Intelligent Plant™

Inform, Enhance, Grow. Intelligently.

Alarm Analysis -User Guide

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01/05/2019	0.1	User Guide (for App Store)	GM	BJN

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1 Overview

1.1 What is Alarm Management?

Alarm Management is the application of human factors (or ergonomics as the field is referred to outside the U.S.) along with instrumentation engineering and systems thinking to manage the design of an alarm system to increase its usability. Most often the major usability problem is that there are too many alarms annunciated in a plant upset, commonly referred to as alarm flood (since it is so similar to a flood caused by excessive rainfall input with a basically fixed drainage output capacity). However, there can also be other problems with an alarm system such as poorly designed alarms, improperly set alarm points, ineffective annunciation, unclear alarm messages, etc.

Poor alarm management is one of the leading causes of unplanned downtime, contributing to over $20B in lost production every year, and of major industrial incidents such as the one in Texas City. Developing good alarm management practices is not a discrete activity, but more of a continuous process (i.e., it is more of a journey than a destination).

Alarm Management is usually necessary in a process manufacturing environment that is controlled by an operator using a control system, such as a DCS or a programmable logic controller (PLC). Such a system may have hundreds of individual alarms that up until very recently have probably been designed with only limited consideration of other alarms in the system. Since humans can only do one thing at a time and can pay attention to a limited number of things at a time, there needs to be a way to ensure that alarms are presented at a rate that can be assimilated by a human operator, particularly when the plant is upset or in an unusual condition. Alarms also need to be capable of directing the operator's attention to the most important problem that he or she needs to act upon, using a priority to indicate degree of importance or rank, for instance.

Intelligent Plant's Alarm Analysis is a tool to:

- Benchmark an asset against latest EEMUA 191 guidelines. (Also ISA 18.02, IEC 62682).
- Benchmark assets against each other
- Identify problem tags
- Determine effectiveness of possible solutions

1.2 What is the Industrial App Store?

Since Jan 1 2016, this is the first and only truly open and secure IIoT portal which will host applications from any vendor or developer.

The Industrial App Store makes your Plant data available to the growing number of apps that are in the Industrial App Store. Big Data Apps, Analytics, Machine Learning, Downtime reduction – Equipment Fault diagnosis, Root Cause Analysis (RCA) and many other problems are solved in the App Store where multiple vendors can make their capabilities available to industry.

With an App Store Connection apps connect directly to your data. No need for time-consuming uploads. Your valuable data remains securely in your site.

Alarm Analysis from Intelligent Plant is just one of a growing number of apps available in the Industrial App Store. By connecting your data to the App Store, you can immediately take advantage of advanced data visualization and analytic tools from multiple vendors.

To see what other apps are available, go to https://appstore.intelligentplant.com

1.3 Document Purpose

The following document is designed for new users of Alarm Analysis and the App Store.

It is broken into 3 distinct parts:

- ***Alarm Analysis - Getting Started***
  Instructions on how to log in to Alarm Analysis
- ***Alarm Analysis – Reports in Detail***
  Guidance on operating and understanding all Alarm Analysis reports.
- ***Alarm Analysis - Terminology***
  A reference of Alarm Analysis terms and phrases employed in the field of Alarm Analysis.

2 Alarm Analysis - Getting Started

2.1 Log on to the App Store

Select this link **appstore.intelligentplant.com** to log into the Industrial App Store.

If your organization is registered with the App Store, log in with your work account. Alternatively, Google or LinkedIn can also be used.

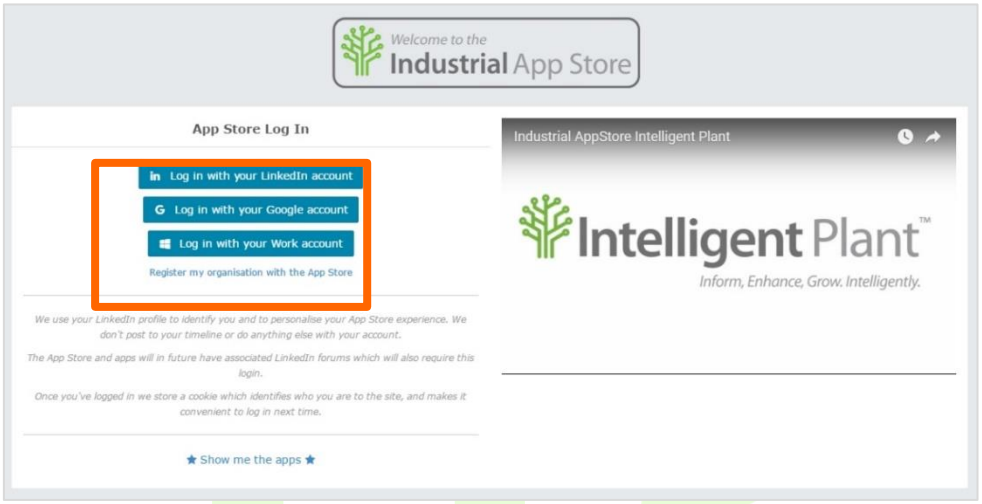


Figure 1: Log on to the App Store

2.2 App Store Credits

Reports must be purchased using App Store Credits.

Your current Credit balance is displayed on the page-top banner. If this is the first time you've logged on, it will most likely read "0.00".

If your organization is registered with the App Store, they may have a credit-pool for employee use, in which case contact your App Store Connect owner and request credits.

Otherwise, credits may be purchased from the App Store Top Up page:
https://appstore.intelligentplant.com/Home/Pricing

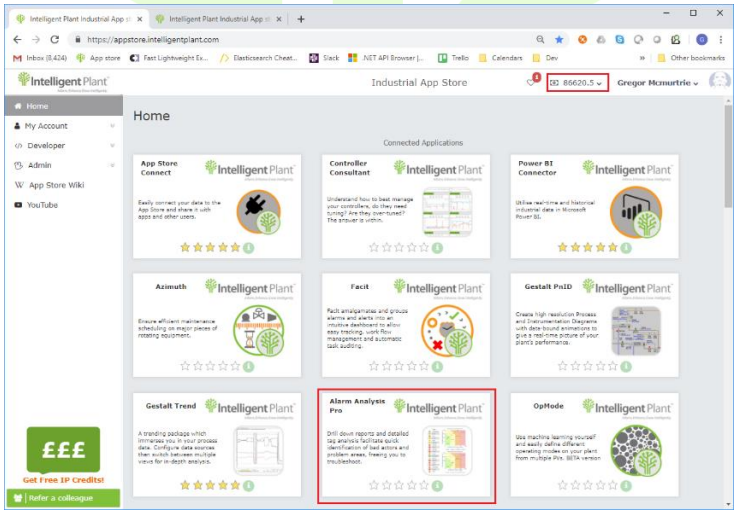


Figure 2: App Store Credit Balance

2.3 Open Alarm Analysis

On the Industrial App Store home page select **Alarm Analysis Pro**

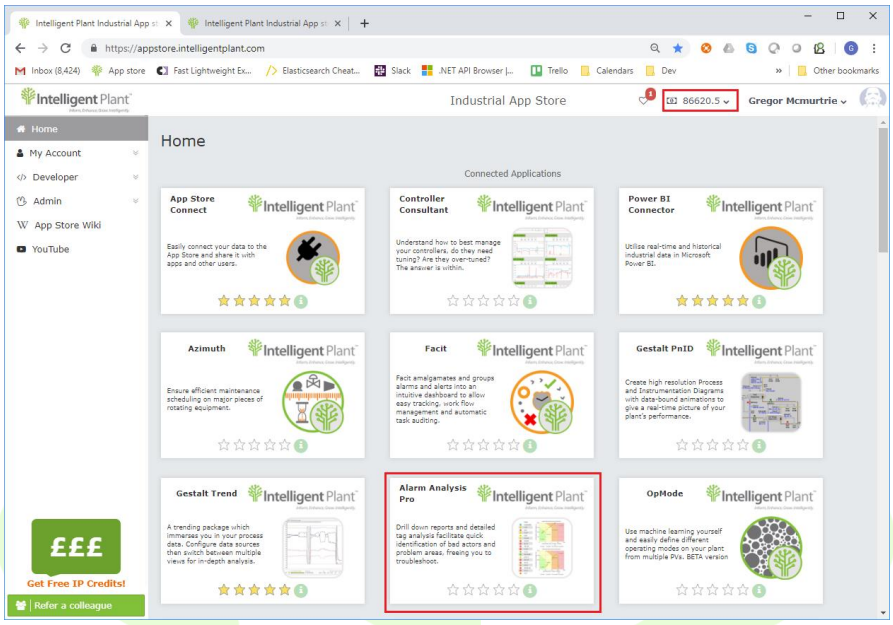


Figure 3: Alarm Analysis Postcard

2.4 Authorize Alarm Analysis to Connect to Data Sources

The first time you log on to Alarm Analysis it requests permission to connect to data.

Click "Choose Data Sources" and select required data sources. By default, a demo data source is pre-selected.

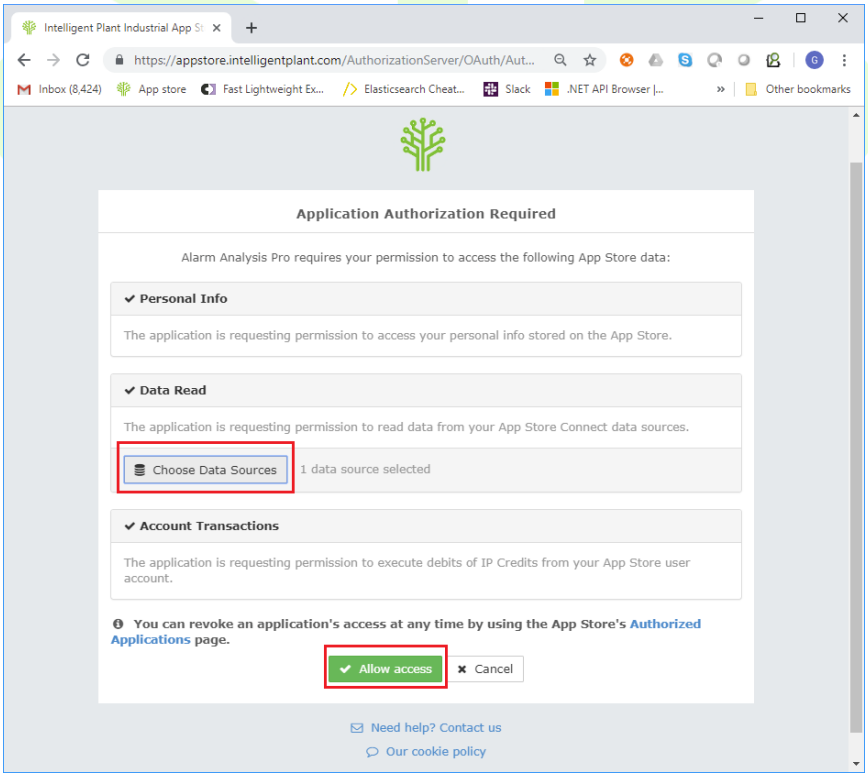


Figure 4: Application Authorization

2.5 Connect my Data

Demo data sources are available, but your own data is more interesting.

If Alarm Analysis detects you don't have other data sources, it will prompt you with instructions on configuring your own Alarm & Event data source. This is a bigger configuration task and outside the scope of this document. Again, contact your App Store Connect owner.

Either proceed to browse demo data source, or if your organization has installed an App Store Connection, request access to your organization's Alarm Analysis data sources.

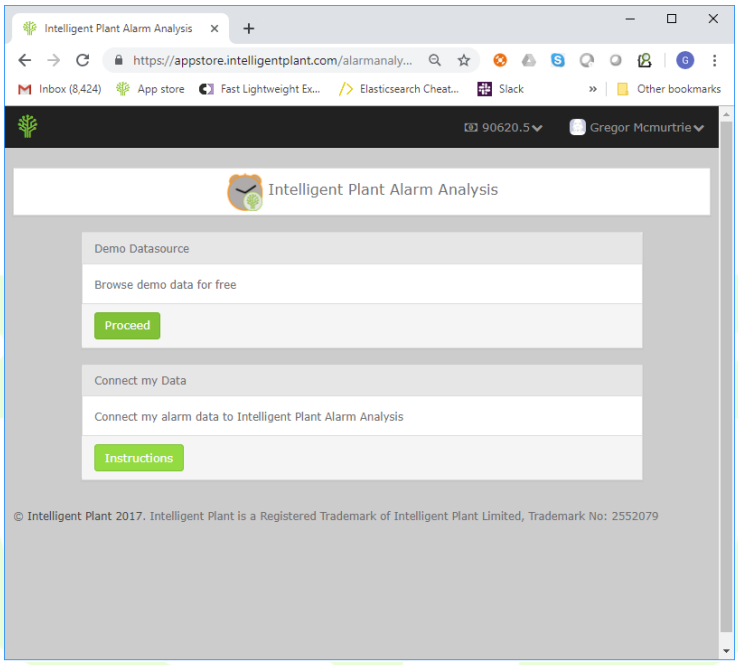


Figure 5: Connect my Data Prompt

2.6 Select Asset

Alarm Analysis defaults to first available asset.

To select an alternative asset, open the Asset Tree and expand the list using arrows.

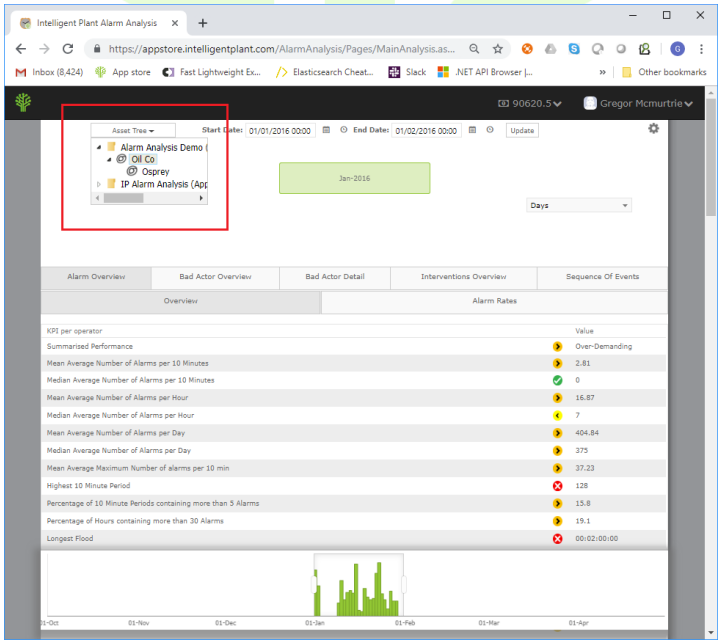


Figure 6: Alarm Analysis Asset Tree

2.7 Manage Data Sources

At a later date, to authorize Alarm Analysis connection to further data sources, select "Manage Data Sources" from App Store banner.

