP
ENVIRONMENTAL	SO2 EMSNS HI (GPM)	TURBINE	TURB THRUST BRG OIL ALARM
ENVIRONMENTAL	SO2 HOURLY EMMISSION HIGH	TURBINE	TURB THRUST BRG OIL PRESS 1 HI
ENVIRONMENTAL	STACK NOx PPM (10 SEC) LO	TURBINE	TURB THRUST BRG OIL PRESS 3 HI
ENVIRONMENTAL	UCEM BACKUP NOX HI	TURBINE	TURB TRIP FROM GEN LO 86G RELAY
ENVIRONMENTAL	UCEM BACKUP SO2 HI	TURBINE	TURB TRIP PB
ENVIRONMENTAL	UCEM PRIMARY NOX HI	TURBINE	TURB VAPOR EXTR TRIP
ENVIRONMENTAL	UCEM PRIMARY SO2 HI	TURBINE	TURBINE BRG OIL HEADER PRESS LLL
ENVIRONMENTAL	VPRZR AREA 1 NH3 PPM HI	TURBINE	TURBINE LUBE OIL LEVEL HIGH
FD FAN	FD FAN DRV IMPLR BRG TEMP -INBD HI	TURBINE	TURBINE LUBE OIL PRESSURE LOW TRIP
FD FAN	FD FAN DRV IMPLR BRG TEMP -OTBD HI	TURBINE	TURBINE OIL RESERVOIR LOW
FD FAN	FD FAN DRV RUNR BRG TEMP -INBD HI	TURBINE	TURBINE SPEED OUTPUT HI
FD FAN	FD FAN DRV RUNR BRG TEMP -OTBD HI	TURBINE	TURBINE STEAM CHEST PRESS HHH
FD FAN	FD FAN FAN BRG TEMP - CPL HI	TURBINE	TURBINE TILTING PAD BRG 1A TMP HHH
FD FAN	FD FAN FAN BRG TEMP - OTBD HI	TURBINE	TURBINE TRIP
FD FAN	FD FAN MTR BRG TEMP - CPL END HI	TURBINE	TURBINE TRIP FAIL TO TRIP
FD FAN	FD FAN MTR BRG TEMP - OTBD END HI	TURBINE	TURBINE ZERO SPEED
FD FAN	FD FAN MTR WINDING TEMP	TURBINE	TURNING GEAR OIL PUMP RUNNING
FD FAN	FD FAN MTR WINDING TEMP	TURBINE	UNEXPECTED TRIP - PROBLEM W/ETD 1 OR 2
FD FAN	FD FAN MTR WINDING TEMP	UPS	FLUE GAS DESULFUR ABSORBER UPS CRITICAL
GENERATOR	#1 GEN LOCKOUT RELAY 86G	UPS	FLUE GAS DESULFUR ABSORBER UPS CRITICAL ALARM
GENERATOR	11B PC 4KV BKR TRIP	UPS	UPS 1A COMMON ALM
GENERATOR	480 BKR TRPD	UPS	UPS DC LOW WARNING
GENERATOR	4KV BKR TRIP	UPS	UPS TROUBLE
GENERATOR	4kV BUS UNDER VOLTAGE TRIP	VAPORIZER	EMERGENCY SHUTDOWN VAPORIZER AREA
GENERATOR	CONDUCTIVITY -STATOR CLNG H20 HI	VAPORIZER	VAPORIZER AREA EMER SHUTDOWN
GENERATOR	COOL WATER PMP BKR TRIPPED	VAPORIZER	VAPORIZER GLYCOL FWD TEMP HH
GENERATOR	Emergency Bearing Oil Pump Locked Out \ Off Stndby	VAPORIZER	VAPORIZER GLYCOL PH HH
GENERATOR	EMERGENCY BEARING OIL PUMP RUNNING	VAPORIZER	VAPORIZER GLYCOL RET PRESS HH
GENERATOR	Emergency Bearing Oil Pump TOC	VAPORIZER	VAPORIZER GLYCOL RET PRESS LL

4.4 Supercritical Units – Priority 2

The Priority 2 alarms determined for supercritical units shown in Table 4-4.

Table 4-4
Supercritical Units Priority 2

Supercritical Unit Priority 2 Alarms - PART 1			
EQUIPMENT	**ALARM - Priority 2**	**EQUIPMENT**	**ALARM - Priority 2**
AIR PRE HEATER	AIR PREHEATER AIR DP HI	ENVIRONMENTAL	OX AIR COOLING WATER LOW
AIR PRE HEATER	AIR PREHEATER GAS DP HI	ENVIRONMENTAL	OXIDATION BLOWER BLOW OFF FAULT
AIR PRE HEATER	AIR PREHEATER GAS IN SOOT BLOWER FAIL TO EXTND	ENVIRONMENTAL	OXIDATION BLOWER DIS FAULT
AIR PRE HEATER	AIR PREHEATER GAS IN SOOT BLOWER FAIL TO RETRC	ENVIRONMENTAL	OXIDATION BLOWER DISCHARGE PRESSURE
AIR PRE HEATER	AIR PREHEATER GAS OUT SOOT BLOWER FAIL TO EXTND	ENVIRONMENTAL	OXIDATION BLOWER INL FAULT
AIR PRE HEATER	AIR PREHEATER GAS OUT SOOT BLOWER FAIL TO RETRC	ENVIRONMENTAL	OXIDATION BLOWER INL FILT DP
AIR PRE HEATER	AIR PREHEATER GUIDE BG CLR VLV PWR FAIL	ENVIRONMENTAL	OXIDATION BLOWER MTR HIGH WINDING TEMP HH
AIR PRE HEATER	AIR PREHEATER GUIDE BRG TEMP HI	ENVIRONMENTAL	OXIDATION BLOWER MTR WND A1 TMP
AIR PRE HEATER	AIR PREHEATER ROTOR DRIVE ANNUN ALARM	ENVIRONMENTAL	OXIDATION BLOWER MTR WND A2 TMP
AIR PRE HEATER	AIR PREHEATER ROTOR DRIVE PWR FAIL	ENVIRONMENTAL	OXIDATION BLOWER MTR WND B1 TMP
AIR PRE HEATER	AIR PREHEATER ROTOR DRIVE ZERO SPEED	ENVIRONMENTAL	OXIDATION BLOWER MTR WND B2 TMP
AIR PRE HEATER	AIR PREHEATER SOOT BLW CLN FAILED	ENVIRONMENTAL	OXIDATION BLOWER MTR WND C1 TMP
AIR PRE HEATER	AIR PREHEATER SUPPORT BRG TEMP HI	ENVIRONMENTAL	OXIDATION BLOWER MTR WND C2 TMP
ASH SLUICE H20 PMP	ASWP PMP BRG TEMP - CPL HI	ENVIRONMENTAL	OXIDATION BLOWER OVERLOAD WARNING
ASH SLUICE H20 PMP	ASWP PMP BRG TEMP - OTBD HI	ENVIRONMENTAL	OXIDATION BLOWER PWR FAIL
BFP	MAIN FW VLV TROUBLE	ENVIRONMENTAL	OXIDATION BLOWER SURGE WARNING
BFP	BFP BALANCING DRUM DIFF PRS HH	ENVIRONMENTAL	SCRA BOTH INL ANLYZRS INVALID
BFP	BFP BEARING TEMP HH	ENVIRONMENTAL	SCRA DIL AIR TO MXR FLOW LO
BFP	BFP BEARING VIB. HH	ENVIRONMENTAL	SCRA NH3/AIR FLOW RATIO HIHI
BFP	BFP INJ H20 LK OFF SUCT TEMP HI	ENVIRONMENTAL	SCRA PATH 1 SELCTD OUTLET NOX LO
BFP	BFP INJ H2O AFTER CLRS TEMP HI	ENVIRONMENTAL	VPRZR 1 NH3 LVL HI
BFP	BFP INJ H2O AFTER CLRS TEMP LO	ENVIRONMENTAL	VPRZR 1 NH3 SPLY FCV PRT ORD
BFP	BFP INJ H2O LK OFF DISC TEMP HI	GENERATOR	HP EXCITER RUNBACK
BFP	BFP ROTOR VIBRATION	GENERATOR	HP GEN REACTIVE LOAD HI
BFP	BFP TURBINE LUBR OIL FRM CLR TEMP HI	GENERATOR	HP GEN REACTIVE LOAD LO
BFP	BFP TURBINE LUBR OIL TO CLR TEMP HI	GENERATOR	LP GEN REACTIVE LOAD HI
BFP	BFP TURBINE RESERVOIR TEMP LO	GENERATOR	LP GEN REACTIVE LOAD LO
BFP	BFP TURBINE-A TRIP TO MAN	GENERATOR	U1 Calisto Hydrogen (H2) HI
BFP	FWB VALVE TROUBLE	GENERATOR	U1 Calisto Hydrogen (H2) RCH
BOILER	AB 2 OF 4 FLAME LOST	GENERATOR	U1 Calisto Hydrogen (H2) RCHH
BOILER	BFW TO FURN FLOW DPT #1 HI	LIME SILO	LIME SILO BLOWER DIS TEMP HI
BOILER	BLR MSTR TRIP TO MAN	LIME SILO	LIME SILO CONV CMP MTR TROUBLE
BOILER	FURN BCP CAV PROT FAIL	LIME SILO	LIME SILO CONV CMP OIL PRES HI HI
BOILER	FURN BCWP CAVIT PROT FAILURE	LIME SILO	LIME SILO CONV CMP OIL PRES LO LO
BOILER	FURN PRESS HIGH	LIME SILO	LIME SILO CONV CMP PRESS HIHI
BOILER	FURN PRESS LO	LIME SILO	LIME SILO CONV CMP PWR FAIL
BOILER	O2 - FURN PROBE LO	LIME SILO	LIME SILO CONV CMP TEMP HI
BOILER	TDSO - FRN HI	LIME SILO	LIME SILO CONV HIGH WIND TEMP HI
BOILER	WW DP-THR PRESS < 1000 PSIG	LIME SILO	LIME SILO DSTCOLROT ILK TRIP
BOOSTER FAN	BOOSTER FAN BRKR TRIPPED	LIME SILO	LIME SILO DSTCOLROT PWR FAIL
BOOSTER FAN	BOOSTER FAN BYP DMP PRESS LOW	LIME SILO	LIME SILO FLTR MTR1 ILK TRIP
BOOSTER FAN	BOOSTER FAN DRV BRG TMP HI	LIME SILO	LIME SILO FLTR MTR1 PWR FAIL
BOOSTER FAN	BOOSTER FAN IDL BRG TMP HI	LIME SILO	LIME SILO FLTR MTR2 ILK TRIP
BOOSTER FAN	BOOSTER FAN INBD BRG VIB HI	LIME SILO	LIME SILO FLTR MTR2 PWR FAIL
BOOSTER FAN	BOOSTER FAN MTR DRV BRG TMP HI	LIME SILO	LIME SILO UNL BLOWER VENT FAN PWR FAIL
BOOSTER FAN	BOOSTER FAN MTR IDL BRG TMP HI	LIME SILO	LIME SILO UNLDG BLOWER DIS PRESS HIHI
BOOSTER FAN	BOOSTER FAN OIL CLR B FAIL STRT	LIME SILO	LIME SILO UNLDG BLOWER PWR FAIL
BOOSTER FAN	BOOSTER FAN OIL CLR FAIL STRT	PULVERIZER	LV FDR CB SB 1/2B PWR FAIL
BOOSTER FAN	BOOSTER FAN OIL PMP B FAIL STRT	PULVERIZER	LV FDR CB SB1/2B COIL MON
BOOSTER FAN	BOOSTER FAN OIL PMP FAIL STRT	PULVERIZER	LV FDR CD SB 2/5C PWR FAIL
BOOSTER FAN	BOOSTER FAN OIL PRESS LO-LO	PULVERIZER	LV LINEUP SB1/4 TRP SEL BUS B
BOOSTER FAN	BOOSTER FAN OIL PRESS LOW	PULVERIZER	LV MAIN CB SB1/1 COIL MON
BOOSTER FAN	BOOSTER FAN OIL TEMP	PULVERIZER	LV MNCB SB 1/1 PWR FAIL
BOOSTER FAN	BOOSTER FAN OUTBD BRG VIB HI	PULVERIZER	LV TIE CB SB1/4 COIL MON
BOOSTER FAN	BOOSTER FAN STR PH B TEMP#1 HH	PULVERIZER	MV FDR CB/DFA1 BD 86 TRIP
BOOSTER FAN	BOOSTER FAN STR PH B TEMP#2 HH	PULVERIZER	MV FDR CB/DFA1 BD COIL MON
BOOSTER FAN	BOOSTER FAN STR PH C TEMP#1 HH	PULVERIZER	MV FDR CB/DFA1 BD PWR FAIL
BOOSTER FAN	BOOSTER FAN STR PH C TEMP#2 HH	PULVERIZER	MV FDR CB/XFMR A1 86 TRIP
BOOSTER FAN	BOOSTER FAN STR PH TEMP#1 HH	PULVERIZER	MV FDR CB/XFMR A1 COIL MON
BOOSTER FAN	BOOSTER FAN STR PH TEMP#2 HH	PULVERIZER	MV FDR CB/XFMR A1 PWR FAIL
BOOSTER FAN	BOOSTER FANIR SUPPLY 2 B TRAIN	PULVERIZER	MV LINEUP SB1A BUS DIFF-MCC

