Control System Studio Training - Alarm System Guidelines

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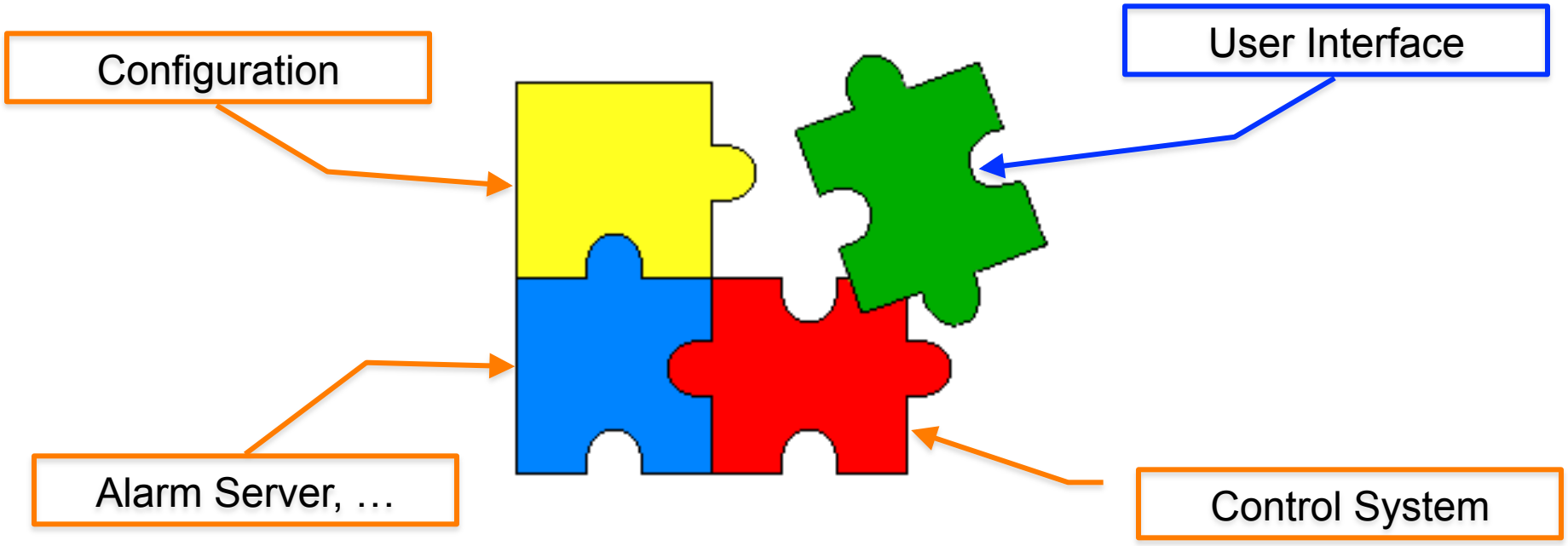
Alarm System Components



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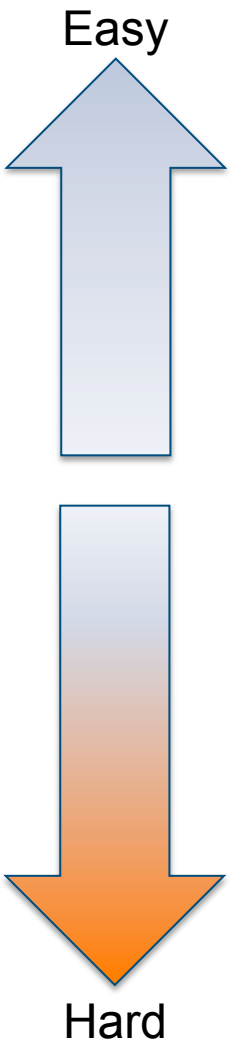
Levels Of Complexity

- **Use the Alarm System**
  - Control Room operator
- **Configure the Alarm System**
  - Certain operators, IOC engineers
- **Alarm System Setup**
  - CSS maintainer for site
- **Coming up with a good configuration**
  - Everybody