You may wish to remove the Demo Data Source so that only your own assets are displayed.

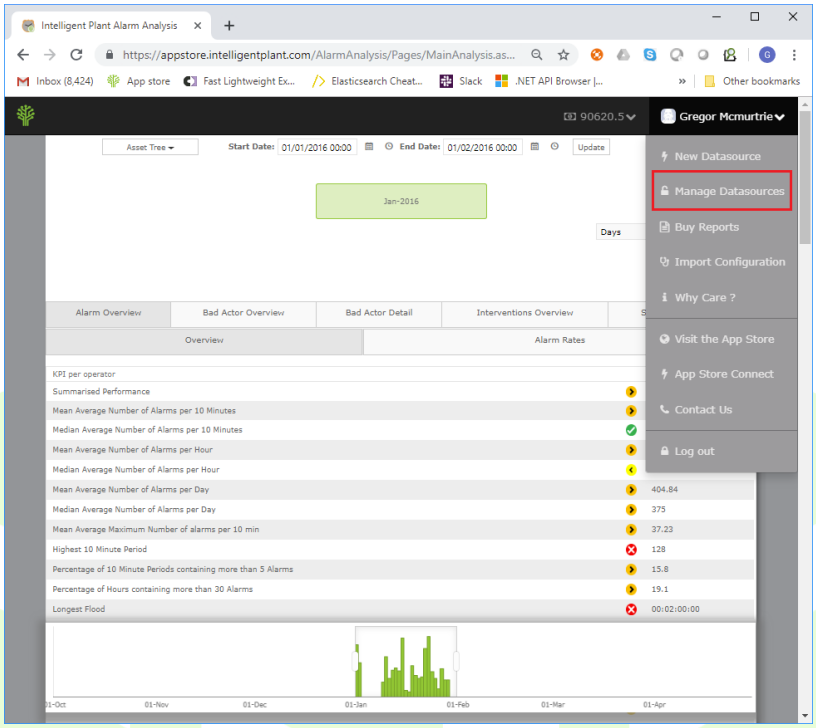


Figure 7: Manage Data Sources

2.8 Purchase Reports

Advanced Alarm Analysis reports must be purchased. Prior to purchase, an App Store "shopping bag" icon indicates a purchase is necessary. Select the icon to proceed.

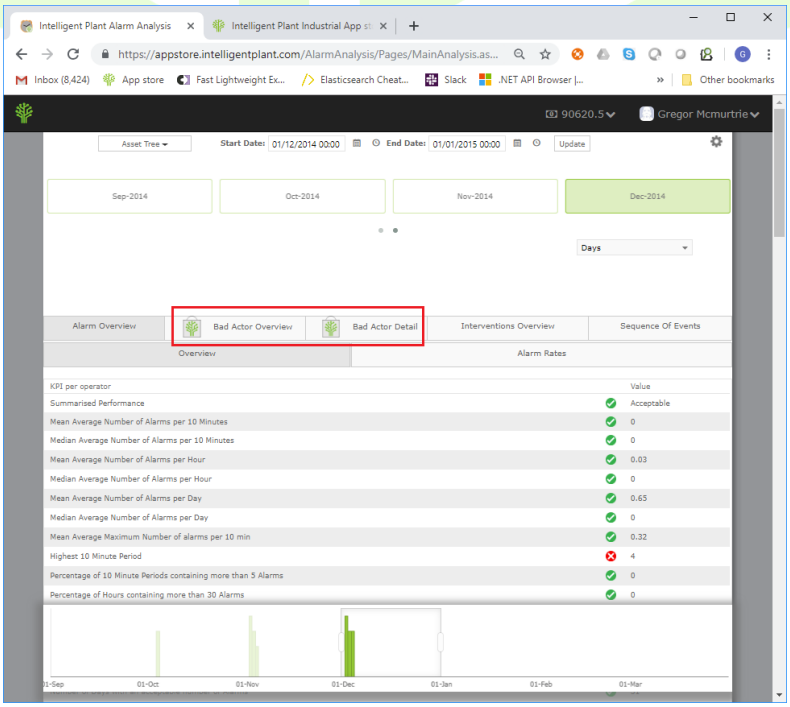


Figure 8: Purchase Reports

Before purchasing, you are presented with some example reports (so you can try before you buy).

If you decide to go ahead with purchase, follow on-screen instruction.

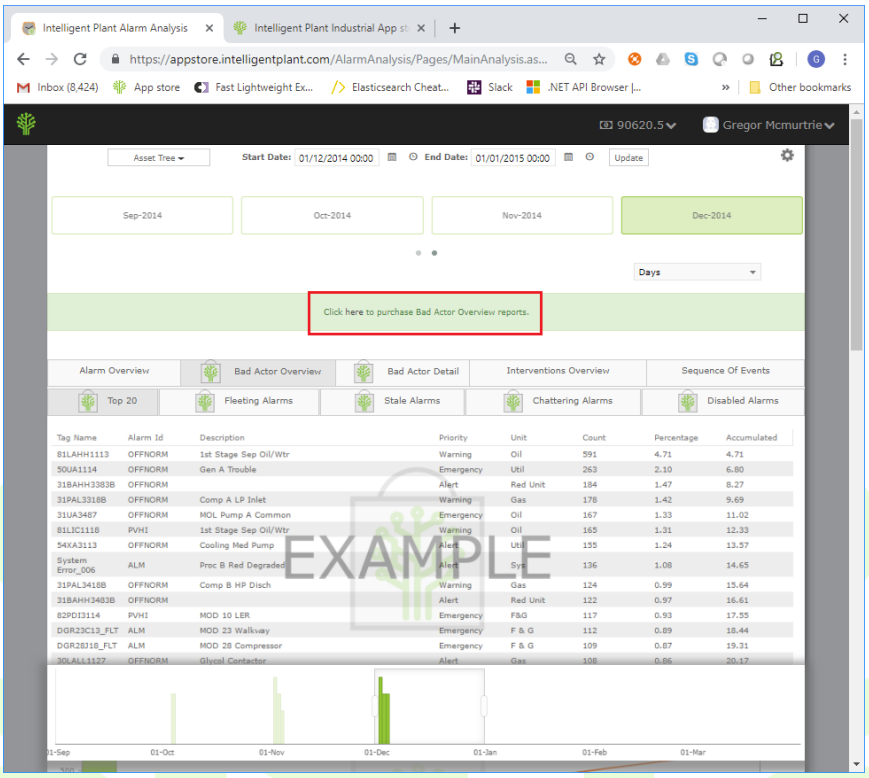


Figure 9: Report Examples

A number of purchase options are presented. Select "Alarm Analytics" for full reporting function.

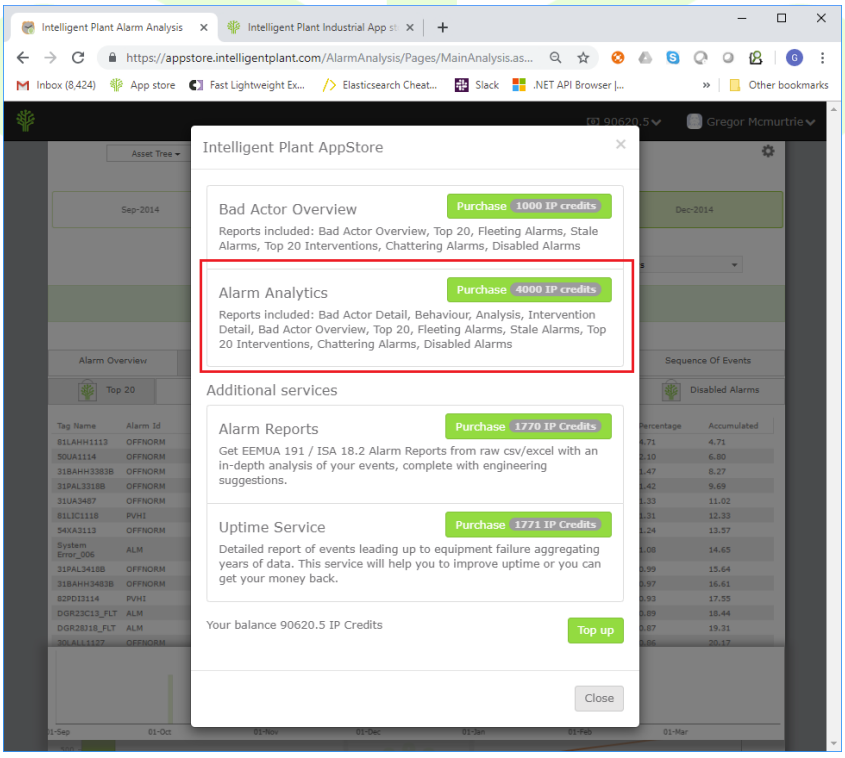
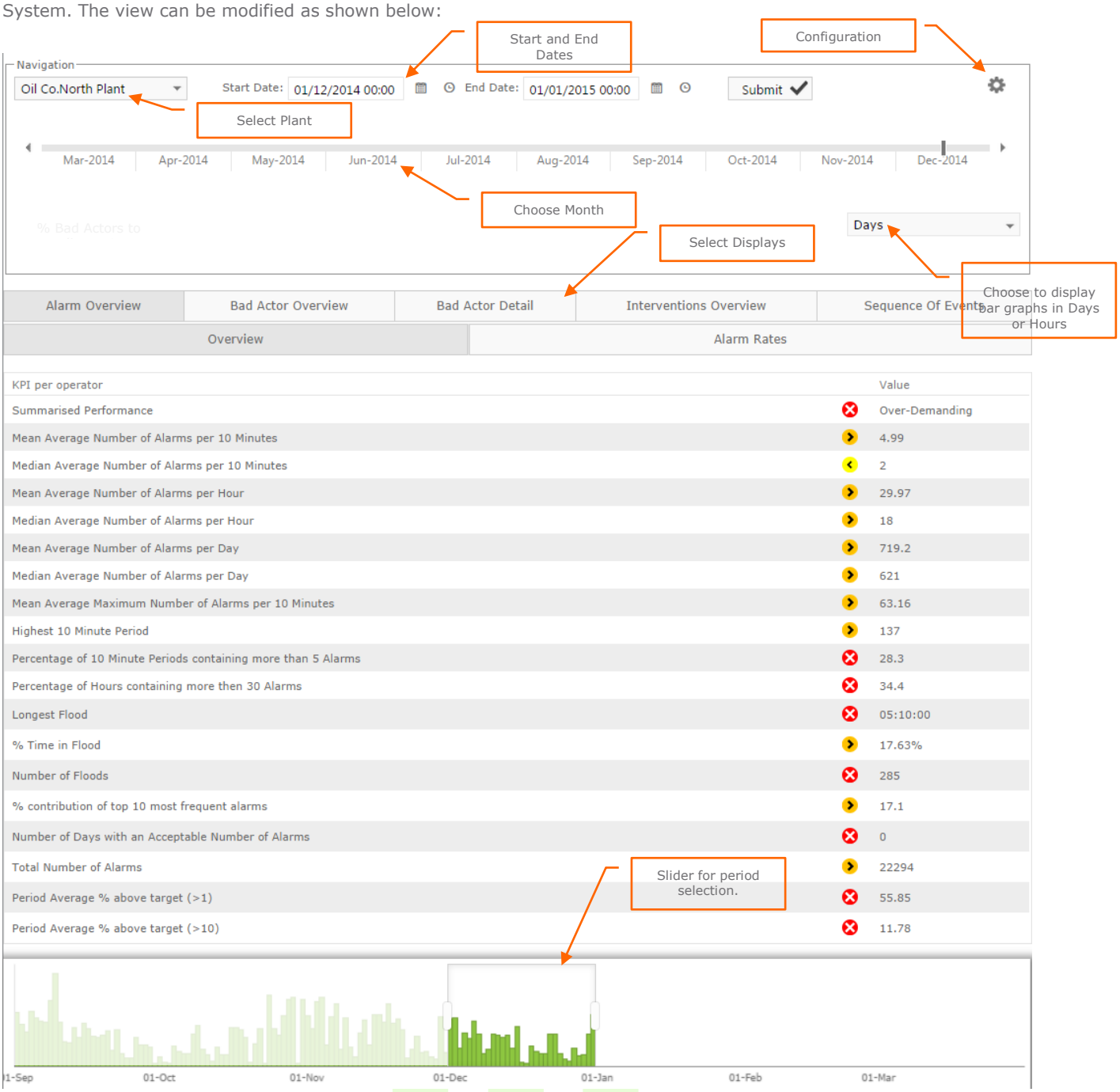


Figure 10: Purchase Options

3 Alarm Analysis – Reports in Detail

3.1 Alarm Overview

The Alarm Overview section provides all the charts and tables required to assess the overall performance of an Alarm System. The view can be modified as shown below:



3.1.1 Time Navigation

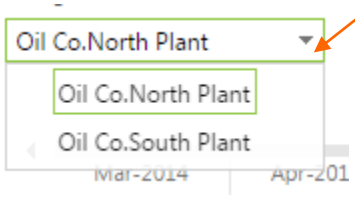
The time navigations are common to all screens. Any changes made to the time selection apply to all displays within the application.

The month selector is the most common method of choosing the time period as the KPIs are designed to be appropriate for that period of time. Smaller time periods will still display KPIs that are correct, but the thresholds will be increasingly inappropriate.

The slider can be used to quickly check areas of interest; it can be moved in its entirety by clicking and dragging inside the pane, or each boundary can be changed by clicking and dragging the handles. The chart within the slider is Alarms per Day.

With the Calendar selector specific time periods can be chosen, the charts will update when "Submit" is clicked. A time after the end of the data, or prior to the beginning of the data cannot be chosen. The End date must be after the Start date.

3.1.2 Plant Selection

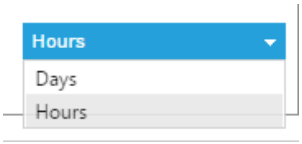


Click and select plant.

Click the drop down to see which plants are available, and select the desired one. The pages will update with data from this plant for the desired period.