Table 4-4 (continued)
Supercritical Units Priority 2

Supercritical Unit Priority 2 Alarms - PART 2			
EQUIPMENT	**ALARM - Priority 2**	**EQUIPMENT**	**ALARM - Priority 2**
CONDENSER	CONDENSATE FLOW DPT HI	PULVERIZER	MV LINEUP SB1A BUS DIFF-SWGR
CONDENSER	HOTWELL LEVEL LOW	PULVERIZER	MV LINEUP SB1A BUS PROT TRIP
CONDENSER	HOTWELL PUMP BRG TEMP - CPL HI	PULVERIZER	MV LINEUP SB1A BUS PROT TRIP
CONDENSER	HOTWELL PUMP BRG TEMP - OTBD HI	PULVERIZER	MV MAIN CB SB1A/C1 86 TRIP
CONDENSER	HOTWELL PUMP MTR BRG TEMP - OTBD HI	PULVERIZER	MV MAIN CB SB1A/C1 COIL MON
CONDENSER	HW PUMP MTR BRG TEMP - CPL HI	PULVERIZER	MV MNCB SB1A/C1 PWR FAIL
CONDENSER	#1GEN STATOR LIQ. COND. LOWER HH	PULVERIZER	FDR FDR SPEED HI
CONDENSER	CONDENSER HOTWELL LOW LEVEL	PULVERIZER	PULV BOWL DP HI
CONDENSER	CONDENSER LEVEL HH	PULVERIZER	PULV EXHAUSTER/FURNACE DP HI
CONDENSER	CONDENSER MU VV TRIP TO MAN	PULVERIZER	PULV MTR WINDING TEMP
CONDENSER	CONDENSER REC VV CHV-45 TRIP TO MAN	PULVERIZER	PULV MTR WINDING TEMP
CONDENSER	DEAERATOR INLET CONDUCTIVITY HH	PULVERIZER	PULV MTR WINDING TEMP
CONDENSER	ECONOMIZER INLET CONDUCTIVITY HH	PULVERIZER	PULV OUTLET TEMP HI-HI
CONDENSER	GLYCOL HTR.DRAIN ACID CONDUCT. HH	PULVERIZER	PULV PA FLOW LOW
CONDENSER	POWDEX B ACID CONDUCTIVITY HI	PULVERIZER	PULV PA TEMP XMTR CNTRL DEV
COOLING WATER PUMP	CCWP MTR BRG TEMP HI	PULVERIZER	PULV PRI AIR MONITOR FAULT
COOLING WATER PUMP	CCWP MTR WINDING TEMP	PULVERIZER	PULVERIZER NO COAL
DEAERATOR	DA STORAGE TANK LEVEL HI-HI	PULVERIZER	SELECTED PULV PA TEMP LO
DEAERATOR	DEAERATOR LEVEL HI	SEPARATOR	SEP PRESS XMTR CONT DEV ALARM
DEAERATOR	DEAERATOR LEVEL LO	SEPARATOR	SEPARATOR LEVEL HIGH
ECONOMISER	BFW TEMP - ECONOMIZER INLET HI	TRANSFORMER	MAIN XMFR 1A RELAY ALARM
ECONOMISER	ECON OUT PRESS LO	TURBINE	AX TURB 1A INACT THBRG MTL TMP HH
ENVIRONMENTAL	ABSORBER ARS LO FLT DP HI	TURBINE	AX TURB 1A OIL TEMP LVG COOLER LO
ENVIRONMENTAL	ABSORBER ARS LO PRESS LOLO	TURBINE	HP EXCTR REDN GEAR TEMP - P1 HI
ENVIRONMENTAL	ABSORBER ARS PWR FAIL	TURBINE	HP LUBE OIL CLR OIL IN TEMP HI
ENVIRONMENTAL	ABSORBER INLET TEMP HI & WDI VV CLS	TURBINE	HP LUBE OIL CLR OIL OUT TEMP HI
ENVIRONMENTAL	ABSORBER INLET TEMP HI AND ME INACT	TURBINE	IP TURBINE SPEED (BENTLY) LO
ENVIRONMENTAL	ABSORBER MSTE DP HI	TURBINE	LP EXCITER RUNBACK
ENVIRONMENTAL	ABSORBER RCRC PMP 1B INTRLOCKS	TURBINE	LP EXCTR REDN GEAR TEMP - L1J1 HI
ENVIRONMENTAL	ABSORBER RCRC STRT UP FAIL	TURBINE	LP LUBE OIL CLR OIL IN TEMP HI
ENVIRONMENTAL	ABSORBER RCRC STRT UP IN HOLD	TURBINE	LP LUBE OIL CLR OIL OUT TEMP HI
ENVIRONMENTAL	ABSORBER REC DSCH NOPN & PMP RNG	TURBINE	MAIN TURBINE OIL TANK LEVEL-H
ENVIRONMENTAL	ABSORBER REC PUMP CTRL FSP	TURBINE	MN TURB OIL TEMP LEAVING COOLR LLL
ENVIRONMENTAL	ABSORBER REC PUMP CTRL FST	TURBINE	MN TURBINE JOURNAL BNG 10 TEMP HH
ENVIRONMENTAL	ABSORBER RECIRC PUMP ILK TRIP	TURBINE	THROTTLE PRESSURE #1 HI
ENVIRONMENTAL	ABSORBER RECIRC PUMP MTR WNDG TMP HI	TURBINE	TURB STEAM SEAL HEADER PRESS HI
ENVIRONMENTAL	ABSORBER RECIRC PUMP PWR FAIL	TURBINE	TURBINE BRG OIL HEADER PRESS LL
ENVIRONMENTAL	ABSORBER SUMP AGT ILK TRIP	TURBINE	TURBINE EXHAUST PRESSURE
ENVIRONMENTAL	ABSORBER SUMP AGT ILK TRIP	TURBINE	TURBINE STEAM CHEST PRESS HH
ENVIRONMENTAL	ABSORBER SUMP AGT PWR FAIL	UPS	SWGR BATT CHRG 1A TROUBLE
ENVIRONMENTAL	ABSORBER SUMP LVL HIHI	UPS	UPS 1A BATTERY OPERATION
ENVIRONMENTAL	ABSORBER SUMP PMP PWR FAIL	UPS	UPS 1A BYPASS ON
ENVIRONMENTAL	ARS OX AIR INL TEMP HI HI	UPS	UPS 1A INVERTER FAULT
ENVIRONMENTAL	CEMS FLUE GAS DESULFUR INLET CRITICAL ALARM	UPS	UPS 1B BYPASS MAINS FAULT
ENVIRONMENTAL	CEMS FLUE GAS DESULFUR INLT OPAC OUT OF LMT	UPS	UPS BATT CHRG 1A FAILURE
ENVIRONMENTAL	CEMS FLUE GAS DESULFUR INLT OPAC OUT OF LMT	UPS	UPS BATT CHRG 1A TROUBLE
ENVIRONMENTAL	CEMS FLUE GAS DESULFUR STACK CRITICAL ALARM	UPS	UPS BATTERY SUPPLYING LOAD
ENVIRONMENTAL	CEMS SHELTER TEMPERATURE HI	UPS	UPS BYPASS SOURCE FAILURE
ENVIRONMENTAL	CLS NH3 VLV OVERRIDE FOR SCRA	UPS	UPS BYPASS SUPPLYING LOAD
ENVIRONMENTAL	FLUE GAS DESULFUR ABSORBER UPS ABNORMAL	UPS	UPS CHARGER/RECTIFIER FAILURE
ENVIRONMENTAL	FLUE GAS DESULFUR ABSORBER UPS ABNORMAL ALARM	UPS	UPS INVERTER FAILURE
ENVIRONMENTAL	FLUE GAS DESULFUR DET BASIN LOLO	UPS	UPS STATIC SWITCH TRANSFER
ENVIRONMENTAL	FLUE GAS DESULFUR NETWORK CAB POWER MON	VAPORIZER	VAPORIZER CCND SPLY PRESS LO
ENVIRONMENTAL	FLUE GAS DESULFUR OPACITY CMP VALUES EQUAL	VAPORIZER	VAPORIZER GLYCOL FWD TEMP HI
ENVIRONMENTAL	FLUE GAS DESULFUR OPACITY FLATLINE CUTOUT	VAPORIZER	VAPORIZER GLYCOL FWD TEMP LO
ENVIRONMENTAL	FLUE GAS DESULFUR OPACITY VALUE FLAT LINED	VAPORIZER	VAPORIZER GLYCOL PH HI
ENVIRONMENTAL	FLUE GAS DESULFUR PH HP4700 PRI PWR FEED ALM	VAPORIZER	VAPORIZER GLYCOL PUMP 1 PWR FAIL
ENVIRONMENTAL	NH3 LIQ PUMP 1 FAILED	VAPORIZER	VAPORIZER GLYCOL RET PRESS HI
ENVIRONMENTAL	NH3 LIQ PUMP 1 PWR FAIL	VAPORIZER	VAPORIZER GLYCOL RET PRESS LO
ENVIRONMENTAL	NH3 STORAGE TANK 1 LVL LLL	VAPORIZER	VAPORIZER GLYCOL RET TEMP 2 HI