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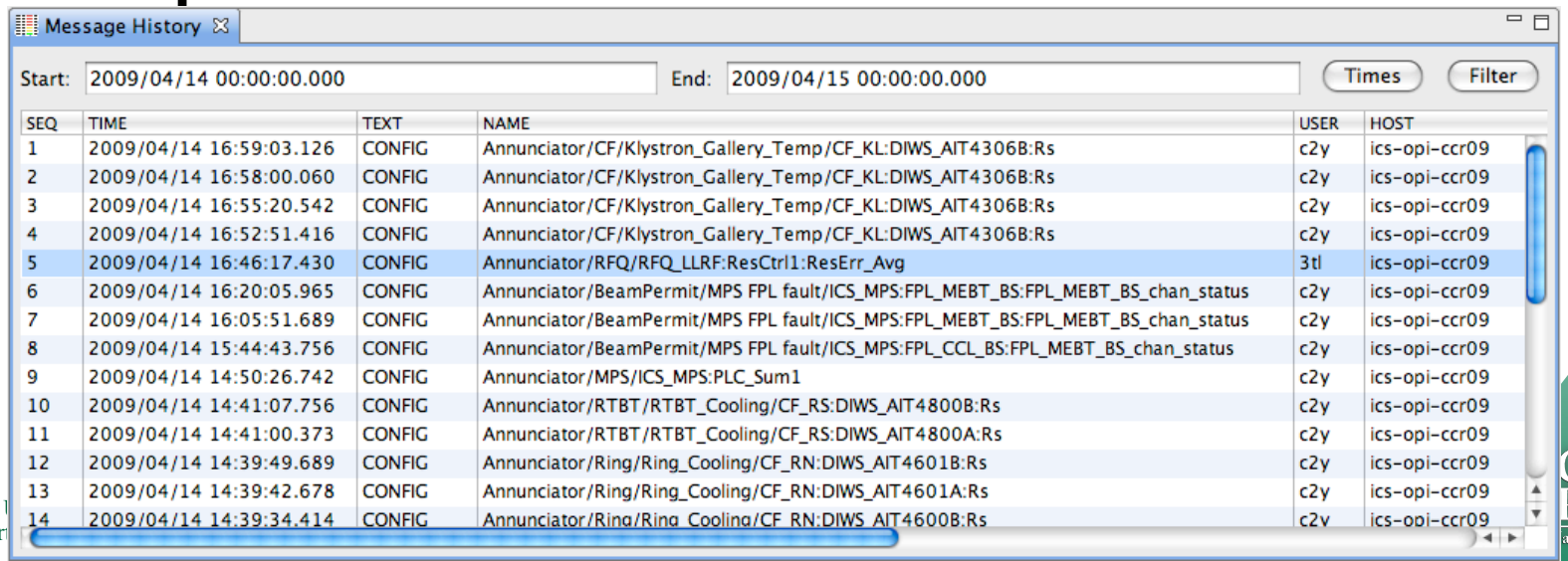
Logging

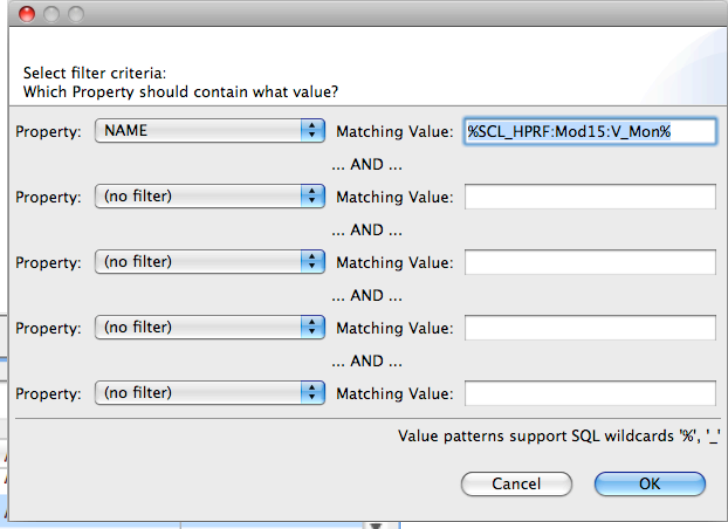
- ..into generic CSS log also used for error/warn/ info/debug messages
- Alarm Server: State transitions, Annunciations
- Alarm GUI: Ack/Un-Ack requests, Config changes
- Generic Message History Viewer
  - Example w/ Filter on TEXT=CONFIG