3.1.3 Displayed Time Period

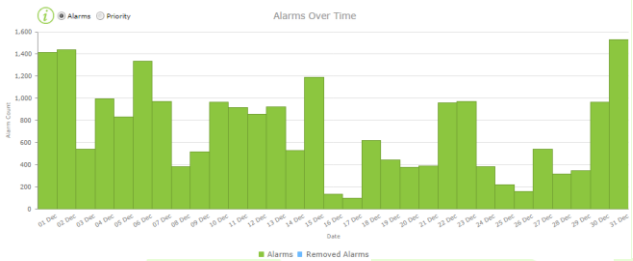
Alarms over time can be viewed in days or hours.

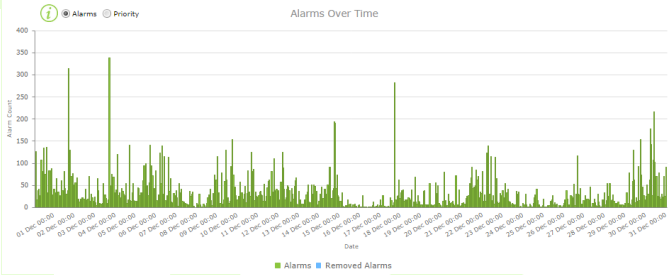


Click to and select.

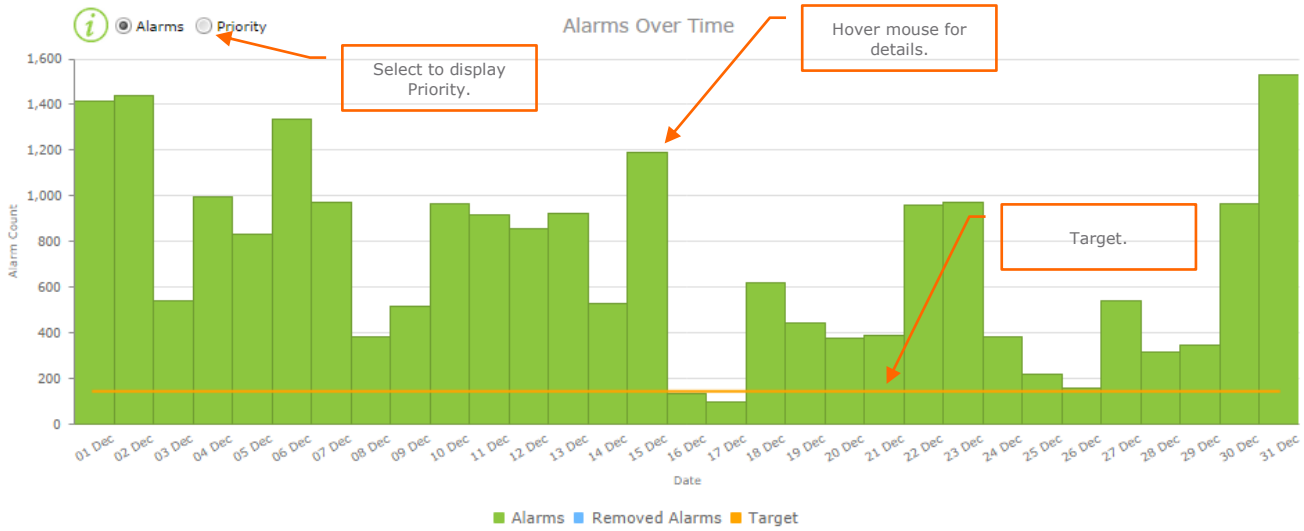
Days.

Hours





3.1.4 Alarms over Time



Select to display Priority.

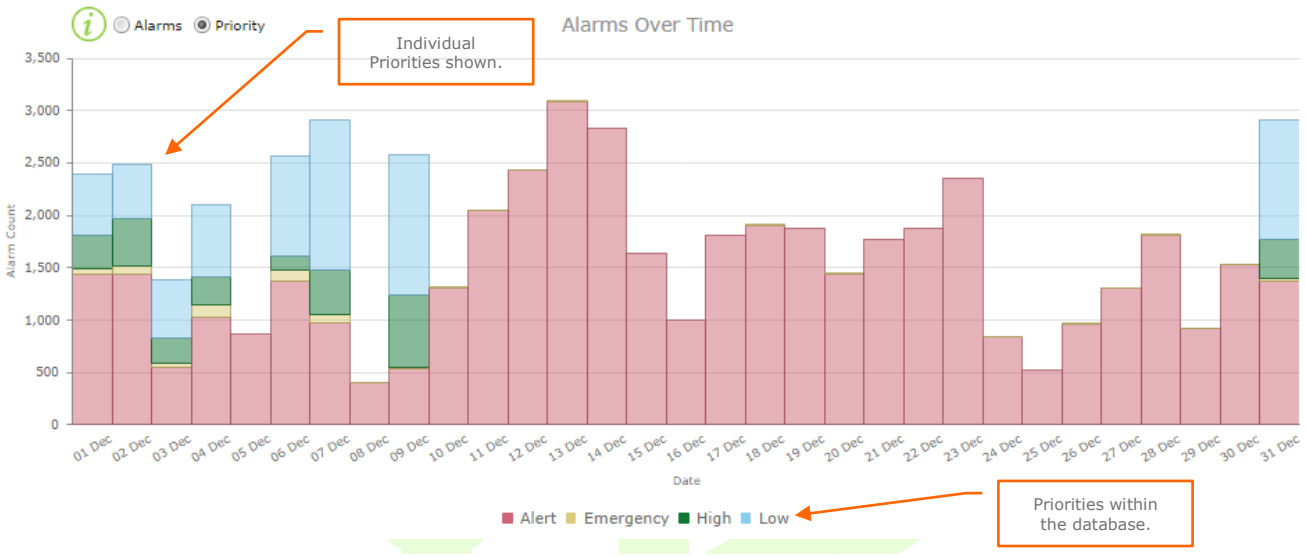
Hover mouse for details.

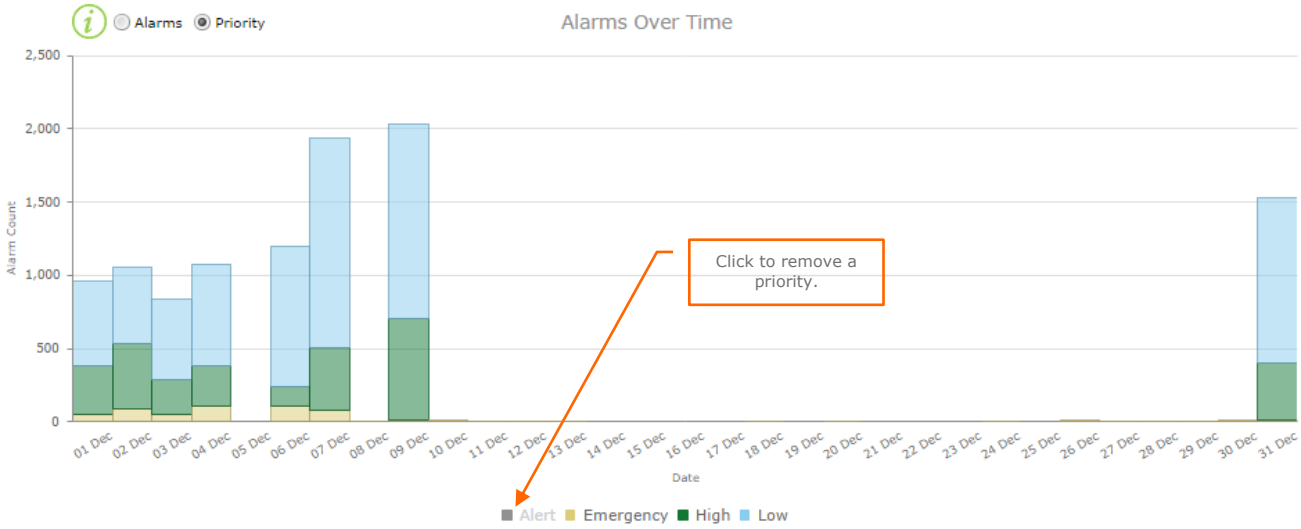
Target.

This chart shows how many alarms there were on each day of the period selected. This is compared with the target line (if configured) to help show how many days had too many alarms.

The chart above shows that there were just over 1,400 alarms on Dec 01.

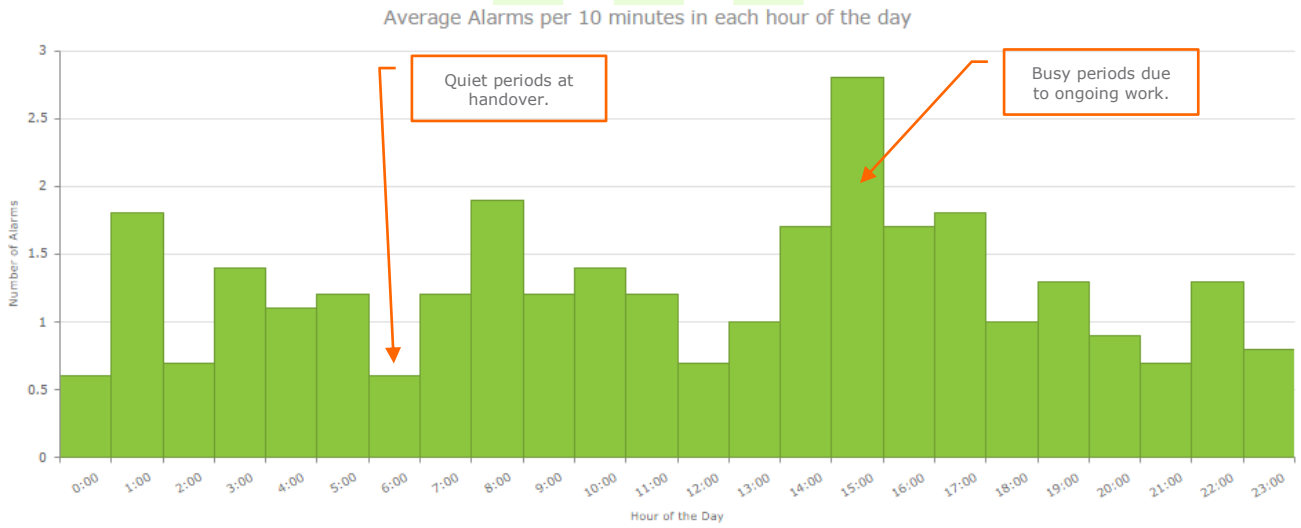
The chart can be changed to show what proportion of each alarm priority occurred:





3.1.5 Alarms in each hour of day

This chart shows the hours of the day where there are more or less alarms. For the period selected, all alarms occurring between 00:00 and 01:00 are summed, divided by the number of days in the period and then divided by 6 to get the average number per 10 minutes. This can show how many alarms are generated by the process, as opposed to operator or maintenance activities. Often there are low counts during meal times or breaks.

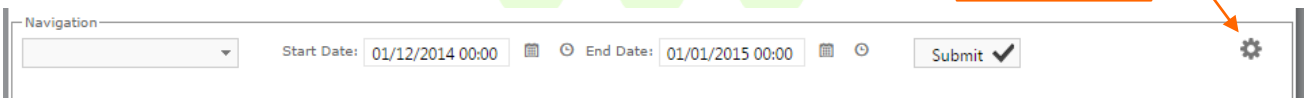


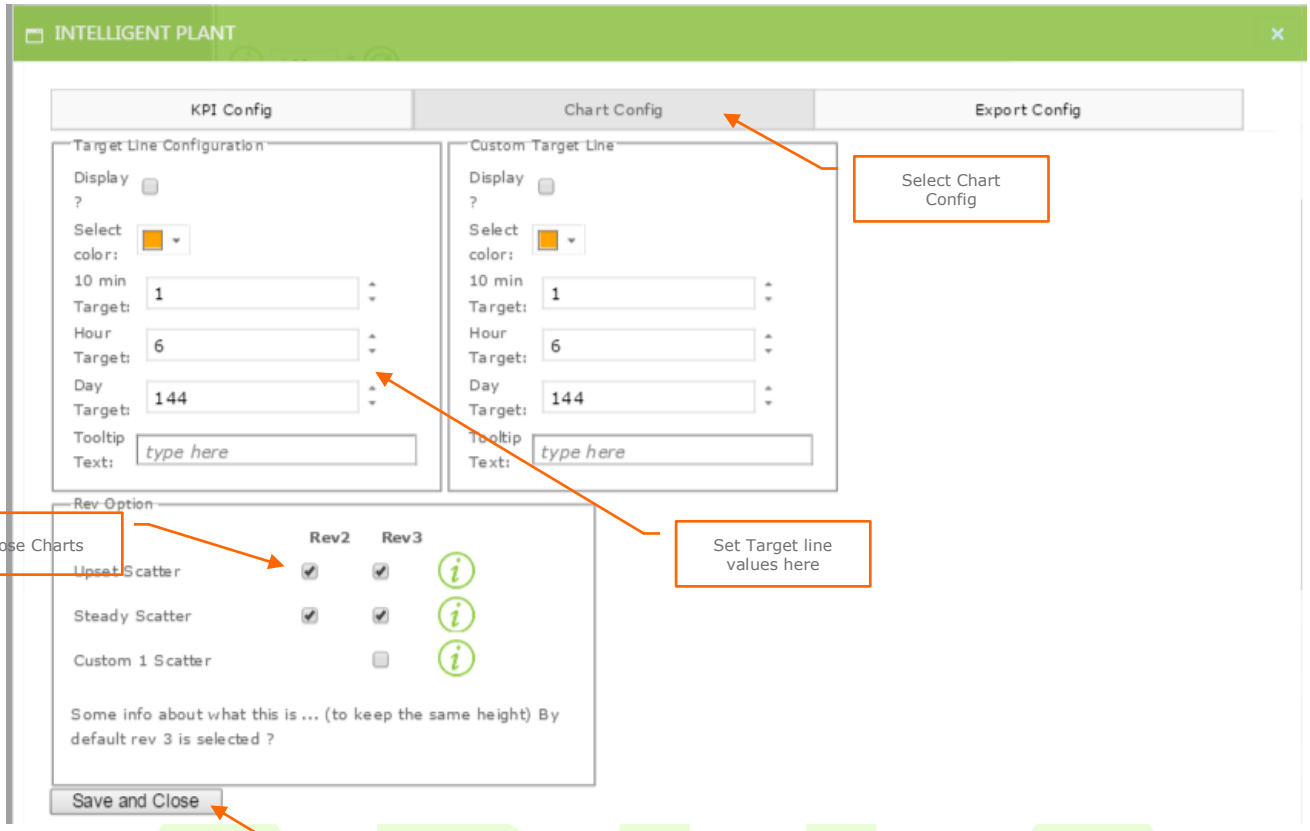
In the chart above, there is an average of 1 alarm per 10 minutes in the period 13:00 to 14:00 for each of the days in the selected period.