4.5 Drum Units – Priority 1

The Priority 1 alarms determined for drum units are shown in Table 4-5.

Table 4-5
Drum Unit Priority 1

Drum Unit Priority 1 Alarms			
Equipment	**Priority 1 Alarm**	**Equipment**	**Priority 1 Alarm**
BCWP	BCWP DIFF PRESS AMBER LT	Boiler	SH FURN EXIT GAS TEMP HI
BCWP	BCWP DIFF PRESS LOW	Boiler	SH FURN EXIT GAS TEMP RECORDER HI
BCWP	BCWP DIFF PRESS MFT	Boiler	SH FURNACE PRESSURE HI HI
BCWP	BCWP DIFF PRESS TRIP	Boiler	SH FURNACE PRESSURE LO LO
Boiler	BLR AUX EMERG TRIPPED (98Y)PT1	Boiler	SH OUTLET STEAM TEMP HI
Boiler	BLR AUX EMERG TRIPPED (98Y)PT2	BOILER FD PMP	BFP A RUNNING
Boiler	BMS LOW AIRFLOW TRP INDICATION	BOILER FD PMP	BFP A TRIP
Boiler	BOILER MFT	BOILER FD PMP	DA LEVEL LOLO TRIP BFPS
Boiler	BOILER MFT TRIP ACTIVE	Condenser	CONDENSER REG CONT VALVE MRE
Boiler	CCS MFT RELAY FAILURE	Deaerator	DA LEVEL XMTR TROUBLE
Boiler	DARK CHECK FAILED RH	Dearartor	LO
Boiler	DRUM LEVEL LOW	Dearartor	DEAERATOR LEVEL A LO
Boiler	EMERGENCY TRIP OPERATED	FD Fan	2 FD FAN RUNBACK INDICATION
Boiler	FLAME IN EACH FURNACE	FD Fan	FD FAN A RUNNING
Boiler	FURN PRESS/DRUM LEVEL MFT B	FD Fan	FD FAN RUNBACK INDICATION
Boiler	FURN PRESSURE HI HI	FD Fan	NO FD FANS RUNNING TRIP LATCH
Boiler	FURN PRESSURE LO LO	Feeder	1 FEEDER RUNBACK
Boiler	FURNACE PRESS TRIP ALL FANS	Generator	GENERATOR OVER EXCITATION
Boiler	FURNACE PRESSURE HI HI	Generator	UNIT 3 MN TRANSFORMER TEMP HI
Boiler	FURNACE PRESSURE LO LO	Generator	UNIT 3 OVER EXCITATION
Boiler	MAIN STEAM TEMPERATURE HIGH	Generator	UNIT 3 REGULATOR REJECT TO MAN
Boiler	MASTER FUEL TRIP CIRCUIT	Generator	VOLTAGE REGULATOR REJECT TO MA
Boiler	MASTER FUEL TRIPPED	ID Fan	2 ID FAN RUNBACK INDICATION
Boiler	MASTER FUEL TRIPPED (PLANT 97)	ID Fan	ID FAN A TRIP
Boiler	MFT RELAY 97 TRIP DRIVE	ID Fan	NO ID FANS RUNNING TRIP LATCH
Boiler	MFT RELAY FAILED TO TRIP	Oil Gun	ALL OIL GUN TRIP VALVES CLOSED
Boiler	NO PARTIAL LOSS OF FLAME	Pulverizer	PULV A AMPS HI TRIP FEEDER
Boiler	RELAY 97 TRIP DRIVE	Pulverizer	PULV A AMPS HI-HI
Boiler	RH FURN EXIT GAS TEMP HIGH	Stack Emission	U1 CO EMISSION HI
Boiler	HI	Turbine	THROTTLE PRESS XMTR TROUBLE
Boiler	RH FURNACE PRESSURE HI HI	Turbine	TURB THRUST EAST POSITION HI
Boiler	RH FURNACE PRESSURE LO LO	Turbine	TURB THRUST EAST POSITION LO
Boiler	RH OUTLET STEAM TEMP HI	Turbine	TURBINE GOVERNOR VALVES
Boiler	SELECTED DRUM LEVEL HI	Turbine	TURBINE GOVERNOR VLV INPUT 1
Boiler	SELECTED DRUM LEVEL LO	Turbine	TURBINE THROTTLE VALVES
Boiler	SELECTED SH STEAM TEMP HI	Turbine	TURBINE THROTTLE VLV INPUT 1
Boiler	SELECTED SH STEAM TEMP LO		

4.6 Drum Units – Priority 2

The Priority 2 alarms determined for drum units are shown in Table 4-6.

Table 4-6
Drum Unit Priority 2

Drum Unit Priority 2 Alarms			
Equipment	**Priority 2 Alarm**	**Equipment**	**Priority 2 Alarm**
BCWP	BCWP DIFF PRESS GREEN LT	BOILER FD PMP	BFP MASTER MRE
Boiler	AIR FLOW BELOW 20 PCT	BOILER FD PMP	BFP RUNBACK
Boiler	AIR FLOW BELOW 25 PCT	BOILER FD PMP	FEEDWATER BYPASS MRE
Boiler	COMMON BMS RELAY OUTPUT	BOILER FD PMP	FEEDWATER FLOW XMTR TROUBLE
Boiler	IGNITOR WARMUP GUN AB1 TRIPPED	Condenser	CONDENSATE VLV DMD VS FDBK DEV
Boiler	REHEAT OUTLET TEMP HI	Cooling Air Fan	COOLING AIR FLOW LOW
Boiler	REHEAT OUTLET TEMP LO	Cooling Air Fan	COOLING FAN B FAILED TO RUN
Boiler	RH A AFTER SPRAY STEAM TEMP LO	Cooling Air Fan	FAN A FAILED TO RUN
Boiler	RH FURNACE O2 XMTRS BAD QUAL	Dearartor	SELECTED DEAERATOR LEVEL HI
Boiler	RH OUTLET STEAM TEMP LO	Feeder	FEEDER A RUNNING
Boiler	RH OUTLET STEAM TEMPERATURE HI	Feeder	RH COAL FEEDER E RUNNING
Boiler	SELECTED RH FURNACE O2 LO	Feeder	SH COAL FEEDER A RUNNING
Boiler	SH A AFTER SPRAY STEAM TEMP HI	Hotwell	HOTWELL LEVEL HI
Boiler	SH A AFTER SPRAY STEAM TEMP LO	Hotwell	HOTWELL LVL XMTR BAD QUALITY
Boiler	SH FURNACE O2 XMTRS BAD QUAL	Hotwell	SMOOTHED HOTWELL LEVEL HI
Boiler	SUPERHEAT OUTLET TEMP HI	Hotwell	SMOOTHED HOTWELL LEVEL LO
Boiler	SUPERHEAT OUTLET TEMP LO	ID Fan	ID FAN RUNBACK
Boiler	TOTAL AIR FLOW > 25 PCT	Oil Gun	OIL GUN ALARM AB1
Boiler	WARMUP GUN AB1 TRIPPED	Pulverizer	PULV A AMPS PROVEN
BOILER FD PMP	BFP A M/A FAIL TO RESPOND	Turbine	CALC TURB GOV POS BAD QUALITY
BOILER FD PMP	BFP A MRE		

5
DCS CONFIGURATION COMPARISON

A detailed file named EPRI DCS ComparisonTable.xlsx accompanies this report and serves as Appendix A. It provides a table of the detailed characteristics and capabilities of the following DCS types:

- Emerson Ovation 3.x
- Foxboro IA Series 8.x
- Siemens T3000 Version 7
- GE Mark V (Cimplicity HMI)
- GE MarK VI (Cimplicity HMI)
- Schneider Wonderware, v10
- Honeywell TDC3000
- Honeywell Experion
- ABB Symphony Plus Operations "800xA Operations" (formerly ABB Process Portal A)"
- ABB Process Portal B

5.1 Table Sections

The table's sections are as listed here.