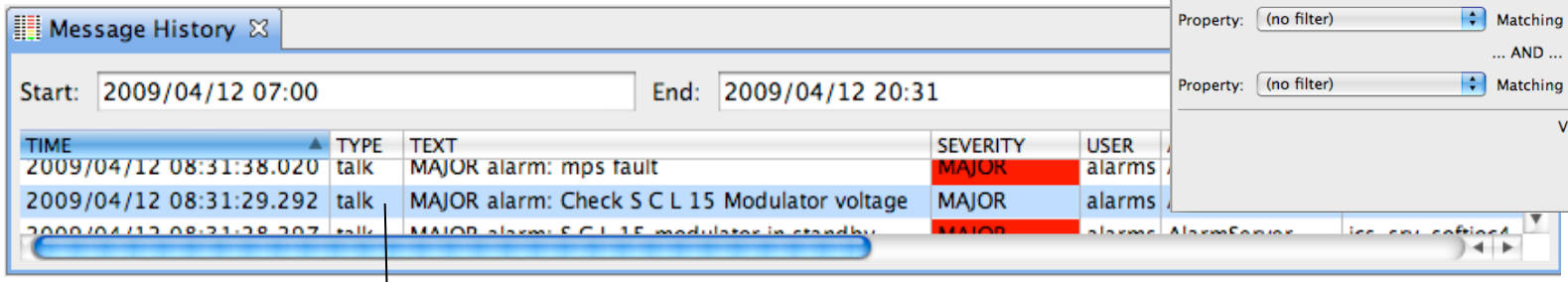


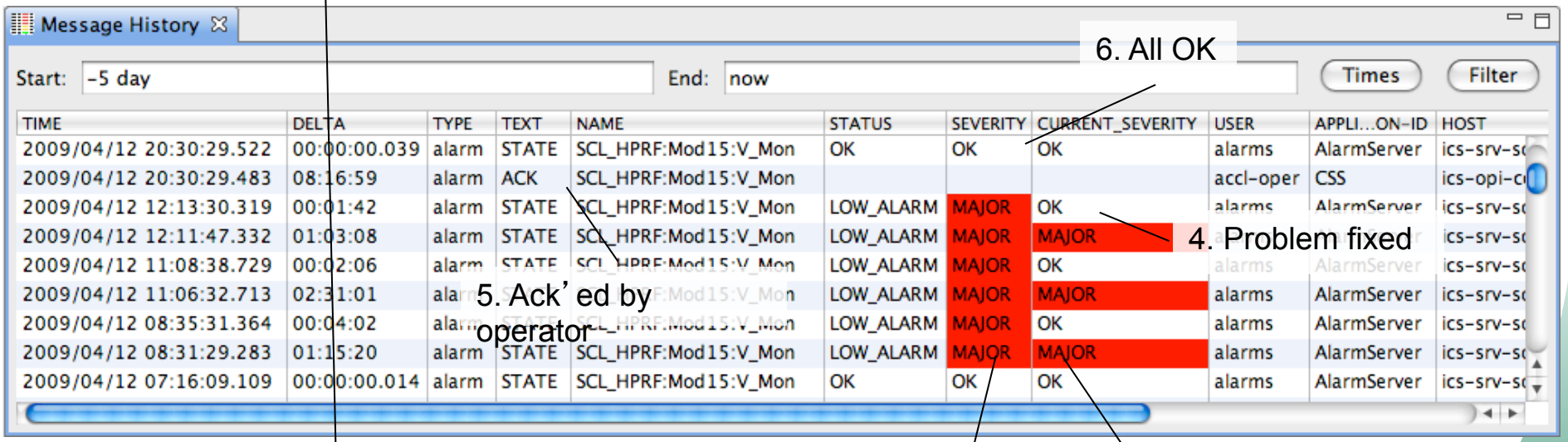
SEQ	TIME	TEXT	NAME	USER	HOST
1	2009/04/14 16:59:03.126	CONFIG	Annunciator/CF/Klystron_Gallery_Temp/CF_KL:DIWS_AIT4306B:Rs	c2y	ics-opi-ccr09
2	2009/04/14 16:58:00.060	CONFIG	Annunciator/CF/Klystron_Gallery_Temp/CF_KL:DIWS_AIT4306B:Rs	c2y	ics-opi-ccr09
3	2009/04/14 16:55:20.542	CONFIG	Annunciator/CF/Klystron_Gallery_Temp/CF_KL:DIWS_AIT4306B:Rs	c2y	ics-opi-ccr09
4	2009/04/14 16:52:51.416	CONFIG	Annunciator/CF/Klystron_Gallery_Temp/CF_KL:DIWS_AIT4306B:Rs	c2y	ics-opi-ccr09
5	2009/04/14 16:46:17.430	CONFIG	Annunciator/RFQ/RFQ_LLRF:ResCtrl1:ResErr_Avg	3tl	ics-opi-ccr09
6	2009/04/14 16:20:05.965	CONFIG	Annunciator/BeamPermit/MPS FPL fault/ICS_MPS:FPL_MEBT_BS:FPL_MEBT_BS_chan_status	c2y	ics-opi-ccr09
7	2009/04/14 16:05:51.689	CONFIG	Annunciator/BeamPermit/MPS FPL fault/ICS_MPS:FPL_MEBT_BS:FPL_MEBT_BS_chan_status	c2y	ics-opi-ccr09
8	2009/04/14 15:44:43.756	CONFIG	Annunciator/BeamPermit/MPS FPL fault/ICS_MPS:FPL_CCL_BS:FPL_MEBT_BS_chan_status	c2y	ics-opi-ccr09
9	2009/04/14 14:50:26.742	CONFIG	Annunciator/MPS/ICS_MPS:PLC_Sum1	c2y	ics-opi-ccr09
10	2009/04/14 14:41:07.756	CONFIG	Annunciator/RTBT/RTBT_Cooling/CF_RS:DIWS_AIT4800B:Rs	c2y	ics-opi-ccr09
11	2009/04/14 14:41:00.373	CONFIG	Annunciator/RTBT/RTBT_Cooling/CF_RS:DIWS_AIT4800A:Rs	c2y	ics-opi-ccr09
12	2009/04/14 14:39:49.689	CONFIG	Annunciator/Ring/Ring_Cooling/CF_RN:DIWS_AIT4601B:Rs	c2y	ics-opi-ccr09
13	2009/04/14 14:39:42.678	CONFIG	Annunciator/Ring/Ring_Cooling/CF_RN:DIWS_AIT4601A:Rs	c2y	ics-opi-ccr09
14	2009/04/14 14:39:34.414	CONFIG	Annunciator/Ring/Ring_Cooling/CF_RN:DIWS_AIT4600B:Rs	c2y	ics-opi-ccr09