3.1.6 EEMUA Scatter Charts.

See Appendix A for a detailed discussion of these charts.

Which charts are displayed are set from the Configuration icon:



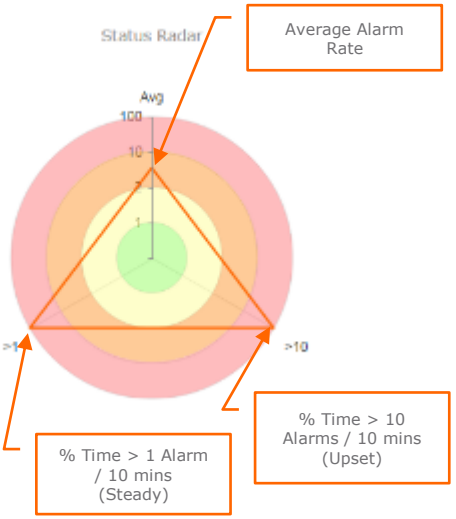

INTELLIGENT PLANT
KPI Config
Chart Config
Export Config
Target Line Configuration
Display ?
Select color:
10 min Target:
1
Hour Target:
6
Day Target:
144
Tooltip Text:
type here
Custom Target Line
Display ?
Select color:
10 min Target:
1
Hour Target:
6
Day Target:
144
Tooltip Text:
type here
Rev Option
Rev2
Rev3
Upset Scatter
Steady Scatter
Custom 1 Scatter
Some info about what this is ... (to keep the same height) By default rev 3 is selected ?
Save and Close
Select Chart Config
Choose Charts
Set Target line values here
Save when complete

3.1.7 EEMUA 191 Rev 3 Radar Chart

The radar chart summarises the three main criteria defined by EEMUA 191 Rev 3. The scales and colours are the same as used in the scatter charts above.

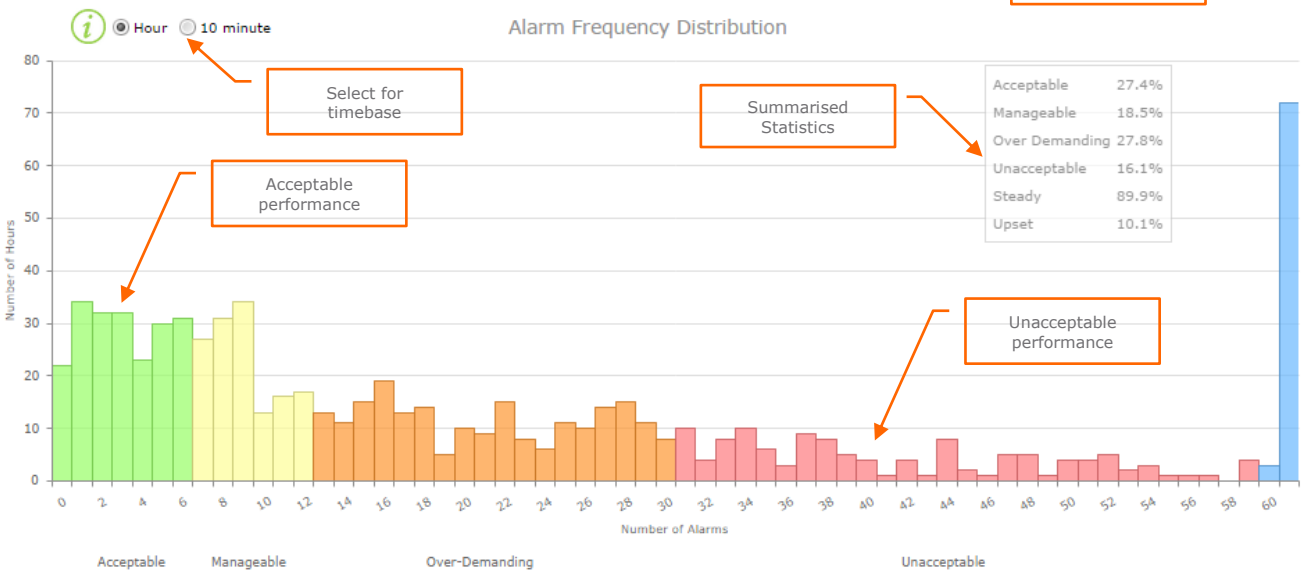
The Steady State leg of the triangle should be easier to get on target than the Upset State leg.

Different methods are used to correct each problem.



3.1.8 Frequency Distribution

The Frequency Distribution chart has a selection for Hourly, or per 10 minutes. Only the Hourly chart is shown below:



This chart gives a very clear indication of how the alarm system is performing with no distortions due to averaging. The performance during Steady State is clear, and how often the system is in upset (blue).

In the above chart, there were 32 hours with 2 alarms.

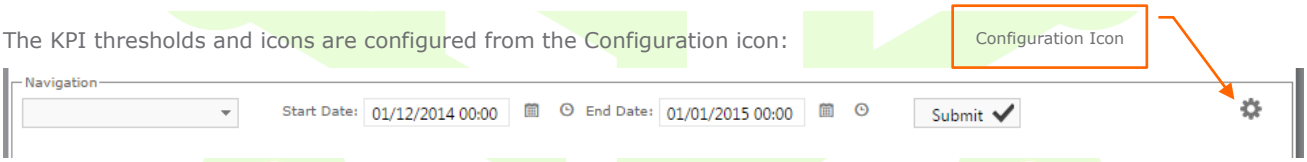
3.1.9 Alarm KPIs

A table of KPIs is shown with icons representing how good or bad the KPI is allowing a quick assessment of overall performance.

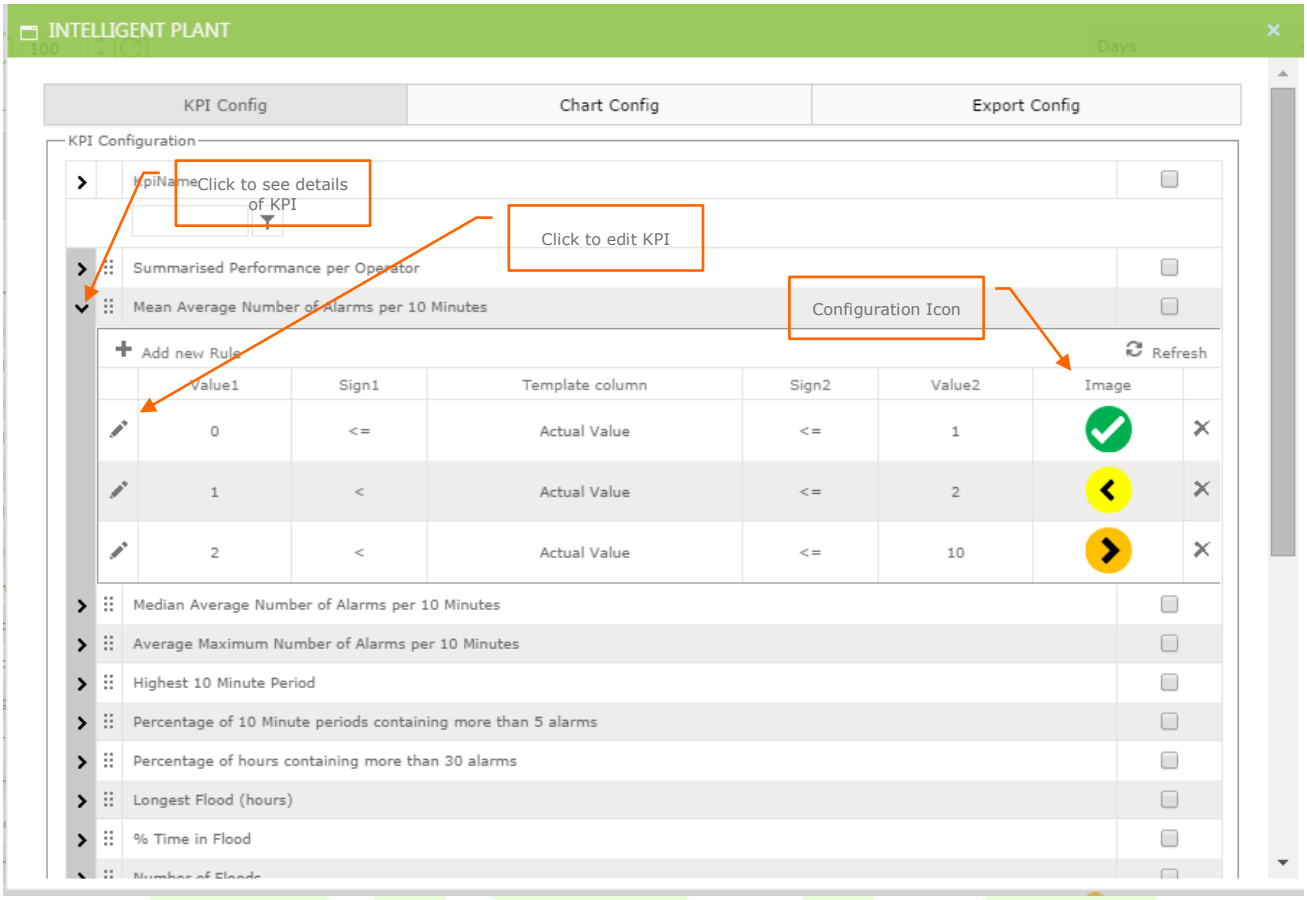
KPI per operator	Value
Summarised Performance	Over-Demanding
Mean Average Number of Alarms per 10 Minutes	4.99
Median Average Number of Alarms per 10 Minutes	2
Mean Average Number of Alarms per Hour	29.97
Median Average Number of Alarms per Hour	18
Mean Average Number of Alarms per Day	719.2
Median Average Number of Alarms per Day	621
Mean Average Maximum Number of Alarms per 10 Minutes	63.16
Highest 10 Minute Period	137
Percentage of 10 Minute Periods containing more than 5 Alarms	28.3
Percentage of Hours containing more then 30 Alarms	34.4
Longest Flood	05:10:00
% Time in Flood	17.63%
Number of Floods	285
% contribution of top 10 most frequent alarms	17.1
Number of Days with an Acceptable Number of Alarms	0
Total Number of Alarms	22294
Period Average % above target (>1)	55.85
Period Average % above target (>10)	11.78

Acceptable Manageable Over-Demanding Unacceptable

The KPI thresholds and icons are configured from the Configuration icon:



Clicking the icon brings up this screen:



3.1.10 Explanation of KPIs

Summarised Performance

This is the worst of the indicators taken from the EEMUA Rev 3 Scatter Charts. The configuration of this KPI is not configurable.

Mean Average Number of Alarms per 10 Minutes

Total Number of Alarms / Number of 10 minutes in selected period / Number of operators.

Default values:

0	<=	Value	<=	1
1	<	Value	<=	2
2	<	Value	<=	10
		Value	>	10

Median Average Number of Alarms per 10 Minutes

Median Average of number of alarms in each 10 minutes in the selected period / Number of operators.

The median of a finite list of numbers can be found by arranging all the observations from lowest value to highest value and picking the middle one (e.g., the median of {3, 3, 5, 9, 11} is 5).

Default values:

0	<=	Value	<=	1
1	<	Value	<=	2
2	<	Value	<=	10
		Value	>	10

Mean Average Number of Alarms per Hour

Total Number of Alarms / Number of hours in selected period / Number of operators.

Default values:

0	<=	Value	<=	6	
6	<	Value	<=	12	
12	<	Value	<=	60	
		Value	>	60	

Median Average Number of Alarms per Hour

Median Average of number of alarms in each hour in the selected period / Number of operators.

Default values:

0	<=	Value	<=	6	
6	<	Value	<=	12	
12	<	Value	<=	60	
		Value	>	60	

Mean Average Number of Alarms per Day

Total Number of Alarms / Number of days in selected period / Number of operators.

Default values:

0	<=	Value	<=	144	
144	<	Value	<=	288	
288	<	Value	<=	1440	
		Value	>	1440	

Median Average Number of Alarms per Day

Median Average of number of alarms in each day in the selected period / Number of operators.

Default values:

0	<=	Value	<=	144	
144	<	Value	<=	288	
288	<	Value	<=	1440	
		Value	>	1440	

Mean Average Maximum Number of Alarms per 10 Minutes

Highest 10 minute period in each day / Number of Days / Number of operators.

Default values:

0	<=	Value	<=	10	
10	<	Value	<=	20	
20	<	Value	<=	100	
		Value	>	100	

Highest 10 Minute Period

Highest 10 minute period in Selection / Number of operators.