5.1.1 Tags

- Tag name Max Length
- Tag name/Function Block Format
- Example
- Tag name Limitations
- Tag Description Max Length

5.1.2 Alarm Configuration - Tag Specific

- Analog Alarms
- Digital Alarms
- Other Alarms
- User Message Capability
- User Message Character Length and Limitations

5.1.3 Alarm Configuration - System Wide

- Priorities
- Priority Fixed or Configurable
- Priority Color
- Alarm Priorities Formatting Limitation
- Alarm Priorities
- Unique Alarm Characteristics
  Can Alarms Be Sent to a Printer
- Are Alarms Sent to a History File

5.1.4 Audible Annunciation

- Levels
- Type
- Configurable
- SMS and Email Capability

5.1.5 Alarm Summary Display

- Example Image
- Displays Available
- Window Protectable from Removal or Cover
- Lines per Display
- Font Style
- Font Size
- Shows Tag Name
- Shows Description
- Shows Current PV/State
- Shows Engineering Units
- Shows Alarm Setpoint
- Shows Configurable Message
- Can the Operator Sort by Timestamp
- Can the Operator Sort by Priority
- Shows Priority and Acknowledges
- Can the Operator Sort by Area/Group

5.1.6 Alarm Acknowledgement

- Alarm Summary - Acknowledge All Visible
- Alarm Summary - Acknowledge Single
- Graphic - Acknowledge All
- Graphic - Acknowledge Single

5.1.7 Alarm Suppression

- Suppression Supported (no time limit)
- Supervisor Permission
- What Priorities Can Be Suppressed
- Can Notes Be Added
- List or Report of Disabled Alarms

5.1.8 Alarm Shelving

- Shelving Supported (time limited)
- Supervisor Permission
- Shelving Duration
- What Priorities Can Be Shelved
- Can Notes Be Added
- List or Report of Shelved Alarms

5.1.9 Other

- Alarm D&R Info Availability
- State Based Alarming
- Alarm Annunciator Keyboard

6
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   Technical Report 5: Alarm System Monitoring, Assessment, and Audit
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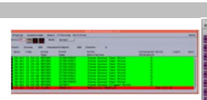
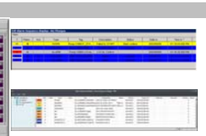
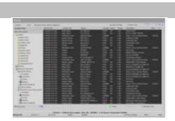
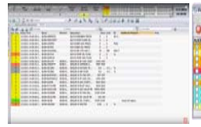
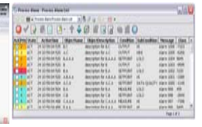
    Part I: Understanding High Performance HMI Principles and Best Practices
    Part II: High Performance HMI Case Studies, Recommendations, and Standards
    Overcoming Common Objections to HPHMI Migration

A
EPRI DCS COMPARISON TABLE

		Emerson Ovation 3.x	Foxboro IA Series 8.x	Siemens T3000 Version 7	GE Mark V (Cimplicity HMI)	GE MarK VI (Cimplicity HMI)	Schneider Wonderware, v10	Honeywell TDC3000	Honeywell Experion	ABB Symphony Plus Operations	800xA Operations (formerly ABB Process Portal A)	ABB Process Portal B
DCS		OVATION	invensys FOXBORO	SIEMENS	GE	GE	Wonderware by Schneider Electric	Honeywell	Honeywell	ABB	ABB	ABB
Tags	**Tagname Max Length**	16 chars	12 chars		32 chars	32 chars	32 chars	8-16 chars	16 chars	20 chars	32 chars	32 chars
	Tagname/Function Block Format	name. unit@network	compound:functionblock	Tagname.Block	Point ID	Point ID	TAGNAME	Tag Name	ControlModule.FunctionBlock	TAGNAME	TAGNAME	TAGNAME
	Example		0330TKF0029:PPS0139_II	BFW PumpA.11143	Pump_01	Pump_01	Pump01		CL050122.DACA	250TC4031	250TC4031	250TC4031
	Tagname Limitations			spaces ok	Some reserved words and characters	Some reserved words and characters	Do not use blank spaces in tag names		must have 1 letter character	Minimum 3 characters [0-9][A-Z]	Minimum 3 characters [0-9][A-Z]	Minimum 3 characters [0-9][A-Z]
	Tag Description Max Length	30 chars	32 chars		40 chars	40 chars	50 chars	24	24 chars	128 Char	64 chars	64 chars
Alarm Configuration - Tag Specific	**Analog Alarms**	High1-4, Low1-4, User High, User Low, Incremental Better, Incremental Worse, Return	HHABS, HHAHHABS HHALIM, HHAPRI, LLABS, LLALIM HHAPRI, HIABS MEASHL ,MEASPR / HLPR LIM, HHAPRI HIABS , MEASHL MEASPR / HLPR	Alarm types can be created individually	•Absolute •Deviation •On Update •Rate of Change Hi-2, Hi-1, Lo-1, Lo-2	•Absolute •Deviation •On Update •Rate of Change Hi-2, Hi-1, Lo-1, Lo-2	Value - LoLo, Low, High, HiHi, Deviation - Major, Deviation - Minor, Rate-of-Change, SPC	BADPV, PVHI, PVHH, PVLO, PVLL, DEVHI, DEVLO	BADPVALM, PVHIALM, PVHHALM, PVLOALM, PVLLALM, DEVHIALM, DEVLOALM, ROCPOSALM, ROCNEGALM	ALPRI_3H, ALPRI_2H, ALPRI_H, ALPRI_L , ALPRI_2L, ALPRI_3L, ALPRI_HROC, ALPRI_LROC, ALPRI_HDEV, ALPRI_LDEV REFSTAT, EVENTTAG, INITVAL, MAX_ROC, TRIP_NUM, ALM_PROG, EVT_PROG		BADALM, HIALM, HI2ALM, HI3ALM, LOALM, LO2ALM, LO3ALM
	Digital Alarms	ALARM and/or CFN (Change from Normal) or STATE CHANGE	BADIO, STATE, EVENT, TRIP, RANGE, CHANGE	Alarm types can be created individually	Alarm on value of 1 or Alarm on value of 0	Alarm on value of 1 or Alarm on value of 0	DSC	CHGOFST, CMDDIS, STATE0, STATE1, OFFNORM, OVRD	CMDDISALM, CMDFALALM, OFFNRM, STATE			DIGITAL, STATE0, STATE1, STATE2, STATE3
	Other Alarms	Sensor Alarms, SID (Bad calculation) Alarms	LOGIC	YES, Activate message and Deactive Message			MAJDEV, MINDEV, ROC, SPC	ADVDEV, BADCTL, BADPV BCLEAL, BCLFAL, C1 C2, C3, C4, CHOFST CLEAM, CLFALM, CMDDIS CNFERR, DEVHI, DEVLO OFFNRM, OPHI, OPLO, PVHH PVHI, PVLL, PVLO PVROCN, PVROCP PVSGCH, SEQ, UNREAS DIAGNOSTIC ALARMS ON AM, HIWAY, ETC Messages from CL programs only (not Alarms on tags)	ADVDEVOPT, BADCTLALMOPT, Control Fail, External Change, OIALM, OPHIALM, OPLOALM, PVHISIGCHG, PVLOSIGCHG, SIALM, TransmitterHigh, TransmitterLow, UNCMDALM, Unreasonable Value	HINS_LIMIT, SPAN, HI_ACTIVE, HI_PROG, H3ALARM, H3_ACTIVE, H2ALARM, H2_ACTIVE, H23_PROG, HALARM, H_ACTIVE, H_PROG, LALARM, L_ACTIVE, L_PROG, L2ALARM, L2_ACTIVE, L3ALARM, L3_ACTIVE, L23_PROG, VAL0, LI_ACTIVE, LI_PROG, HVARALMTAG, H2VARALMTG, H3VARALMTG, H2DELTA, H3DELTA, LVARALMTAG, L2VARALMTG, L3VARALMTG, L2DELTA, L3DELTA		
	User Message capability	Digital - SET Description, RESET Description	Yes, Alarm text parameter per Alarm type		Yes, Alarm Message	Yes, Alarm Message	Yes, Alarm Comment		Message Summary (not Alarm)	Yes, Alarm Message		No
	User Message character length	30 chars	32 chars		80 chars	80 chars	131 chars	64 chars	No limit in message length			
	User Message character limitations		Text string				Text string, The Alarm Comment box should not contain the double-quote character ("). A process that uses the double-quote as a delimiter will fail if it is fetching an alarm comment that includes a double-quote.	Text string	Text string	Text string		
Alarm Configuration - System Wide	**Priorities**	1-8, 1=Highest Priority	1-5, 1=Highest, 0 = No Alarm	A=Alarm (Critical alarm) W=Warning (Less critical alarm) T=Tolerance (Least critical alarm) M=Maintenance(service required) S=Status(important device started or stopped or device changeover) I&C=(fault in the instrument and control system)	0 to 99, where 0 is the highest priority and 99 is the lowest priority	0 to 99, where 0 is the highest priority and 99 is the lowest priority	1-999 Critical 1-249, Major 250-499, Minor 500-749, Informational 750-999	NOACTION, JOURNAL, LOW, HIGH, EMERGNCY	NONE, JOURNAL, LOW, HIGH, URGENT	0=Priority Error!, 1=DIRE, 2=dire, 3=CRUCIAL, 4=crucial, 5=CRITICAL, 6=critical, 7=ALERT, 8=alert, 9=WARNING, 10=warning, 11=ADVISE, 12=advise, 13=NOTIFY, 14=notify, 15=INFORM, 16=inform	1=Critical, 2=High, 3 = Medium, 4=Low	0=Priority Error!, 1=DIRE, 2=dire, 3=CRUCIAL, 4=crucial, 5=CRITICAL, 6=critical, 7=ALERT, 8=alert, 9=WARNING, 10=warning, 11=ADVISE, 12=advise, 13=NOTIFY, 14=notify, 15=INFORM, 16=inform
	Priority fixed or configurable	Configurable	Fixed	Fixed	Configurable	Configurable	Configurable (1-990 characters)	Fixed	Fixed	Fixed	Fixed	Fixed
	Priority Color	Foreground and Background color is configurable for each priority	Fore/Back is configurable. Defaults: 1 = Red 2= Magenta 3= Brown 4= Cyan 5= Dark Gray	Default A=Red W=Yellow T=Cyan M=Magenta S= Orange I&C=Blue	Configurable	Configurable	Configurable based on priority group	Configurable 7 color choices per priority. Default:Emergency=Red Default:High=Yellow Low=Magenta	Configurable	Alarm priority levels range from 1 through 16. 1 through 3 are red, orange, and yellow respectively by default. All alarm priorities can be configured.	Alarm priority levels range from 1 through 16. 1 through 3 are red, orange, and yellow respectively while 4 through 16 can be configured.	Alarm priority levels range from 1 through 16. 1 through 3 are red, orange, and yellow respectively while 4 through 16 can be configured.
	Alarm Priorities						Priority=Numerical,					
	Formatting Limitation		Numerical	String	Numerical	Numerical	Group=Alphanumeric	string	string		N/A	N/A
	Alarm Priorities		1 = Red 2= Purple 3= Brown 4= Blue 5= Gray	TS=Trip Stop, TW=Trip Watch, DR=Diagnostic Recommended,				Emergency=Red, High=Yellow,			Alarm priority levels range from 1 through 16. 1 through 3 are red, orange, and yellow respectively while 4 through 16 can be configured.	Alarm priority levels range from 1 through 16. 1 through 3 are red, orange, and yellow respectively while 4 through 16 can be configured.
	Unique Alarm Characteristics			A=Alarm, W=Warning, T=Tolerance			Configurable based on priority group	Low=Magenta				
	Can alarms be sent to a printer	YES	YES		YES	YES	YES	YES	YES	YES	YES	YES
	Are alarms sent to a history file	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Audible Annunciation	**Levels**	Per Priority	Per Priority	Per Alarm Type	Per Alarm Class	Per Alarm Class		Selectable (E only or ALL)			Per Priority	
	Type	User supplied audio file	.wav file	Sound Alarms are produced out by the Thin Clients using a sound cardsound card	.wav file / beep	.wav file / beep	.wav file / windows default sound	Hardware horn, 3 levels	.wav file / beep	.wav file / beep / activation of tag (RCM type) usually connected with a relay digital output (that is a switch of a relay contact)	.mp3 file	
	Configurable	YES, Continuous (Silence required) or non-continuous (single sound)	YES	Yes	Yes	Yes	Yes	NO	YES	YES	YES	
	SMS text	NO	NO		NO	NO	Yes	NO	YES via Alarm Pager	YES	YES	
	Email		NO	YES	NO	NO	Yes	NO	YES via Alarm Pager		YES	