Logging: Get timeline

- **Example: Filter on TYPE, PV**







6. All OK

4. Problem fixed

5. Ack'ed by operator

3. Alarm Server annunciates

2. Alarm Server latches alarm

1. PV triggers, clears, triggers again

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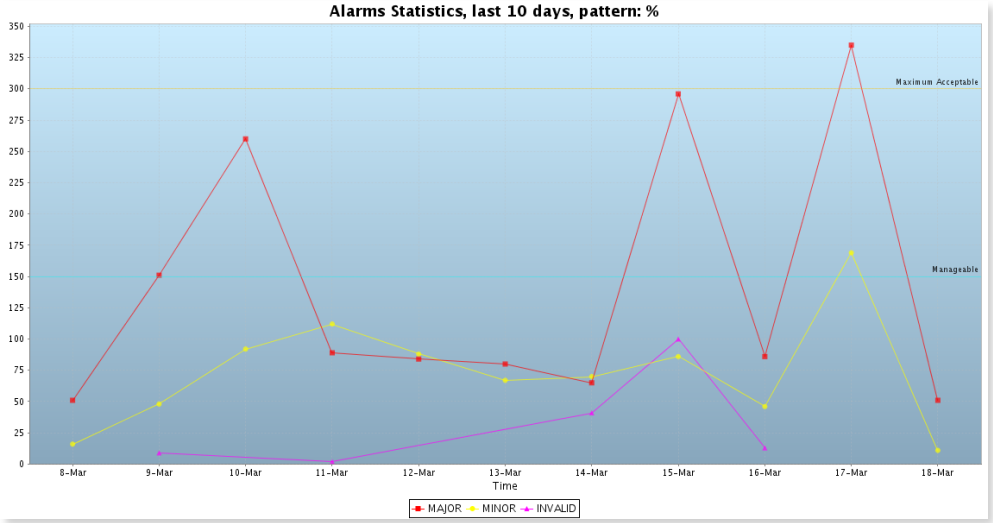
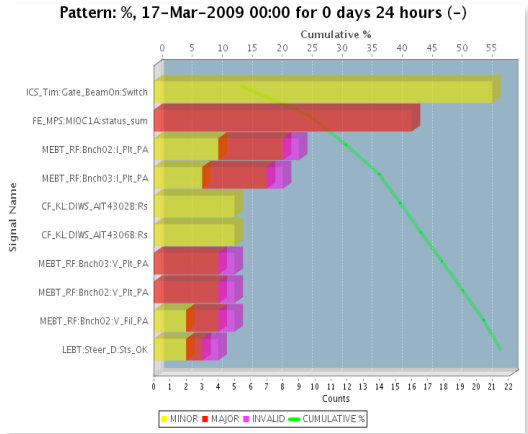
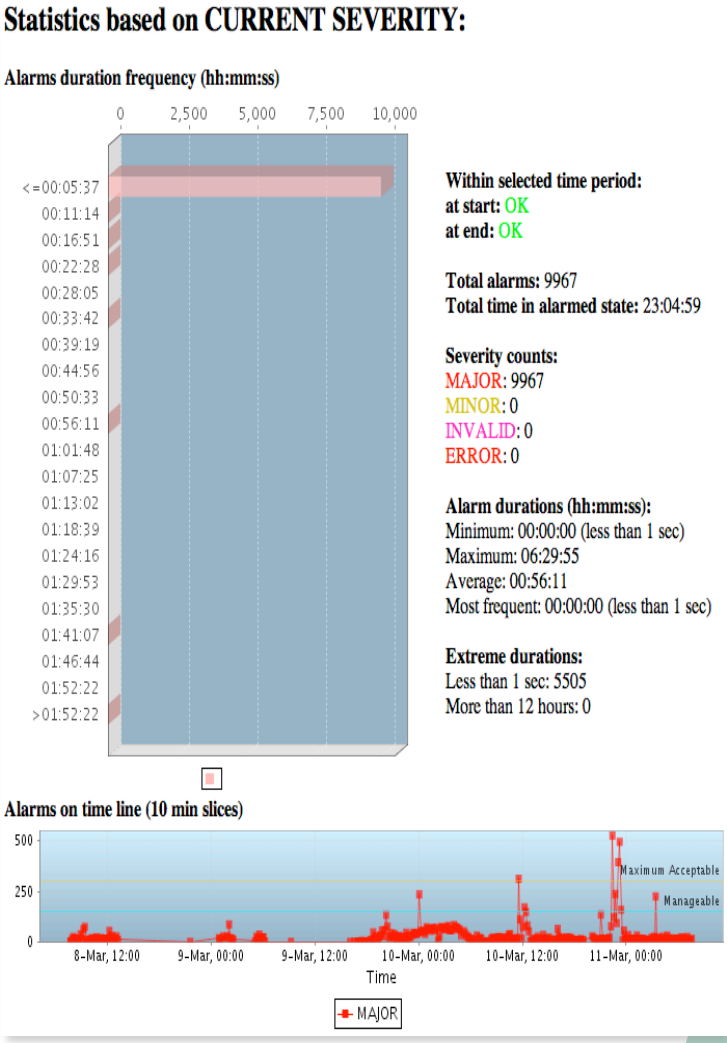
Web Report Examples