Default values:

0	<=	Value	<=	10	
10	<	Value	<=	20	

20	<	Value	<=	100	
		Value	>	100	

Percentage of 10 Minute Periods containing more than 5 Alarms

Number of 10 minute periods with 5 or more alarms / number of 10 minute periods in selection / number of operators

Default values:

0	<=	Value	<=	1	
1	<	Value	<=	5	
5	<	Value	<=	25	
		Value	>	25	

Percentage of Hours containing more than 30 Alarms

Number of hours with 30 or more alarms / number of hours in selection / number of operators

Default values:

0	<=	Value	<=	1	
1	<	Value	<=	5	
5	<	Value	<=	25	
		Value	>	25	

Longest Flood

Longest period of time where number of alarms per operator in ten minutes >= 10; the period ends when number of alarms per operator in ten minutes < 5

Default values:

0	<=	Value	<=	10	
10	<	Value	<=	60	
60	<	Value	<=	180	
		Value	>	180	

% Time in Flood

Percentage of 10 minute periods where number of alarms per operator in ten minutes >= 10; the period ends when number of alarms per operator in ten minutes < 5

Default values:

0	<=	Value	<=	1	
1	<	Value	<=	2	
10	<	Value	<=	25	
		Value	>	25	

Number of Floods

Number of times where number of alarms per operator in ten minutes >= 10; the period ends when number of alarms per operator in ten minutes < 5

Default values:

0	<=	Value	<=	1	
1	<	Value	<=	10	
10	<	Value	<=	100	
		Value	>	100	

% contribution of top 10 most frequent alarms

Percentage of all alarms that are from the Top 20 alarms

Default values:

0	<=	Value	<=	5	✅
5	<	Value	<=	10	⚠
10	<	Value	<=	25	⚠
		Value	>	25	❌

Number of Days with an Acceptable Number of Alarms

Number of days within the selection where the number of alarms per operator is less than 144 (1 every 10 minutes)

Default values:

		Value	>	30	✅
25	<=	Value	<=	30	⚠
15	<	Value	<=	25	⚠
0	<	Value	<=	15	❌

Total Number of Alarms

Total number of alarms in the selected period / number of operators

0	<=	Value	<=	4320	✅
4320	<	Value	<=	8640	⚠
8640	<	Value	<=	43200	⚠
		Value	>	43200	❌

Period Average % above target (>1)

Number of ten minute periods where number of alarms per operator in ten minutes > 1 / Number of ten minute periods

0	<=	Value	<=	1	✅
1	<	Value	<=	10	⚠
10	<	Value	<=	25	⚠
		Value	>	25	❌

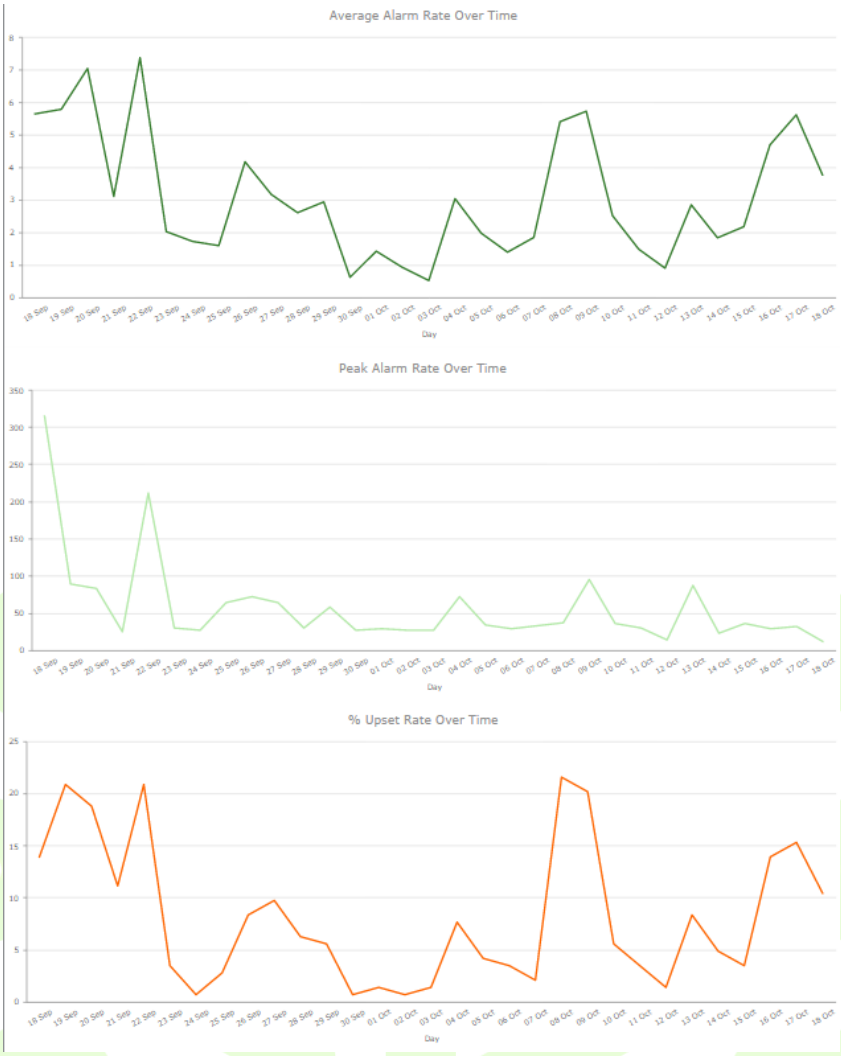
Period Average % above target (>10)

Number of ten minute periods where number of alarms per operator in ten minutes > 10 / Number of ten minute periods

0	<=	Value	<=	0.5	✅
0.5	<	Value	<=	1	⚠
1	<	Value	<=	2.5	⚠
		Value	>	2.5	❌

3.2 Alarm Rates

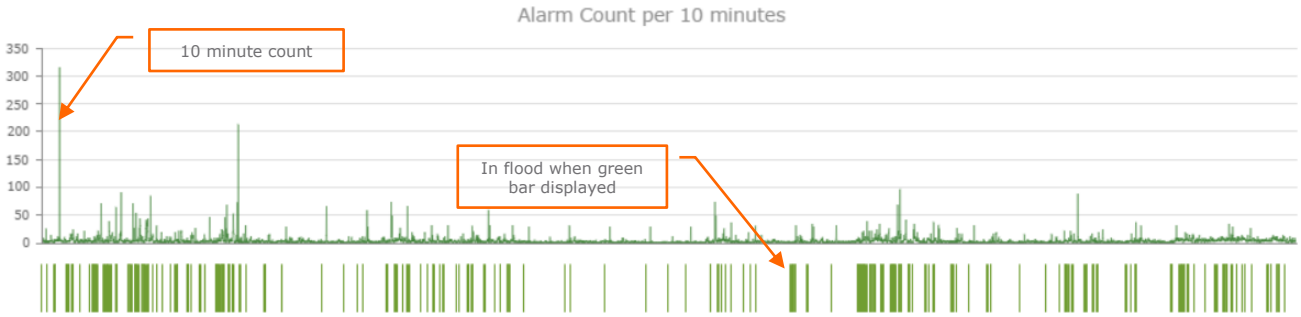
The second tab in the Alarm Overview section is for Alarm Rates. These are trends over time of the main KPIs listed above.



In the chart above, the % upset was 21% on the 19 Sep. These charts will also display hourly values when that option is selected.

3.2.1 Alarm Floods

Alarm Count per 10 minutes, including Flood Indicator and Flood KPIs:



Condition	Value
Highest 10 minute value	314
Time of Largest Flood	2014-09-18 10:40:00
Number of Floods	178
Length of longest flood in minutes	70
Start of Longest Flood	2014-10-09 13:00:00
End of Longest Flood	2014-10-09 14:10:00
Time spent in Flood	8.13%

Main KPIs

3.3 Bad Actor Overview – Top 20

The Top 20 tab in the Bad Actor Overview displays the 20 worst performing Alarms.
Addressing problems with these alarms will go a long way to reduce the overall KPIs for a system.

Tag Name	Parameter	Description	Count	Percentage	Accumulated
50UA1114	OFFNORM		648	2.91	2.91
31BAHH3383B	OFFNORM		467	2.09	5.00
31PAL3318B	OFFNORM		465	2.09	7.09
81LIC1118	PVHI		445	2.00	9.08
31UA3487	OFFNORM		416	1.87	10.95
54XA3113	OFFNORM		349	1.57	12.51
31PAL3418B	OFFNORM		279	1.25	13.77
13TI1163	PVLO		261	1.17	14.94
31BAHH3483B	OFFNORM		244	1.09	16.03
82PDI3114	PVHI		234	1.05	17.08
32XA3110	OFFNORM		223	1.00	18.08
30LALL1127	OFFNORM		217	0.97	19.05
82PAH3188	OFFNORM		204	0.92	19.97
63UA1181	OFFNORM		197	0.88	20.85
32UA3103	OFFNORM		194	0.87	21.72
83PDY1123A	PVLO		170	0.76	22.49
32XA3118	OFFNORM		164	0.74	23.22
81LAHL3018_0	OFFNORM		156	0.70	23.92
73XA3113	OFFNORM		155	0.70	24.62
33TIC1183	PVLO		150	0.67	25.29

Tagname

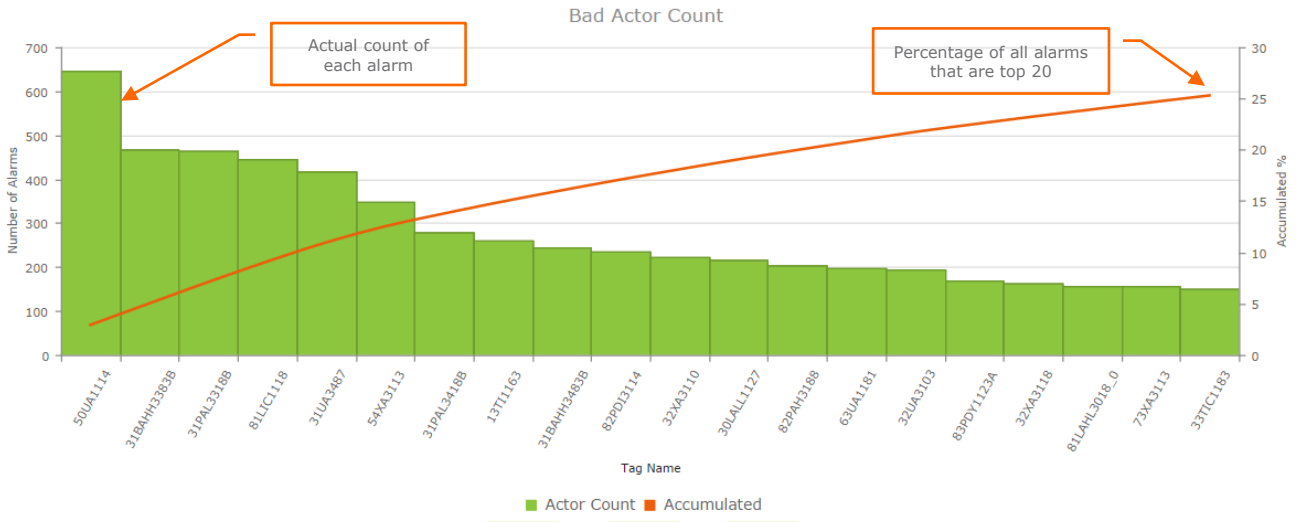
Number of times this alarm occurred.

Percentage of all alarms that this alarm is.

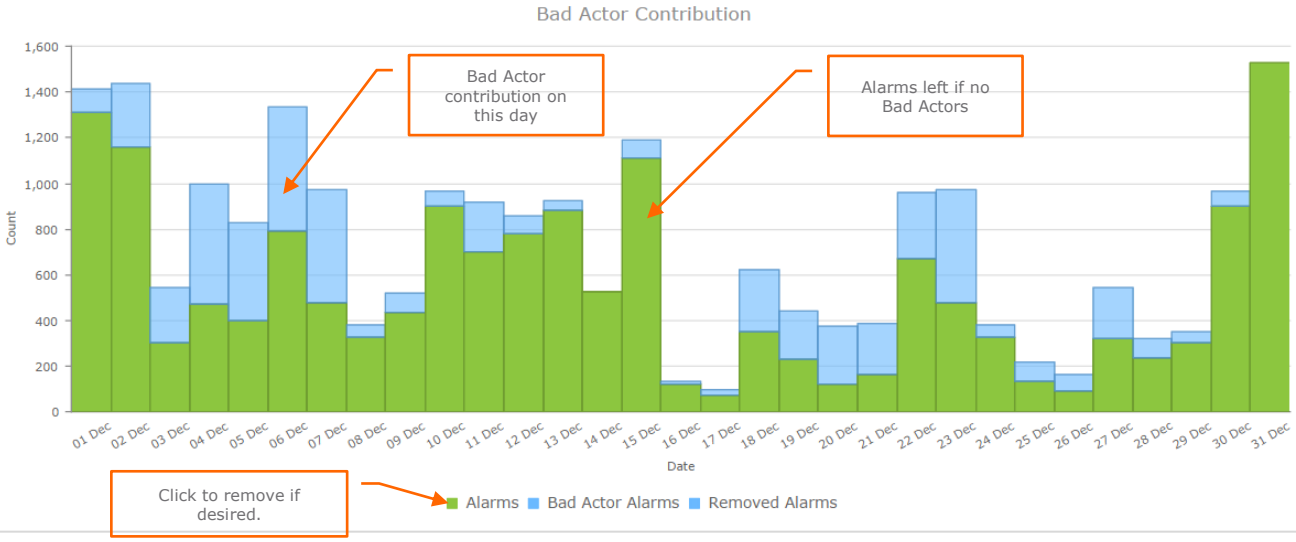
Accumulated Percentage with all previous alarms.

Alarm type

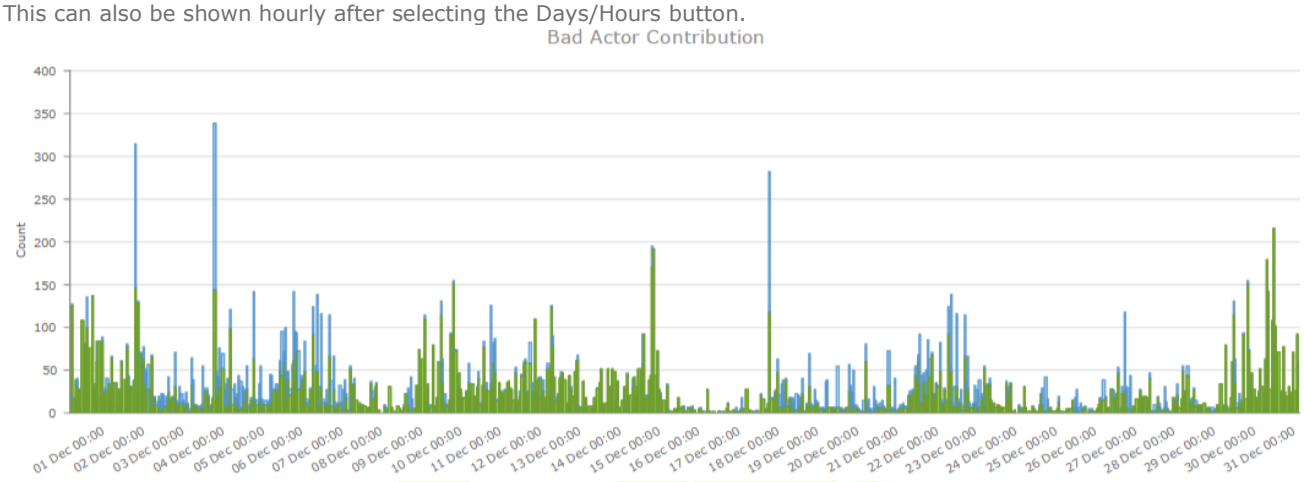
They are also displayed in a chart to highlight the relative frequencies:



The alarms per day chart is displayed again, but with the count from Bad Actors highlighted in blue to show what the counts would be with Bad Actors removed. (Note: Previously discounted alarms are also shown here, if selected).