		Emerson Ovation 3.x	Foxboro IA Series 8.x	Siemens T3000 Version 7	GE Mark V (Cimplicity HMI)	GE MarK VI (Cimplicity HMI)	Schneider Wonderware, v10	Honeywell TDC3000	Honeywell Experion	ABB Symphony Plus Operations	800xA Operations (formerly ABB Process Portal A)	ABB Process Portal B
DCS		OVATION	invensys FOXBORO	SIEMENS			Wonderware by Schneider Electric	Honeywell	Honeywell	ABB	ABB	ABB
Alarm Summary Display	Example											
	Displays Available	- Current Alarms (newest to oldest) - History of last 5000 alarms and returns -Unacknowledged Alarm List - List of Icons (groups of alarms)	- Current Alarms (default) - Most Recent Alarms - New Alarm Summary -Unacknowledged Alarm Summary - Acknowledged Alarm Summary - History of All Alarms and RTNs -Horn management	Default and Custom	Configurable	Configurable	Configurable	Alarm Annunciator Area Alarm Summary Unit Alarm Summary	Filtering and Sorting Summary of Unacknowledged, Acknowledged, Shelved, and Suppressed Alarms	Filtering and Sorting	Configurable	
	Window protectable from removal or cover	YES	YES					NO				
	Lines per display	Configurable (Default 30)	Configurable					20 per display (100 max)		1000	500	
	Font Style	Fixed Width Font	YES		YES	YES	YES	Fixed Width (not changeable)			YES	
	Font Size	Configurable	YES		YES	YES	YES	Fixed				
	Shows Tagname	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
	Shows Description	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
	Shows Current PV/State	YES	YES	YES	YES	YES	YES	Toggles with Engineering Units	YES	YES	YES	
	Shows Engineering Units	YES	YES		NO	NO	NO	Toggles with Current PV/State	YES	YES		
	Shows Alarm Setpoint	YES	YES		NO	NO	YES	YES	YES	YES		
	Shows Configurable Message	NO	NO	YES	YES	YES	YES	NA		YES	YES	
	Can the operator sort by Timestamp	Yes, Newest to Oldest or Oldest to Newest	NO	YES	YES during configuration, not sure for operator during runtime	YES during configuration, not sure for operator during runtime	YES	NO	YES	FILTER	YES during configuration, not sure for operator during runtime	
	Can the operator sort by Priority	YES	Filter but not sort		YES during configuration, not sure for operator during runtime	YES during configuration, not sure for operator during runtime	FILTER	SORT-YES FILTER-YES	YES	FILTER		
	Shows Priority and Acknowledges	By color only, no blinking	YES	YES	YES	YES	YES	YES	YES	YES	YES	
	Can the operator sort by Area/Group	YES	NO	YES	YES during configuration, not sure for operator during runtime	YES during configuration, not sure for operator during runtime	FILTER	FILTER BY AREA	YES	FILTER		
Alarm Acknowledgement	Alarm Summary Acknowledge All Visible	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
	Alarm Summary Acknowledge single	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	
	Graphic Acknowledge All			YES			YES	YES	YES	YES	YES	
	Graphic Acknowledge Single						YES	NO	YES			
Alarm Suppression	Alarm Suppression Methods	Alarm Window Banner - Button, Alarm configuration Auto-Reset	1) Block alarm inhibition parameter options perform specific actions to each block alarm	Suppress	Disable	Disable	Disable, Inhibit, or Suppress	Disable Alarm from Alarm Summary Page	Disable/Shelve Alarm from Alarm Summary Page, tag detail or any process graphic.	Shelve, Suppress, Out of Service	Shelve, Hidden, Disable	
	Suppression Supported (no time limit)	NO	YES	YES by(Tag, Equipment,Alarm Type)	YES during configuration, not sure for operator during runtime	YES during configuration, not sure for operator during runtime	YES	YES	YES - Suppress	YES - Suppress	YES	
	Supervisor permission	na	NONE	NO			Depends on security privilege	YES via KEY	Depends on security privilege	Depends on security privilege	Depends on security privilege	
	What Priorities can be Suppressed	na	ALL	ALL	ALL	ALL	ALL	ALL	ALL - Suppress	ALL - Suppress	ALL	
	Can Notes be added	na	NO	NO	NO	NO	NO	NO	YES - Suppress			
	List or Report of Suppressed Alarms	na	VIA FILTER	YES (from Alarm Summary)				YES	YES - Suppress	YES - Suppress		
Alarm Shelving	Shelving supported (time limited)	NO	NO	NO	NO	NO	YES	NO	YES	YES	YES	
	Supervisor permission	na	na	na	na	na	Depends on security privilege	na	Depends on security privilege	Depends on security privilege	Depends on security privilege	
	Shelving Duration	na	na	na	na	na	HOURS	na	65535 seconds		Infinity	
	What Priorities can be shelved	na	na	na	na	na	ALL	na	ALL	ALL	ALL	
	Can Notes be added	na	na	na	na	na	YES	na	YES		YES	
	List or Report of Shelved Alarms	na	na	na	na	na	YES	na	YES	YES	YES	
Other	Alarm D&R info availability	NO	NO	NO	NO	NO	NO	NO				
	State Based Alarming	NO	NO	NO				YES-LIMITED				
	Alarm Annunciator Keyboard		YES	NO				YES	YES			

B
EPRI DCS BEST PRACTICES – GRAPHICS ISSUES V1.0

EPRI Project:
Alarm Configuration / DCS Best Practices

APPENDIX B – PROCESS CONTROL GRAPHIC ISSUES

Product ID 3002012970

Final Version 1.0, August 2018

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This following section is in the overall report. This Appendix provides visual examples of the issues noted.

Alarm Depiction on Process Graphics
Several responders supplied over 40 process graphics showing alarms in effect. Depictions of alarms should stand out, attract the operator's attention, and be unmistakable. Most of the examples provided had a wide range of issues, including the following:

1. Inconsistent use of color in alarm depiction, for example, using the same color to indicate both alarm and normal conditions
2. Indicating an alarm condition solely by a slight or inconspicuous color change
3. Failure to associate the priority with the depicted alarm condition
4. Depicting alarms in ways that are far less prominent and visible than items on the screen that are depicting their normal, or even static, condition
5. Inconsistent depiction of alarm conditions from one graphic to the next (in the same unit).
6. Depictions of alarms identically to showing simple non-alarm status conditions

Besides alarm depiction issues, other aspects of many graphics were problematic as well:

7. Process values depicted without context as to if the numbers are in a desirable range or are approaching alarm or trip conditions
8. Confusing, "busy" depictions cluttered with extraneous detail
9. Depiction of some abnormal conditions in subtle ways, in a manner overwhelmed by bright, vivid depictions of equipment and conditions that are normal
10. A significant lack of trends, which are essential for operator situation awareness

These issues are common with graphics that were not designed in accordance with principles reflecting human factors and human performance. Tables of numbers and P&ID representations covered in numbers are the most common forms of process graphics. Such designs make operator situation awareness and early detection of abnormal conditions much more difficult to achieve. The References section, including an EPRI case study, provides more detail on the design of graphics for high performance. Such designs maximize an operator's capability for early detection and successful resolution of abnormal situations.

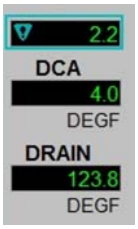
Color usage principles from HMI resources and standards:

- **Color, alone, is ineffective when used as the sole means to differentiate an important status condition.**
- **Color must be used consistently.**
- **Colors chosen to be part of an alarm condition indication should not be used for other purposes.**

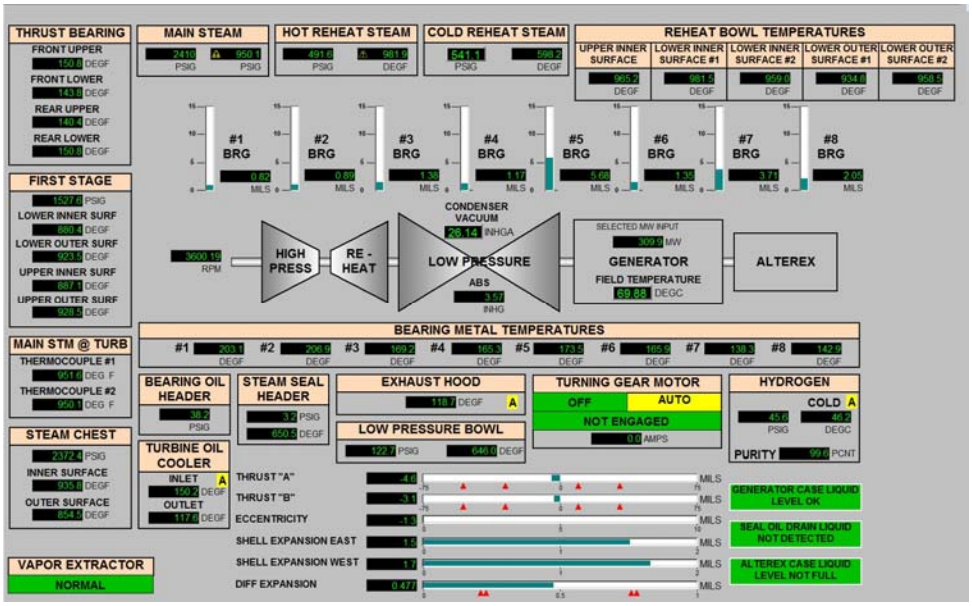
The alarm indication method is almost invisible, even when enlarged:

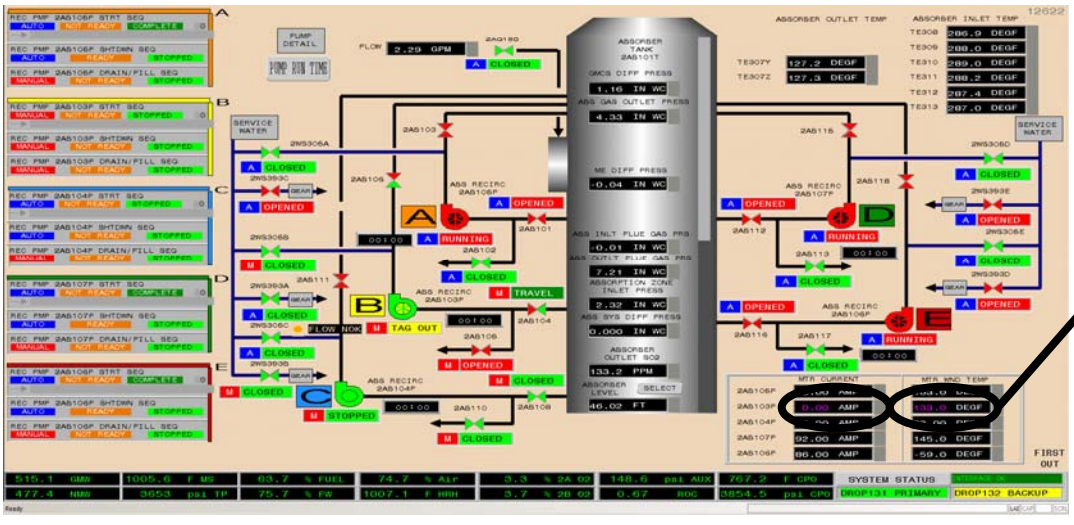
Notice the visual difficulty in finding it on the screen

Similar, enlarged from another graphic:



Redundantly coded alarm indicator elements are a good idea, but they must stand out on the graphic.



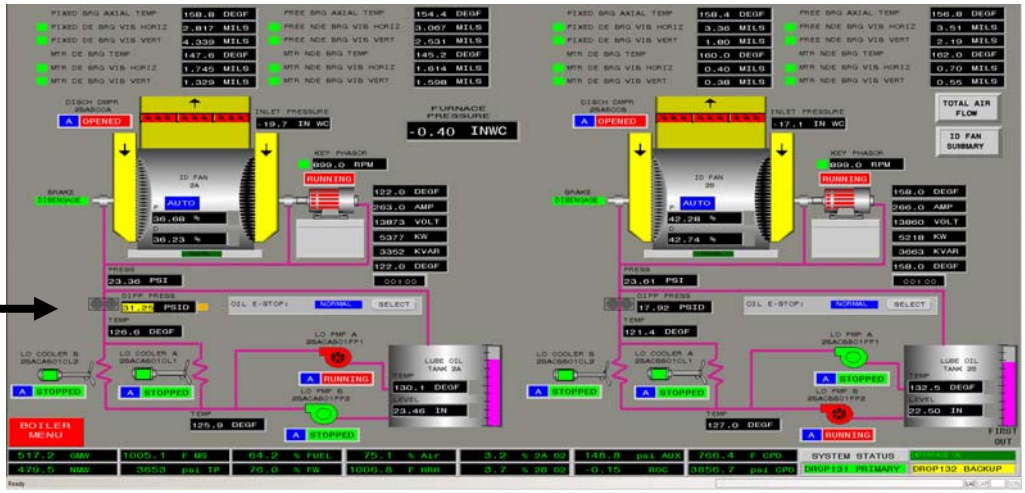


Alarm conditions should stand out and get one's attention.

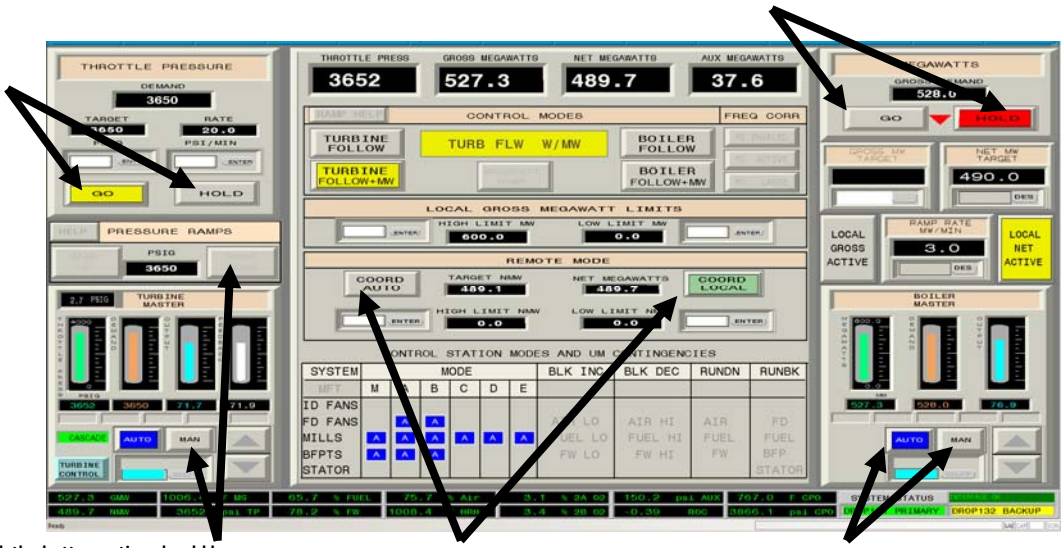
These magenta numbers are alarms. Almost all of the other red items on the screens are not alarms, but simply status conditions.

Almost all of the other items on the screen are much more visually prominent than these alarm conditions.

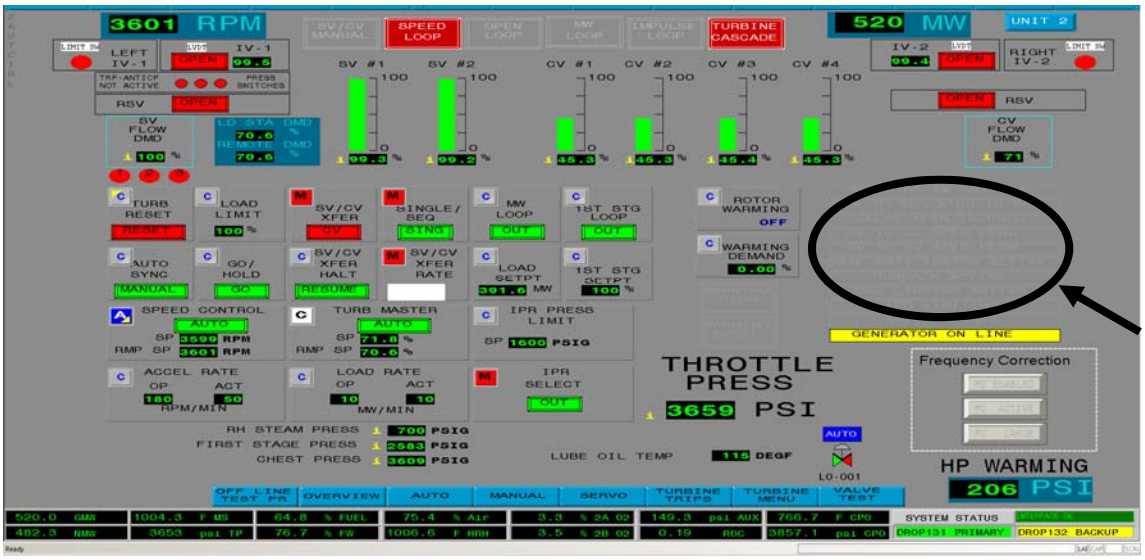
The yellow number is in alarm, but the other large yellow screen items are not representing an alarmed condition and are much more visually prominent



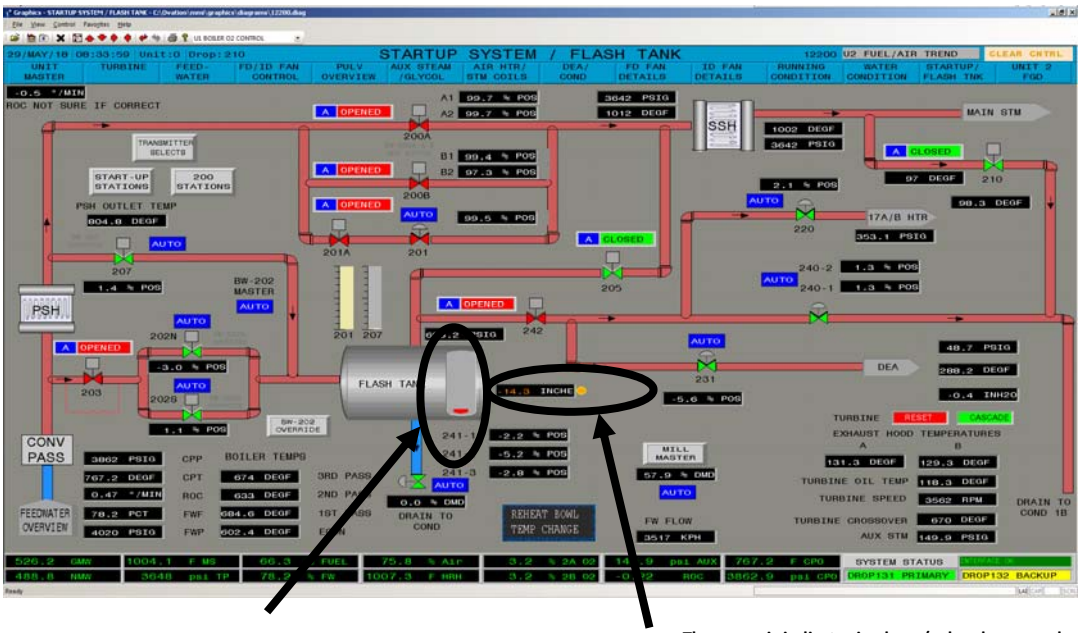
On other screens, yellow indicates an alarmed condition; on this screen, it is a status highlight color and is inconsistent with other uses of color to differentiate a status condition



Even when unselected, the button option should be readable. On this graphic, some are and some are not.