- **Anything is possible**
- **Examples from SNS**
  - **Code would need some rework to port to other sites**

Alarms Active 24.0 h or more

#	PV Name	Description	Path	Alarm Time	...Duration [HH:MM:SS]	Severity	Alarm Message	Current Severity
1	MEBT_CHOP:PS_1:V	mebbit chopper power supply one voltage fault	/Annunciator/MEBT	2009-03-16 13:17:35	42:58:57	MAJOR_ACK	LOLO_ALARM	MAJOR
2	MEBT_CHOP:PS_2:V	mebbit chopper power supply two voltage fault	/Annunciator/MEBT	2009-03-16 13:17:35	42:58:57	MAJOR_ACK	LOLO_ALARM	MAJOR
3	HEBT_Coll:CT2:Cond	HEBT_Coll:CT2:Cond	/Annunciator/HEBT/HEBT_Cooling	2009-03-14 20:22:50	83:53:42	INVALID_ACK	READ_ALARM	MAJOR
4	TMod:Summary_MPS:Alarm	Moderator System MPS Trip	/Annunciator/Target/CMS	2009-02-07 09:25:09	934:51:23	INVALID_ACK	READ_ALARM	INVALID

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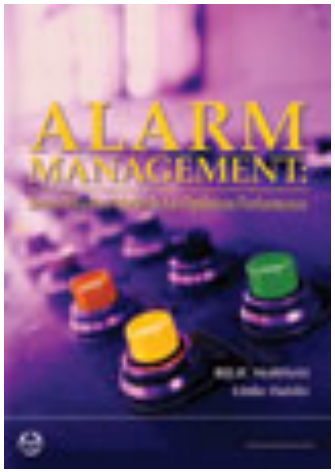
Creating a good Alarm Configuration



**B. Hollifield, E. Habibi,
"Alarm Management:
Seven Effective Methods
for Optimum Performance", ISA, 2007**

Hard

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Alarm Philosophy

Goal:

Help operators take correct actions

- Alarms with guidance, related displays
- Manageable alarm rate (<150/day)
- Operators will respond to every alarm (corollary to manageable rate)

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What's a valid alarm?

- ***DOES IT REQUIRE IMMEDIATE OPERATOR ACTION?***
  - **What action? Alarm guidance!**
    - **Not "make elog entry", "tell next shift", …**
  - **Consequence of not reacting?**
  - **How much time to react?**

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How are alarms added?

- **Alarm triggers: PVs on IOCs**
  - **But more than just setting HIGH, HIHI, HSV, HHSV**
  - **HYST is good idea**
  - **Dynamic limits, enable based on machine state,...**

  <u>Requires thought, communication, documentation</u>
- **Added to alarm server with**
  - **Guidance: How to respond**
  - **Related screen: Reason for alarm (limits, …), link to screens mentioned in guidance**
  - **Link to rationalization info (wiki)**

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Example: Elevated Temp/Press/Res.Err./…

- Immediate action required?
  - Do something to prevent interlock trip
- Impact, Consequence?
  - Beam off: Reset & OK, 5 minutes?
  - Cryo cold box trip: Off for a day?
- Time to respond?
  - 10 minutes to prevent interlock?

- MINOR? MAJOR?
- Guidance: “Open Valve 47 a bit, …”
- Related Displays: Screen that shows Temp, Valve, …

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Avoid Multiple Alarm Levels

- Analog PVs for Temp/Press/Res.Err./…:
  - Easy to set LOLO, LOW, HIGH, HIHI
- Consider:
  - Do they require *significantly different* operator actions?
  - Will there be a lot of time after the HIGH to react before a follow-up HIHI alarm?
- In most cases, HIGH & HIHI only double the alarm traffic
  - Set only HSV to generate single, early alarm
  - Adding HHSV alarm assuming that the first one is ignored only worsens the problem

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Bad Example: Old SNS 'MEBT' Alarms

- **Each amplifier trip: ≥ 3 ~identical alarms, no guidance**
- **Rethought w/ subsystem engineer, IOC programmer and operators: 1 better alarm**

#	Date	Type	Name	Severity	TEXT
1	2009-03-16 13:46:20.255	talk		MAJOR	MAJOR alarm: MEBBIT two power amplifier trip
2	2009-03-16 13:46:19.962	talk		MINOR	MINOR alarm: MEBBIT two power amplifier trip
3	2009-03-16 13:45:56.241	talk		MAJOR	MAJOR alarm: S C L 18 modulator in standby
4	2009-03-16 13:45:25.963	talk		MAJOR	MAJOR alarm: MEBBIT two power amplifier trip
5	2009-03-16 13:45:25.891	talk		MINOR	MINOR alarm: MEBBIT two power amplifier trip
6	2009-03-16 13:45:25.884	talk		MAJOR	MAJOR alarm: MEBBIT two power amplifier trip
7	2009-03-16 13:23:09.202	talk		MINOR	MINOR alarm: DTL 3 RCCS CV one valve open limit is exceeded