In the chart above, there would have been 800 alarms on 6th Sep if there had been no bad actors. The bad actors on this day totalled approximately 500.
This can also be shown hourly after selecting the Days/Hours button.



3.3.1 Bad Actor barcodes

A "barcode" of each alarm is then displayed to see if any have similar behaviour, or stand for long periods of time:

3.3.2 Bad Actor Overview – Fleeting Alarms

Fleeting Alarms are those that come on for one minute or less and then clear, not returning for a period of 10 minutes. The assumption is that no operator action could have been performed within that minute that would clear the alarm, therefore the alarm has cleared itself. It is then a possibility that the alarm need never have annunciated in the first place.

Count of fleets for this alarm

Percentage of this alarm that were fleets

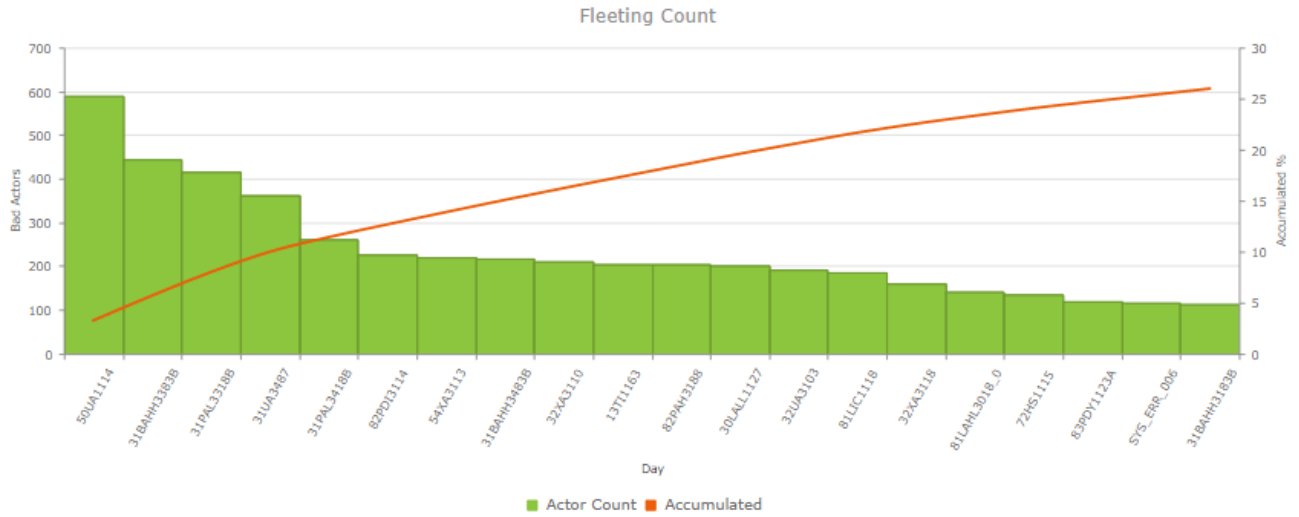
Percentage of all fleets that this alarm is

Accumulated percentage of all fleets

Average time alarm spends in the On condition

Tag Name	Alarm Identifier	Count	Percentage Of Itself	Percentage Of Total	Accumulated	AverageOntoOff (s)
50UA1114	OFFNORM	589	95.00	3.24	3.24	21
31BAHH3383B	OFFNORM	444	95.07	2.44	5.68	1
31PAL3318B	OFFNORM	417	89.68	2.29	7.98	6
31UA3487	OFFNORM	362	87.23	1.99	9.97	6
31PAL3418B	OFFNORM	261	93.55	1.44	11.40	2
82PDI3114	PVHI	226	97.00	1.24	12.65	3
54XA3113	OFFNORM	220	63.40	1.21	13.86	16
31BAHH3483B	OFFNORM	218	89.71	1.20	15.05	1
32XA3110	OFFNORM	211	94.62	1.16	16.21	5
13TI1163	PVLO	204	78.46	1.12	17.34	9
82PAH3188	OFFNORM	204	100.00	1.12	18.46	4
30LALL1127	OFFNORM	203	93.55	1.12	19.58	17
32UA3103	OFFNORM	192	98.97	1.06	20.63	4
81LIC1118	PVHI	186	41.80	1.02	21.65	35
32XA3118	OFFNORM	159	96.95	0.87	22.53	5
81LAHL3018_0	OFFNORM	142	91.03	0.78	23.31	6
72HS1115	OFFNORM	135	100.00	0.74	24.05	1
83PDV1123A	PVLO	119	70.83	0.65	24.71	23
SYS_ERR_006	ALM	115	84.56	0.63	25.34	12
31BAHH3183B	OFFNORM	114	95.00	0.63	25.97	1

Again with a chart showing the relative frequencies:



3.3.3 Bad Actor Overview – Stale Alarms

A stale alarm is one that is continuously on for a period of greater than 24 hours. Stale alarms clutter up alarm summaries and graphics with spurious indications of problems.

Tag Name	Alarm Identifier	Count	Avg days On to Off
54XI3113	OFFNORM	10	1
31BAHH3483B	OFFNORM	9	2
54XA3113	OFFNORM	8	1
73XA3113	OFFNORM	8	1
13XXV1102	OFFNORM	8	3
25XXV1120	OFFNORM	8	2
FAG32413		8	1
FAG32313	ALM	8	1
FAG32312	ALM	8	1
FAG32316		7	1
FAG32438		7	2
FAG85534	ALM	7	2
FAG85535	ALM	7	2
FAG32406	ALM	7	2
FAG32407	ALM	7	2
13TI1140C	PVLO	7	2
13TI2840C	PVLO	7	2
13TI2840B	PVLO	7	2
30LAH3135	OFFNORM	7	2
38SIC3011	PVLL	6	3

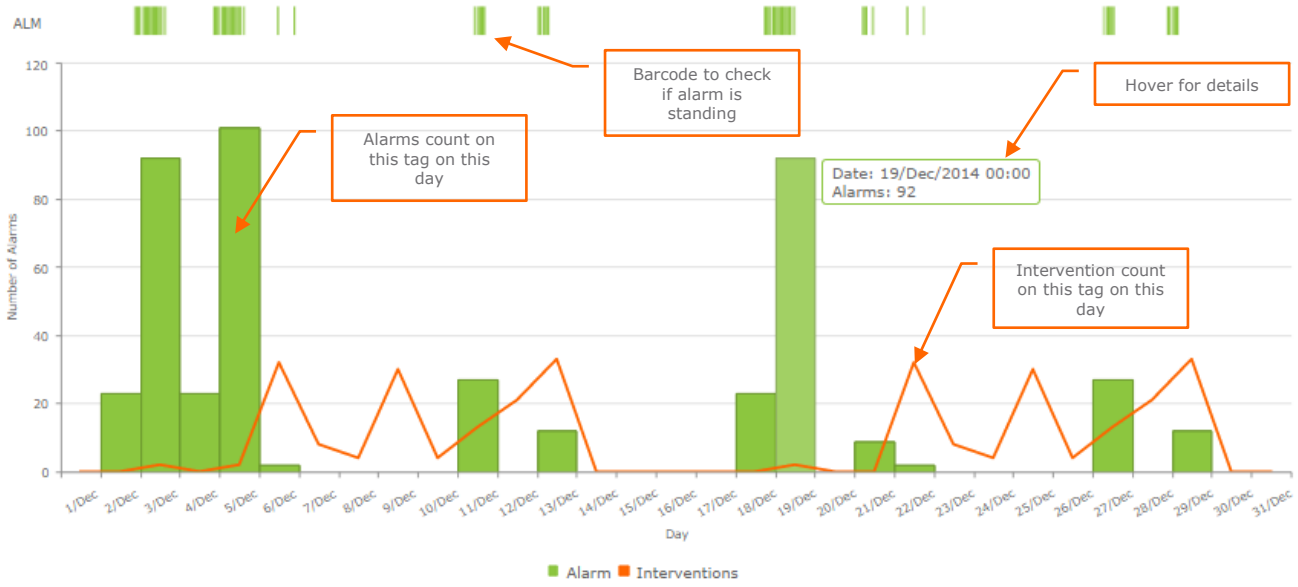
How many times Alarm was on for greater than 24 hours

Average number of days the alarm was on for.

Followed by a barcode showing when they were stale:

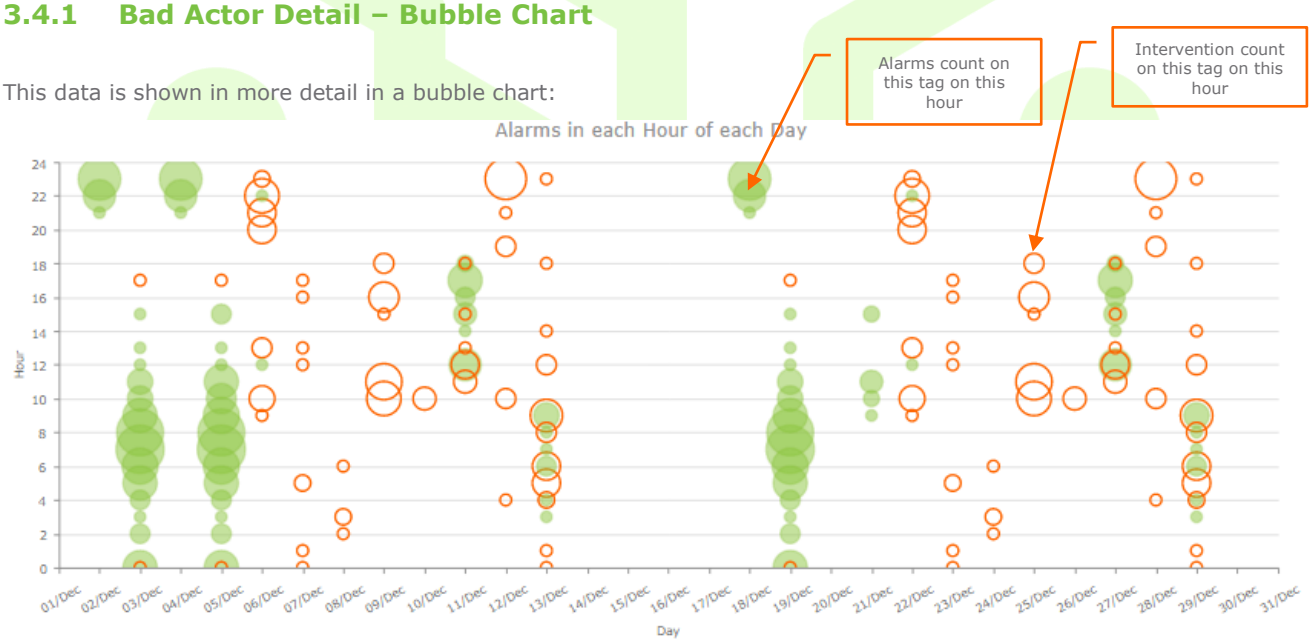
3.4 Bad Actor Detail – Behaviour

This section shows the individual alarms behaviour in detail. First are the alarm and interventions over time:



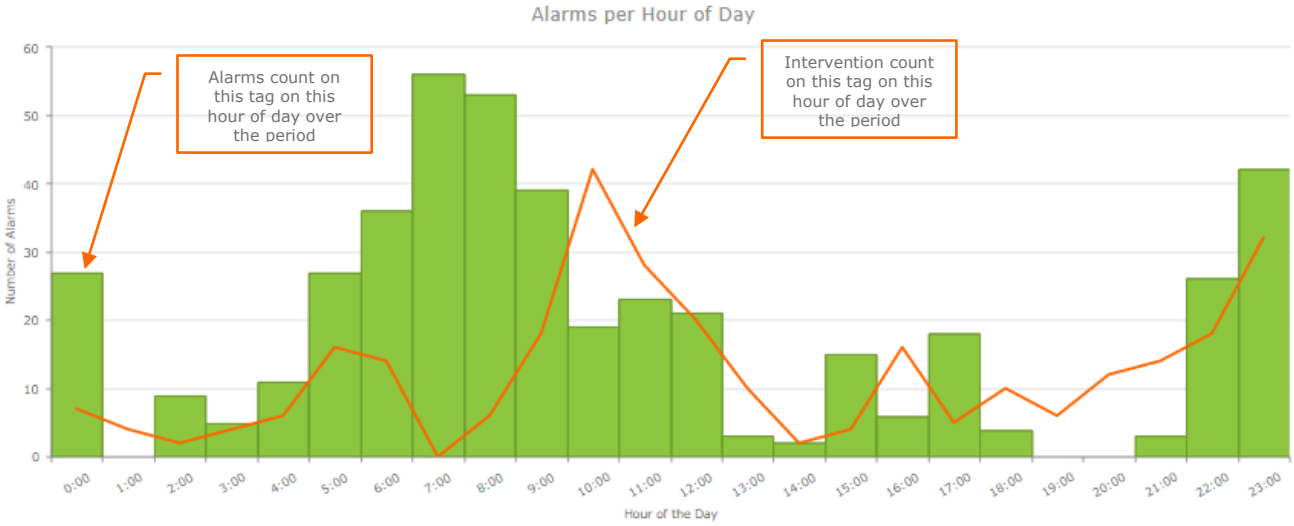
3.4.1 Bad Actor Detail – Bubble Chart

This data is shown in more detail in a bubble chart:



3.4.2 Bad Actor Detail – Alarms and Interventions per hour of day

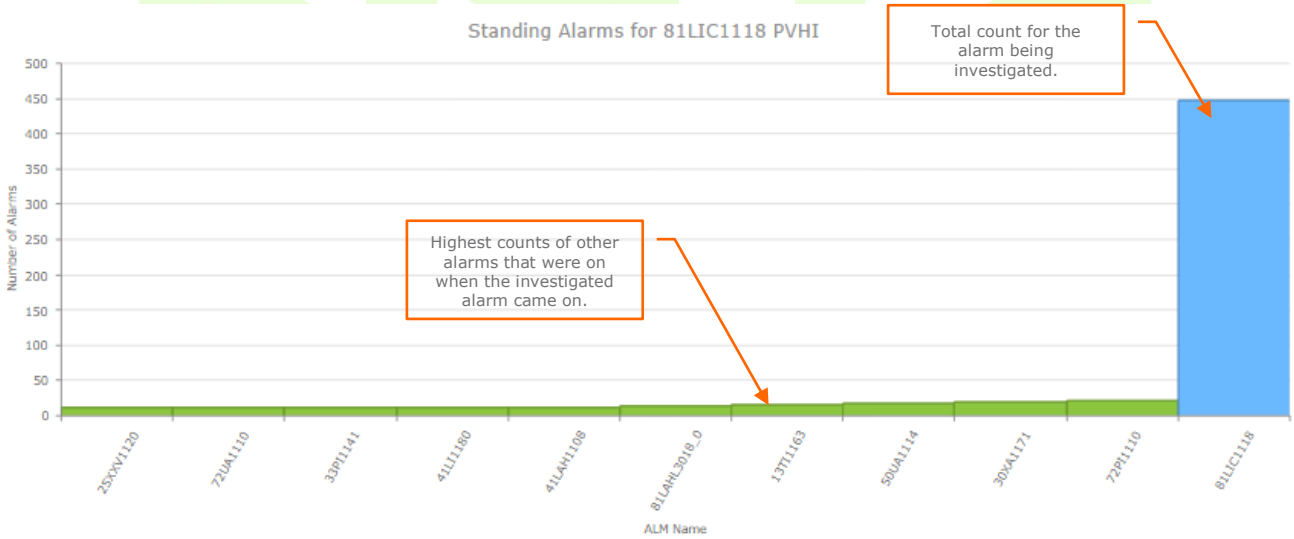
And then summarised by hour of each day:



3.4.3 Bad Actor Detail – Standing Symptomatic Alarms

Symptomatic alarms and interventions are those that are associated with the alarm being investigated. Often there may be two alarms that indicate the same process problem, and therefore activate together. They should be examined, and if possible one should be removed. In a typical bad actor situation however, there are no other alarms or interventions closely associated, because the tag is broken. Both situations can be checked with these charts.