In a display of a list of items that can be highlighted, the items not currently highlighted should also be legible so the operator learns what they are and can see what to expect.



Flash Tank Low Level Alarm – The condition does not stand out on the graphic. The bar-type indicator gets smaller and less visible as the situation gets worse. It is smaller than other red elements signifying normal operation.

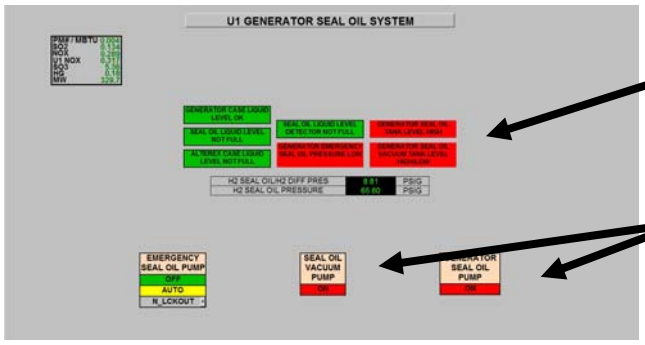
The numeric indicator in alarm (color change and circle) does not stand out compared to other elements on the screen showing "normal"

Slight difference only of color indicates an alarm condition

DEAERATOR LEVEL	8.0 FEET
DEAERATOR SHELL PRESS	95.8 PSIG
DEAERATOR INLET TEMP	255.3 DEG F
DEAERATOR OUTLET TEMP	326.2 DEG F
DEAERATOR INLET COND	0.06 Us/cm
DEAERATOR OUTLET COND	0.05 Us/cm
BFP FLOW	3727.8 KLB/HR
COND FLOW TO DEAERATOR	2985.8 KLB/HR

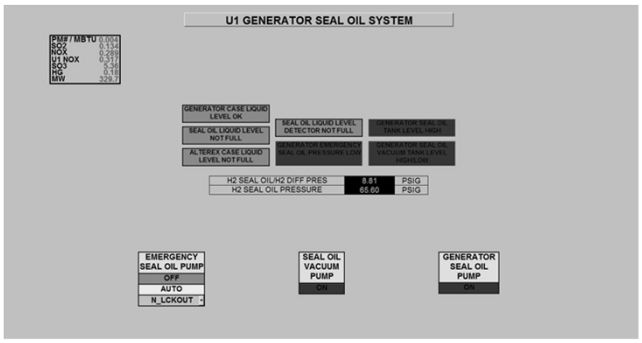
The yellow vessel liquid level is in alarm. Note that the lower the level is, the worse the alarm condition, but the yellow colored area will be getting smaller and less visible.

Note that an unbounded yellow number (yellow because it is in alarm) on a gray background has low contrast and is almost invisible.

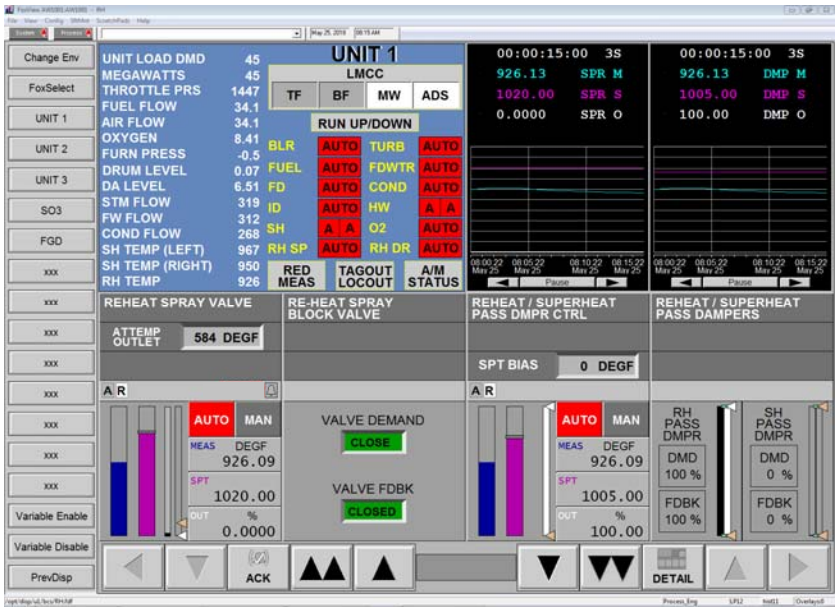


On this same screen, these three red items are in alarm…

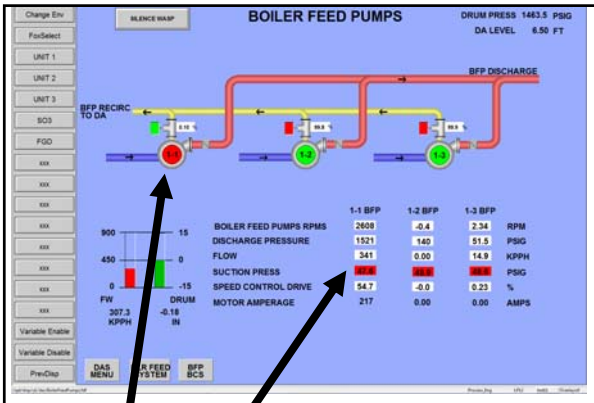
And these two red items are normal



Version of the screen as seen by someone with red-green color deficiency

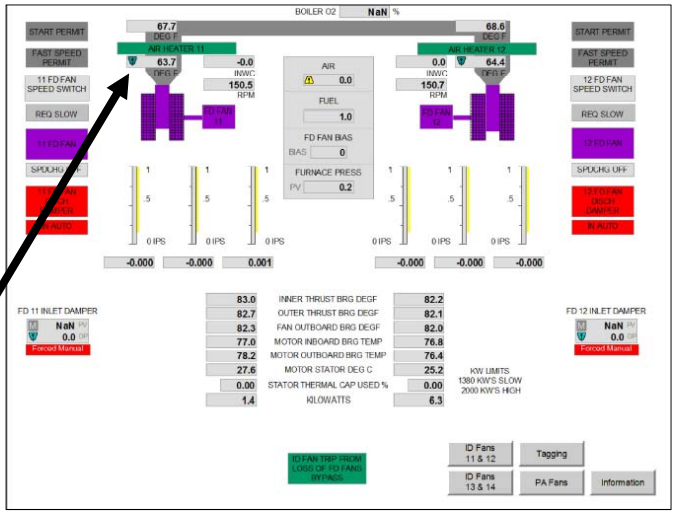


Here is the first view of a screen. It may or may not have an important alarm shown on it. In a few slides, another view of this same screen will be shown, with (or without) that alarm condition as the only difference. Can you spot which screen has the alarm?