MEBT_RF:Bnch02:V_Plt_PA	MEBBIT two power amplifier trip
MEBT_RF:Bnch02:V_Fil_PA	MEBBIT two power amplifier trip
MEBT_RF:Bnch02:I_Plt_PA	MEBBIT two power amplifier trip

ky9 Preferences

AlarmHandling/ HPRF_PA_Alarm

FrontPage » AlarmHandling/RFQVacAlarm » AlarmHandling » AlarmHandling/Alarms » HPRF_PA_Alarm

FrontPage | RecentChanges | FindPage | HelpContents | LogOut | HPRF_PA_Alarm

Edit (Text) Comments Info Add Link Attachments More Actions:

Alarm PV: MEBT_RF:Bnch*:V_Plt_PA

Purpose of Alarm

Indicates MEBT high power RF amplifier problem: Plate voltage dropped, so amplifier won't be able to provide sufficient RF to cavity.

Operator Guidance

- Verify that the plate voltage is indeed off.
- Turn OFF the plate voltage through EPICS.
- At the amplifier, observe the fuses to determine which phase/phases blew.
- Change all three fuses according to procedure.
- Turn on plate voltage.
- Ramp up RF power slowly.
- After two fuse changes, call for RF support.

Failure Consequence

Minor Consequence: Beam will be off while MEBT is off, but recovery is usually quick as soon as for example the fuses are replaced.

Operator Response Time Available

The sooner operators respond, the sooner beam is back up. Since this might require calling RF personnel, the sooner they're called, the better.

Contacts

Mark Middendorf, Mike Clemmer for MEBT RF,
Alan Justice for IOC.

Alarm Table | PV Fields Viewer

PV Name: MEBT_RF:Bnch02:V_Plt_PA

Record Type: ai IOC Name: fe-ctl-ioc2

Boot Date: 2009-1-23.10.40. 6. 0 Boot File: nebt/R2-2-1/db/rfq-mebt.db

Field	DBD Type	Value in File	Live Value
VAL			
LINR	DBF_MENU	LINEAR	LINEAR
HSV	DBF_MENU	MINOR	MINOR
HHSV	DBF_MENU	MAJOR	MAJOR
MDEL	DBF_DOUBLE	0.005	0.00
INP	DBF_INLINK	@0xe 1 3 6	@0xe 1 3 6
EGU	DBF_STRING	kV	kV
LOLO	DBF_DOUBLE	6.5	5.00
LSV	DBF_MENU	MINOR	MINOR
PREC	DBF_SHORT	2	2
LOPR	DBF_DOUBLE	0.0	0.00
DESC	DBF_STRING	PA Plate V	PA Plate V
SCAN	DBF_MENU	I/O Intr	I/O Intr
DTYP	DBF_DEVICE	Group3 C	Group3 C
HOPR	DBF_DOUBLE	10.0	10.00
EGUL	DBF_DOUBLE	-10.75	-10.75
LOW	DBF_DOUBLE	6.8	5.20
LLSV	DBF_MENU	MAJOR	MAJOR
EGUF	DBF_DOUBLE	10.75	10.75
HIHI	DBF_DOUBLE	7.5	7.50
HIGH	DBF_DOUBLE	7.2	7.20