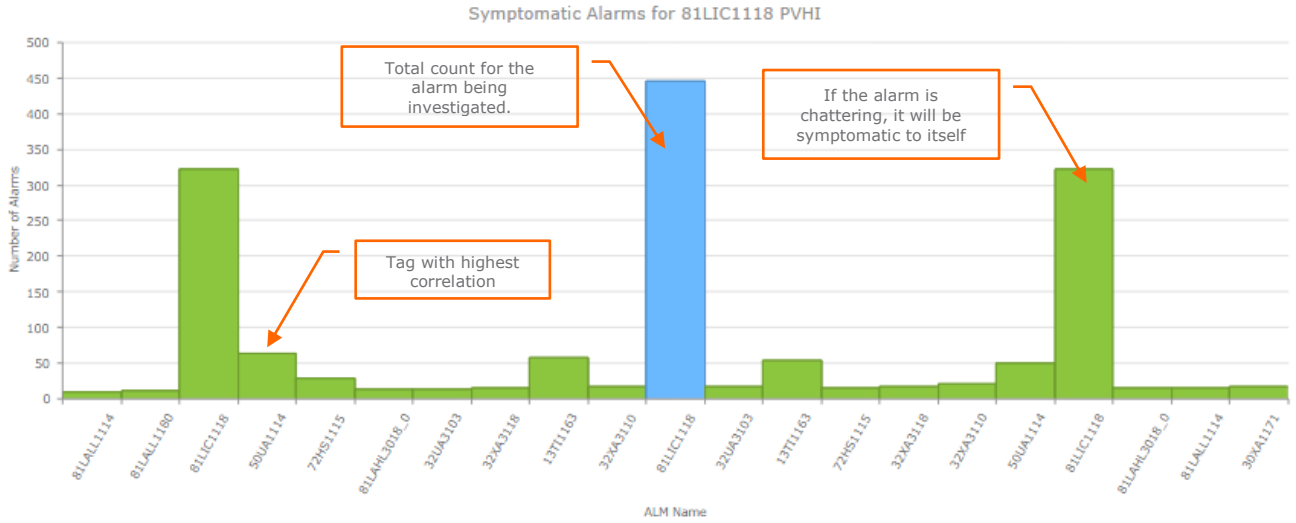
The chart checks 10 minutes before the annunciation of the alarm being investigated.



3.4.4 Bad Actor Detail – Symptomatic Alarms

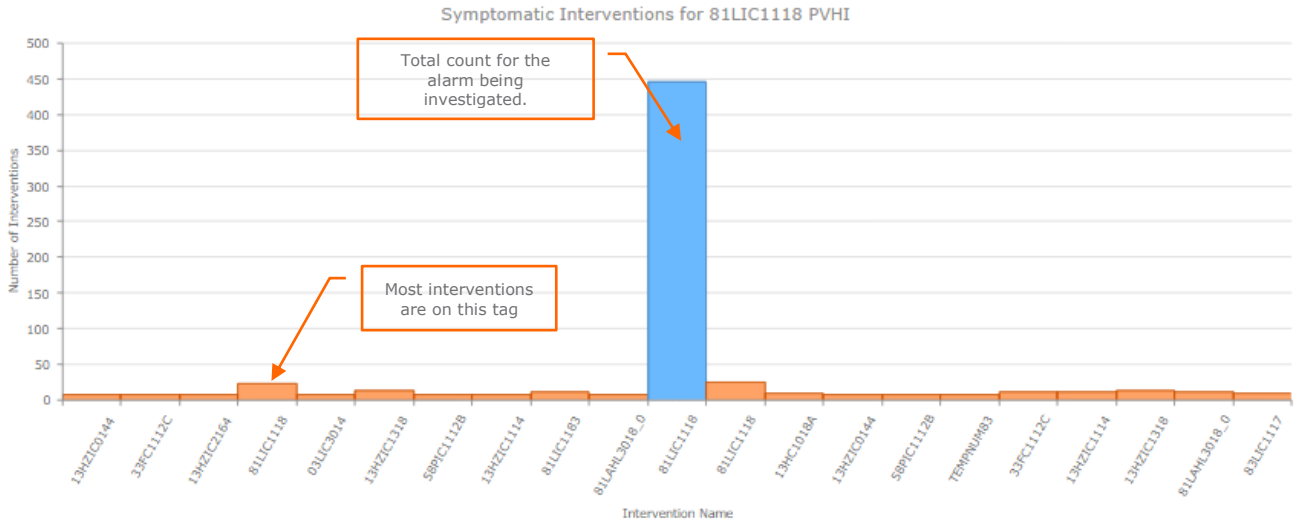
For this chart 10 minutes before and after the alarm is checked to find associated alarms.

If the alarm itself is encountered in this period then no more counts are performed as those alarms would be part of that alarms count. If the same alarm is found more than once in the period before is only counted once, and similarly for the after period. These actions are taken to try and minimise the distortion caused by chattering alarms.



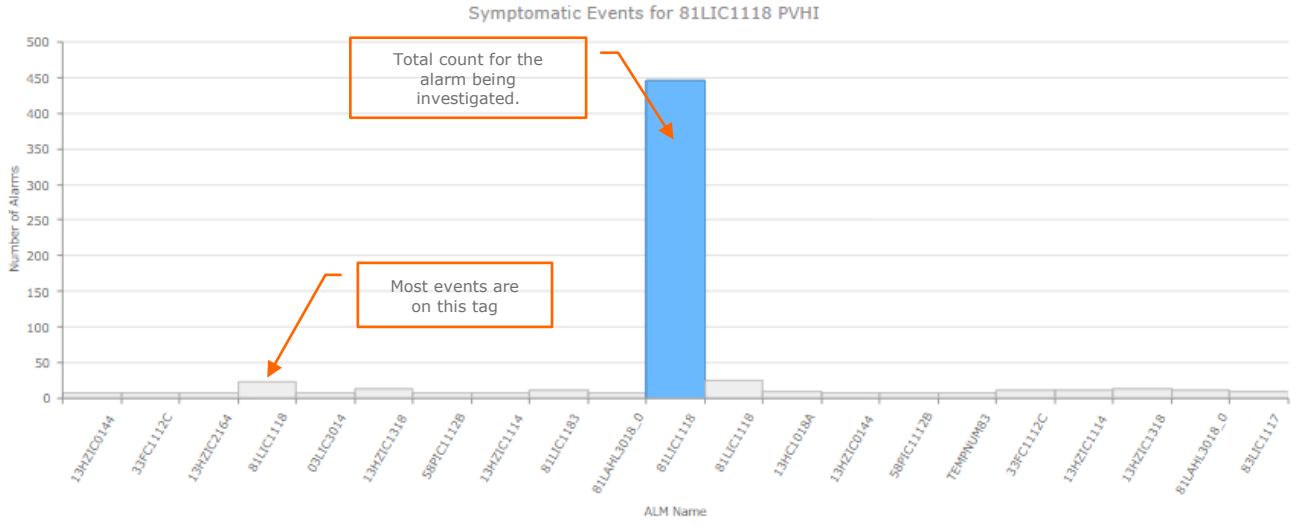
3.4.5 Bad Actor Detail – Symptomatic Interventions

For this chart 10 minutes before and after the alarm is checked to find associated interventions.



3.4.6 Bad Actor Detail – Symptomatic Events

For this chart 10 minutes before and after the alarm is checked to find associated events.



3.5 Bad Actor Detail – Analysis

This section shows the details of how the alarm is going on and off; from this, important diagnostic information can be determined.

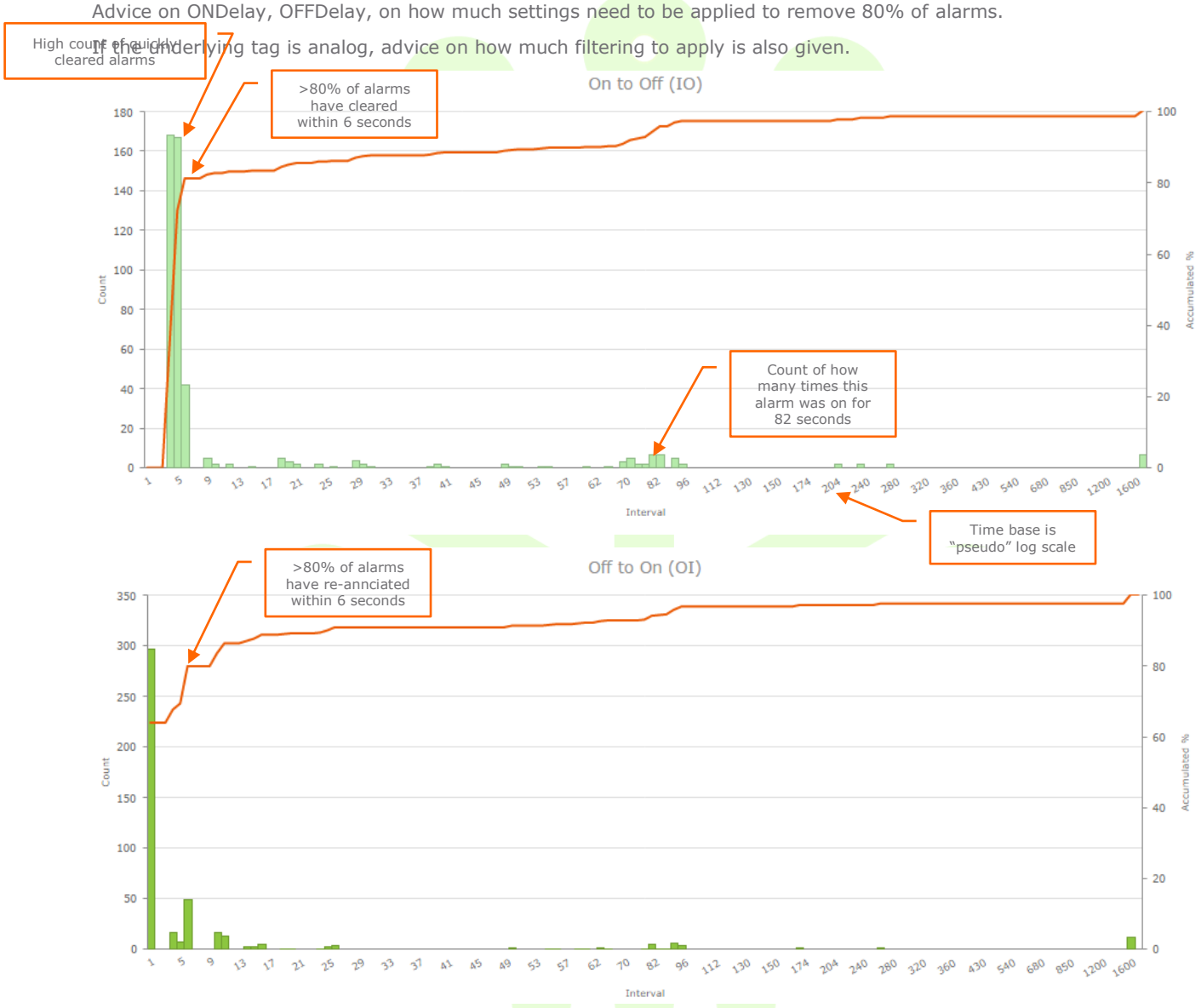
3 measurements are recorded:

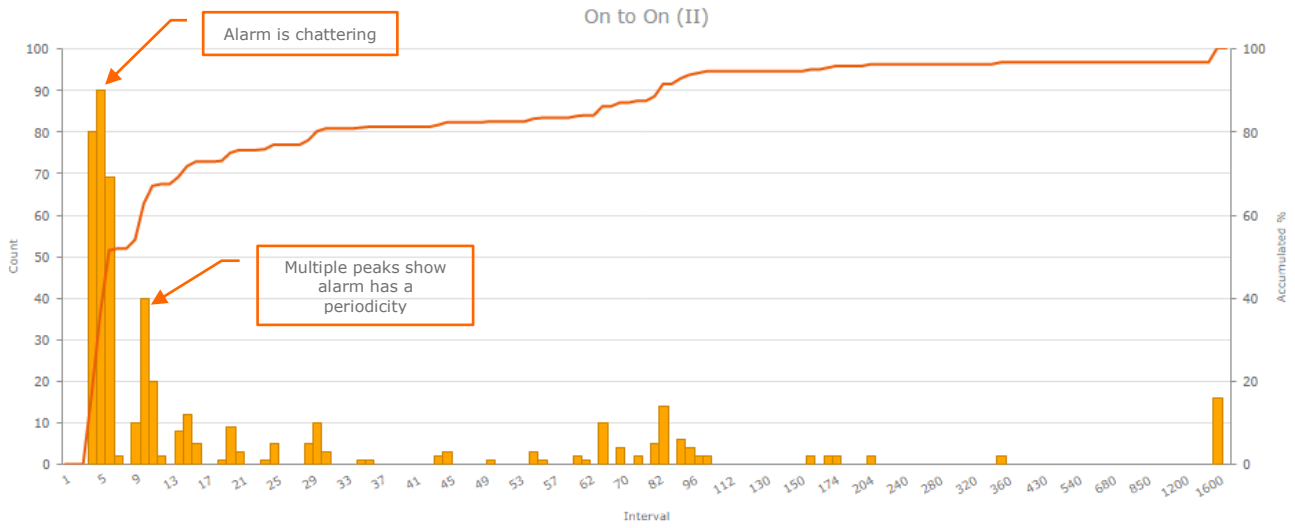
- Time from the alarm coming on to it going off (how long it is on)
- Time from alarm going off to it next coming on (how long it is off)
- Time from the alarm coming on to it next coming on (time between alarms)

These are plotted on 3 charts from which detailed alarm behaviour can be determined.