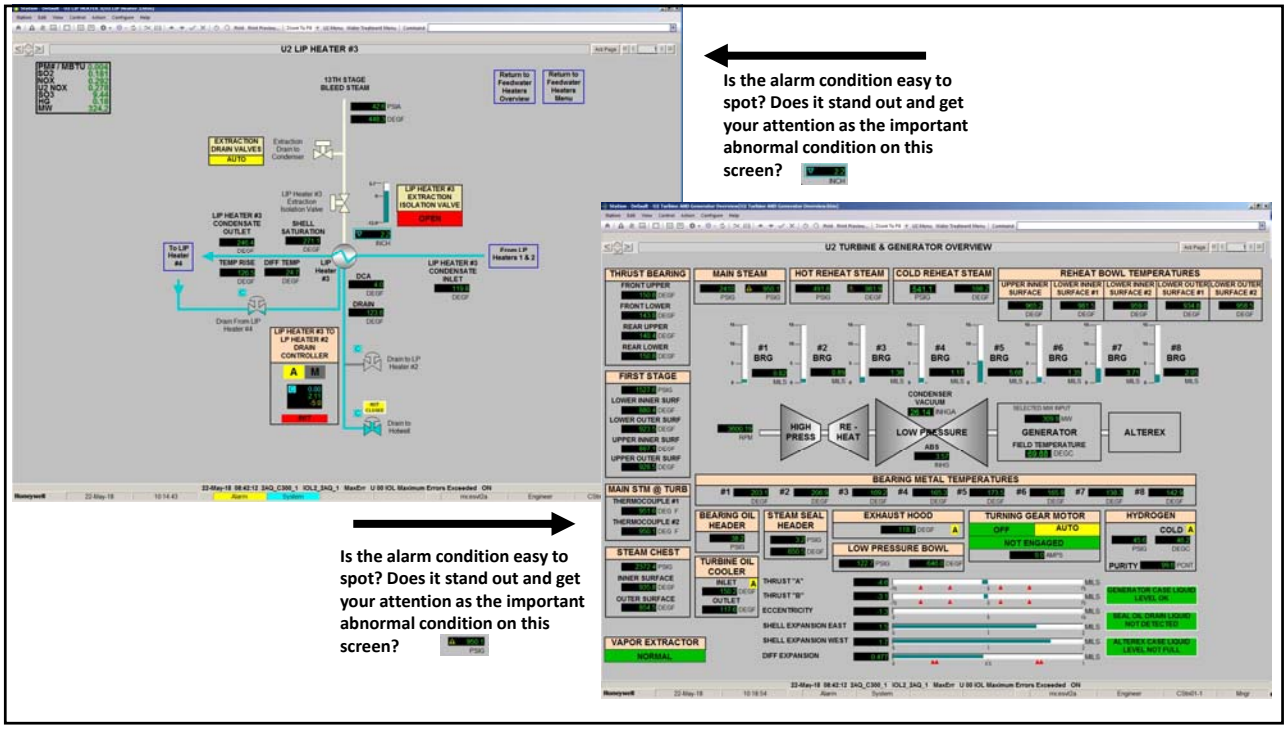


Not an alarm

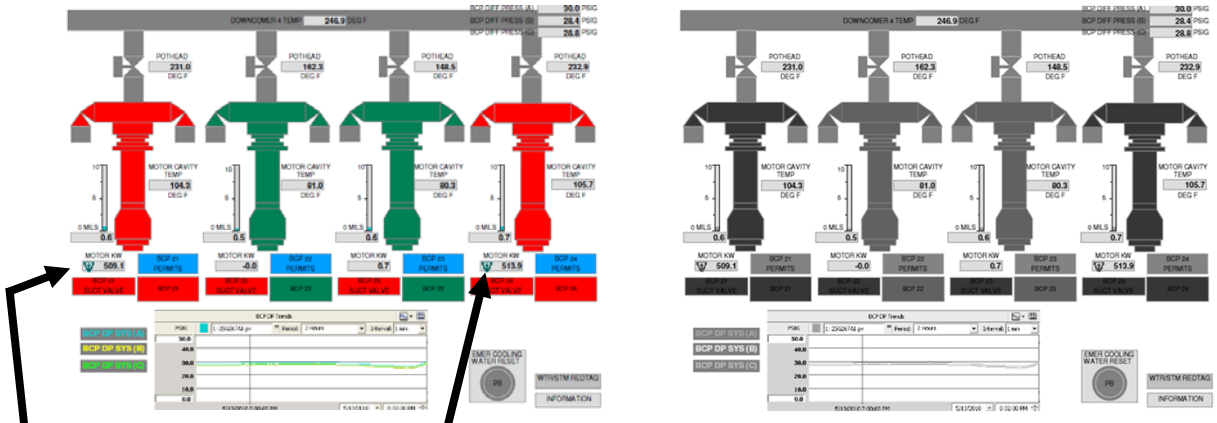
Alarm

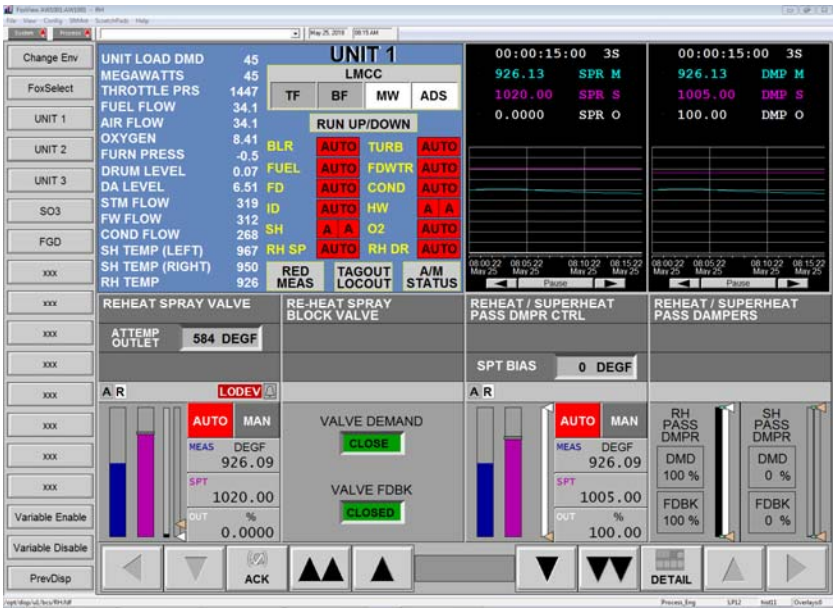


Alarm condition difficult to see, does not stand out.



An example of why red-green coding should be avoided:
The original graphic is on the left. On the right, it is simply decolored to grayscale, as someone with red-green color deficiency is viewing it. Brightness coding is a superior alternative.

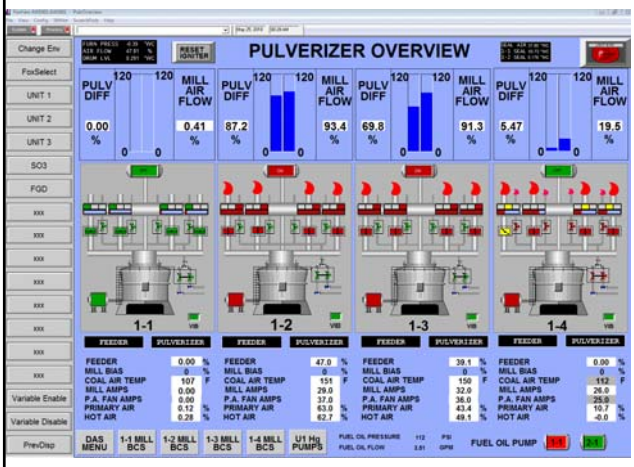


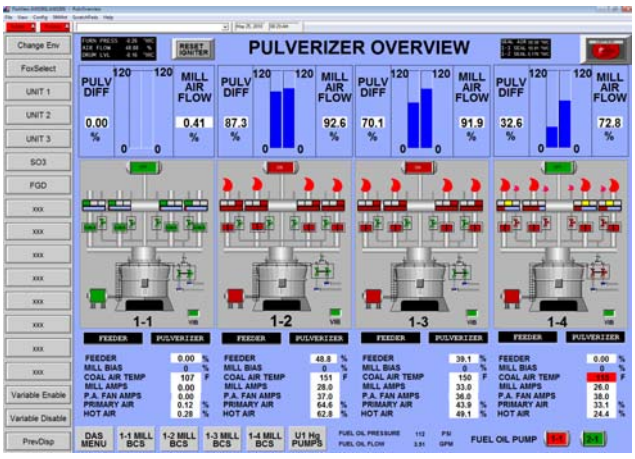


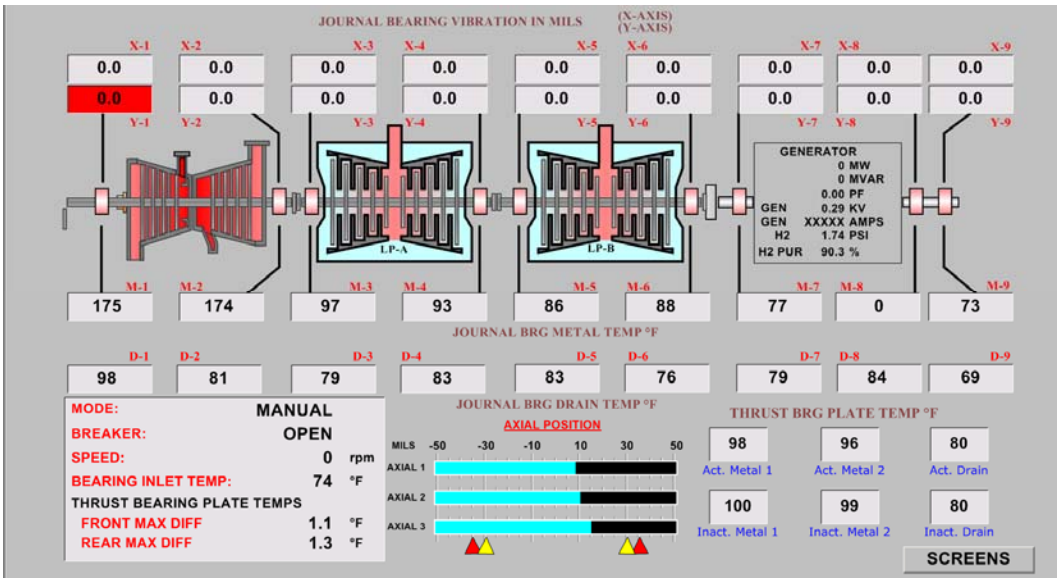
Here is the second view of the screen previously mentioned. Either it or the prior version has an important alarm displayed.

Having seen both, are you now certain which screen has the alarm?

Same screen, but two alarm conditions have changed.
Can you spot them? Would you notice them?

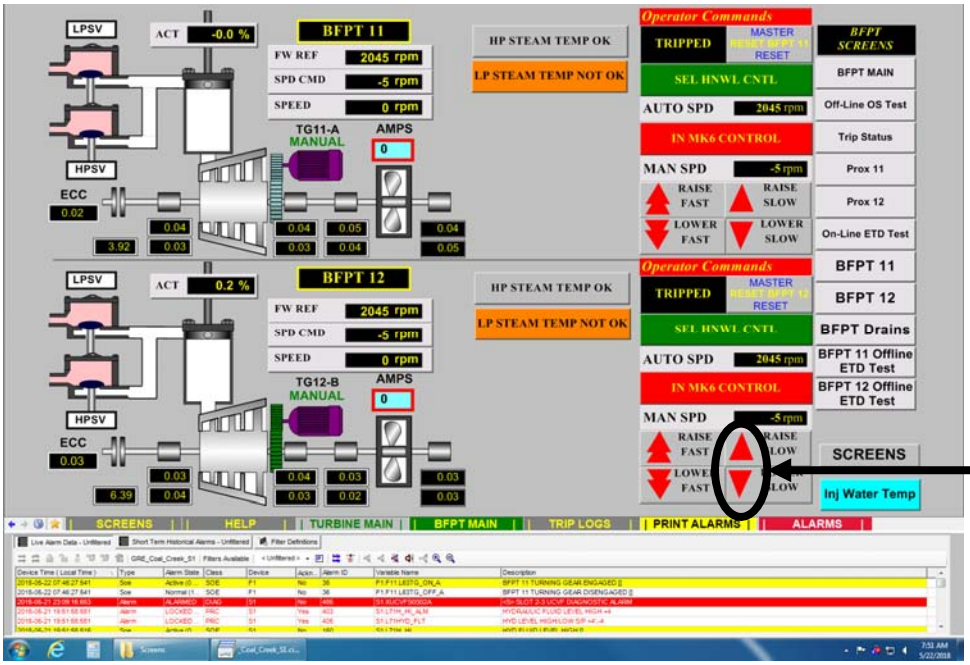






The display of live process values should always be distinguishable from plain text labels on the screen.

In this graphic, red and black and blue and brown are all used for text labels, and black is also used for process values.



The large variety of fonts, text sizes, text colors, variations, background colors, outline colors, unnecessary equipment detail, and 3D shading makes for a confusing depiction.

If red is used in any dynamic way to indicate status, its use for coloration of pushbuttons to raise or lower a setpoint does not conform with any paradigm.

For guidance on creating displays that maximize an operator's situation awareness and improves their ability to spot abnormal conditions and address them quickly, this free reference is recommended.

High Performance HMI White Papers (2015-2016)
https://www.pas.com/resources/white-papers
Part I: Understanding High Performance HMI Principles and Best Practices
Part II: High Performance HMI Case Studies, Recommendations, and Standards
Overcoming Common Objections to HPHMI Migration

The material includes a summation of an EPRI case study and dozens of depictions and examples.

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