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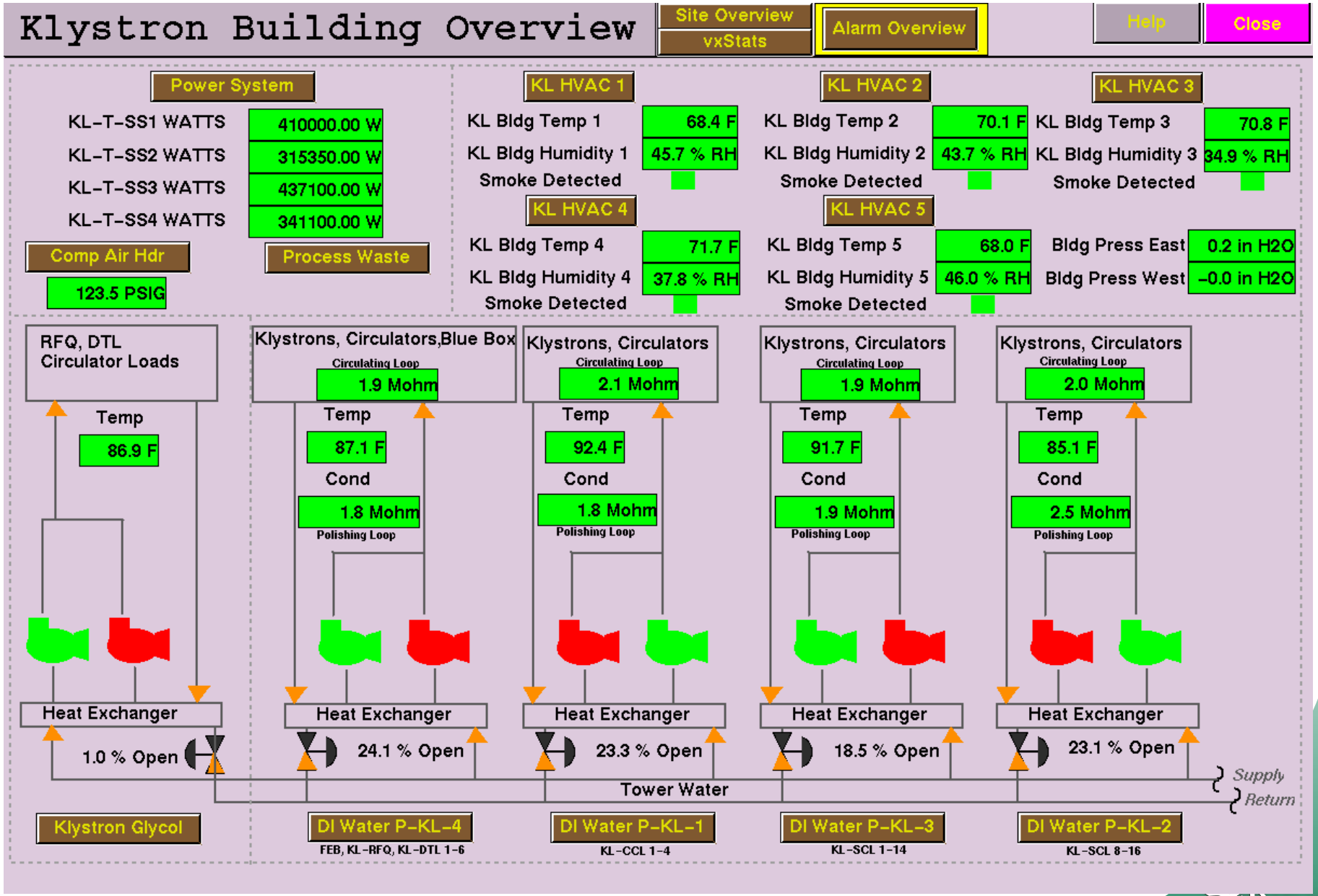
Alarms for Redundant Pumps



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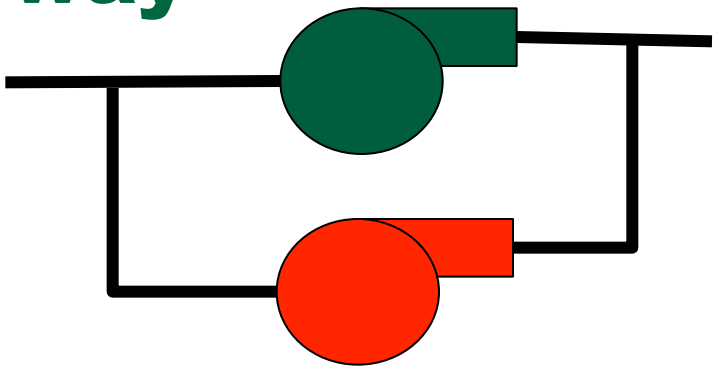
Alarm Generation: Redundant Pumps the wrong way



- Control System
  - Pump1 on/off status
  - Pump2 on/off status

- Simple Config setting: Pump Off => Alarm:
  - It's normal for the 'backup' to be off
  - Both running is usually bad as well
    - Except during tests or switchover
  - During maintenance, both can be off

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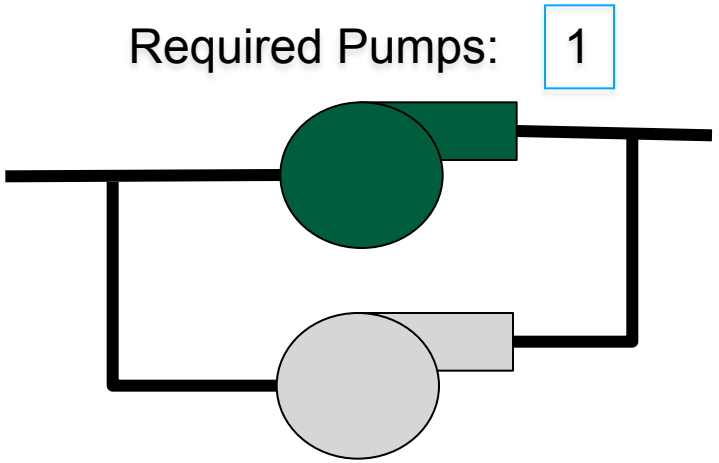
Redundant Pumps



- Control System
  - Pump1 on/off status
  - Pump2 on/off status
  - Number of running pumps
  - Configurable number of desired pumps

- Alarm System: Running == Desired?
  - … with delay to handle tests, switchover
- Same applies to devices that are only needed on-demand

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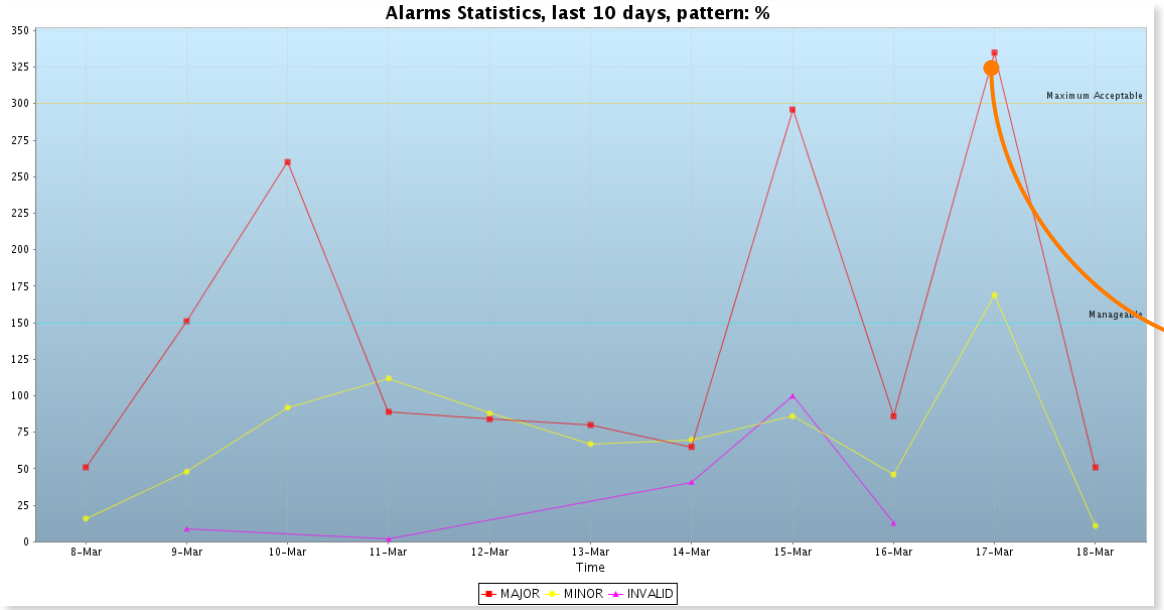
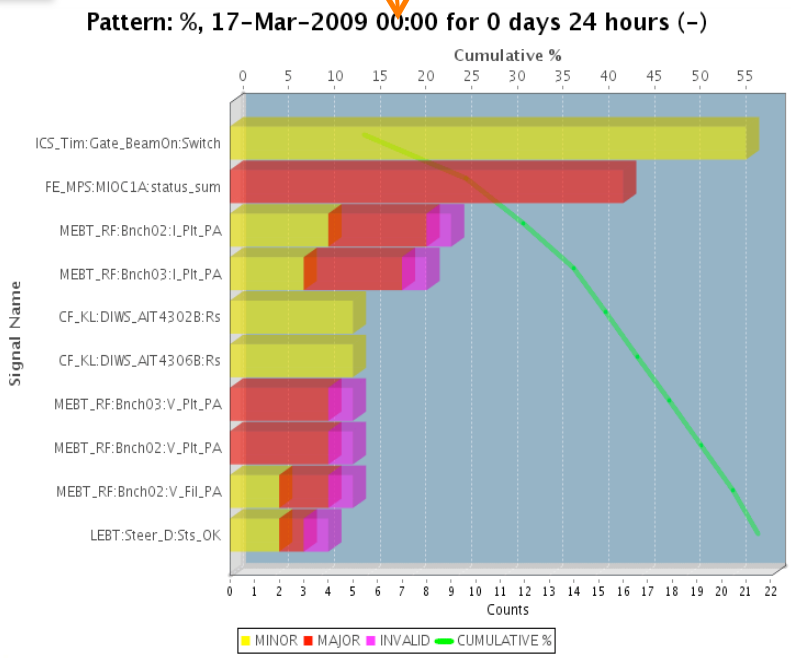
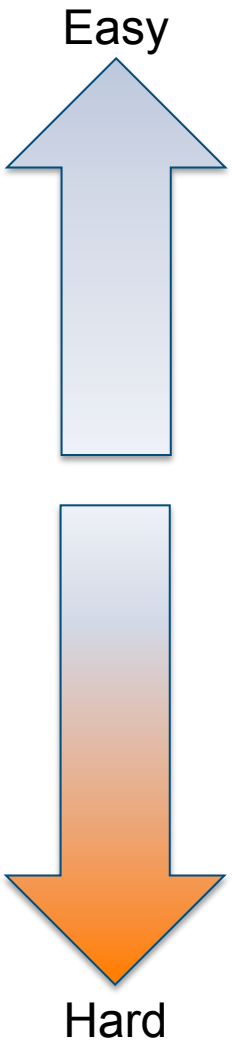
Weekly Review: How Many? Top 10?





Summary

- **Easy to use**
  - **Check alarms in Table, Tree, Panel**
  - **Fix it: Read Guidance, use Display Links**
  - **✔Acknowledge**
- **Configuration**
  - **Can be changed online**
  - **Operators can update guidance or add better display links**
- **Alarm System Setup**
  - **Somewhat Involved, but only once**
- **Coming up with a good configuration**
  - **Hard**



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