Advice on ONDelay, OFFDelay, on how much settings need to be applied to remove 80% of alarms.

If the underlying tag is analog, advice on how much filtering to apply is also given.





A table shows the statistics in numbers:

(Note: this table does not correspond to charts above, it is for a different tag)

KPI per operator	Value
Total Alarms	465
% of Total Alarms	0.83%
Total Chatters	320
Number of Days Alarm occured	16
Times Standing	0
Total On time	04:13:12:31
Total Interventions	0
Alarm / Intervention Ratio	0
Alarm / Intervention Correlate	NaN
Number of Days Intervention occured	0
Number of Disables	0
Time Disabled	0%
Number of Manuals	0
Time in Manual	0%
Mean ON time	845
Median ON time	5
Modal ON time	4
Off Delay	10
On Delay	6
Filter	2 seconds
PV / Alarm setting relationship	PV is above Trip Point

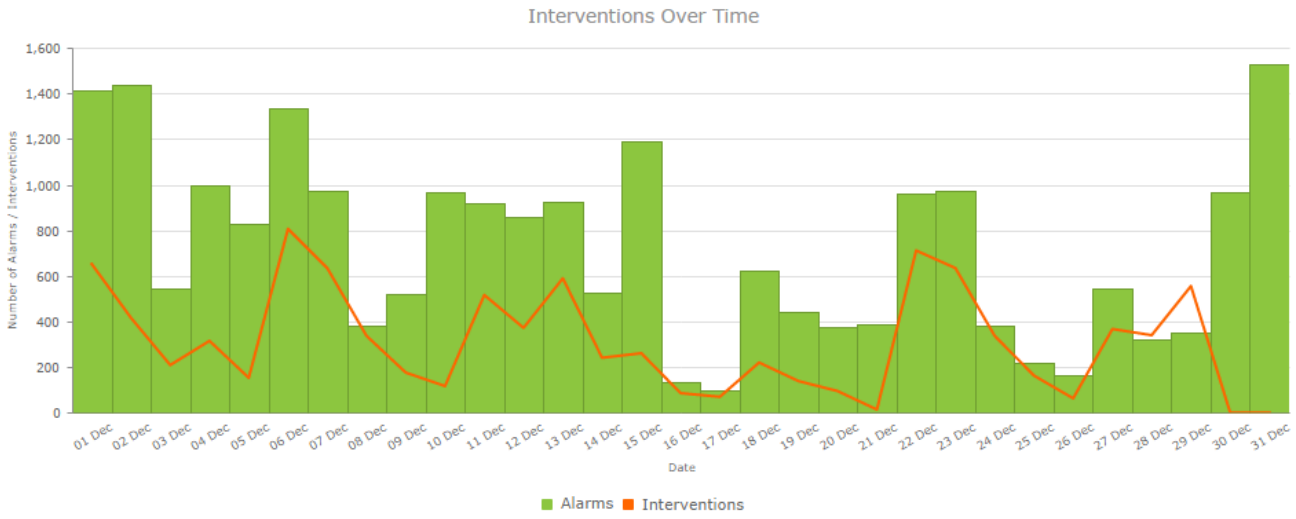
KPI Name

Advice to fix alarm

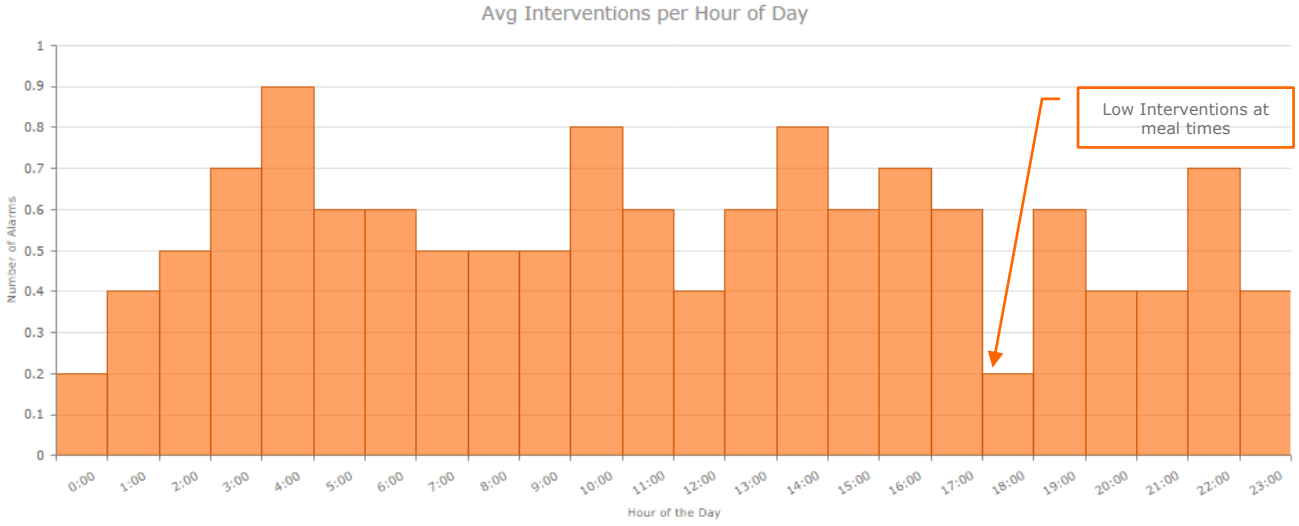
The advice for this tag is either to add Off Delay of 10 seconds OR to add On Delay of 6 seconds. Far an analog tag, 2 seconds filtering may be effective.

3.6 Interventions – Overview

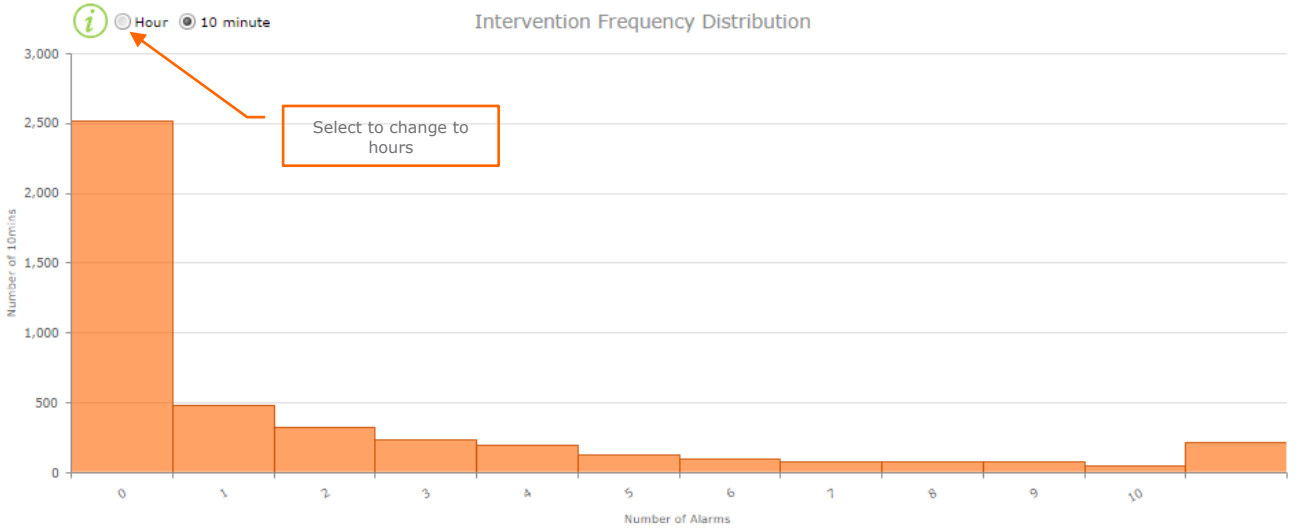
The Interventions section displays intervention statistics similarly to alarms. The first chart shows interventions over time against alarms over the same period:



3.6.1 Interventions – Per Hour of Day



3.6.2 Interventions – Frequency Distribution

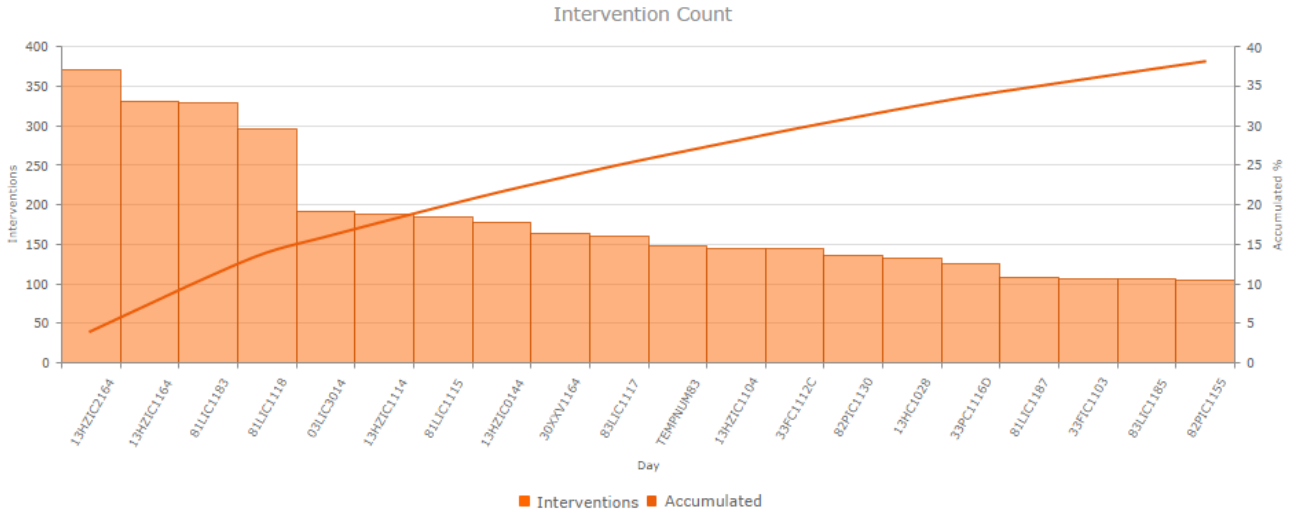


3.7 Interventions – Top 20

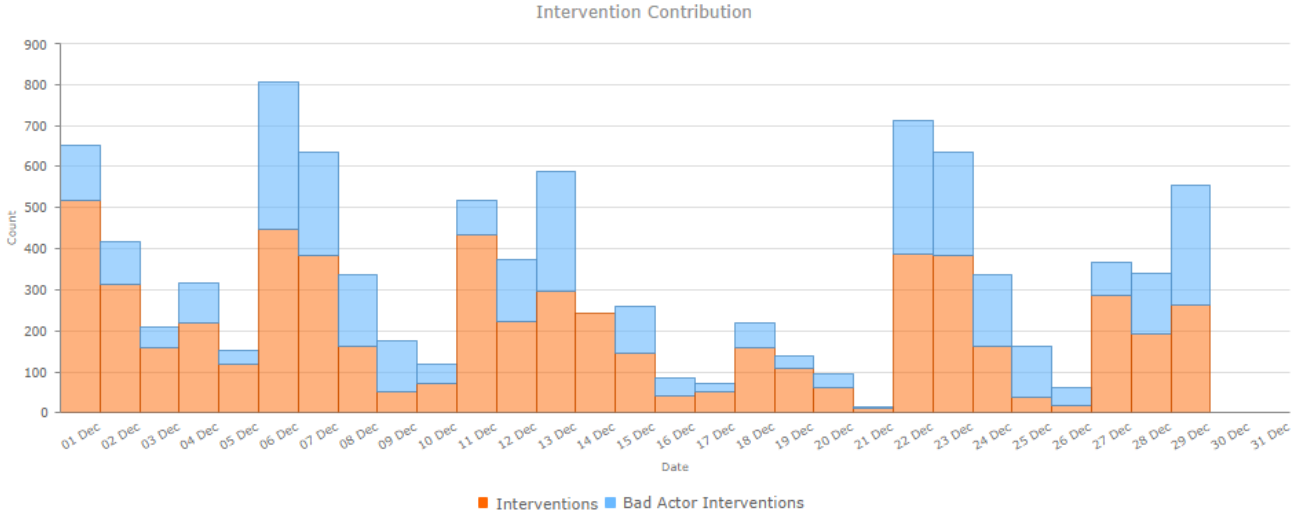
The Top 20 tab in the Intervention Overview displays the 20 highest interventions.

Tag Name	Description	Count	Percentage	Accumulated
13HZIC2164		371	3.87	3.87
13HZIC1164		331	3.45	7.32
81LIC1183		328	3.42	10.74
81LIC1118		296	3.09	13.83
03LIC3014		191	1.99	15.82
13HZIC1114		187	1.95	17.77
81LIC1115		184	1.92	19.69
13HZIC0144		177	1.85	21.54
30XXV1164		164	1.71	23.25
83LIC1117		160	1.67	24.92
TEMPNUM83		148	1.54	26.46
13HZIC1104		145	1.51	27.97
33FC1112C		144	1.50	29.47
82PIC1130		136	1.42	30.89
13HC1028		133	1.39	32.28
33PC1116D		126	1.31	33.59
81LIC1187		108	1.13	34.72
33FIC1103		106	1.11	35.83
83LIC1185		106	1.11	36.93
82PIC1155		104	1.08	38.02

They are also displayed in a chart to highlight the relative frequencies:

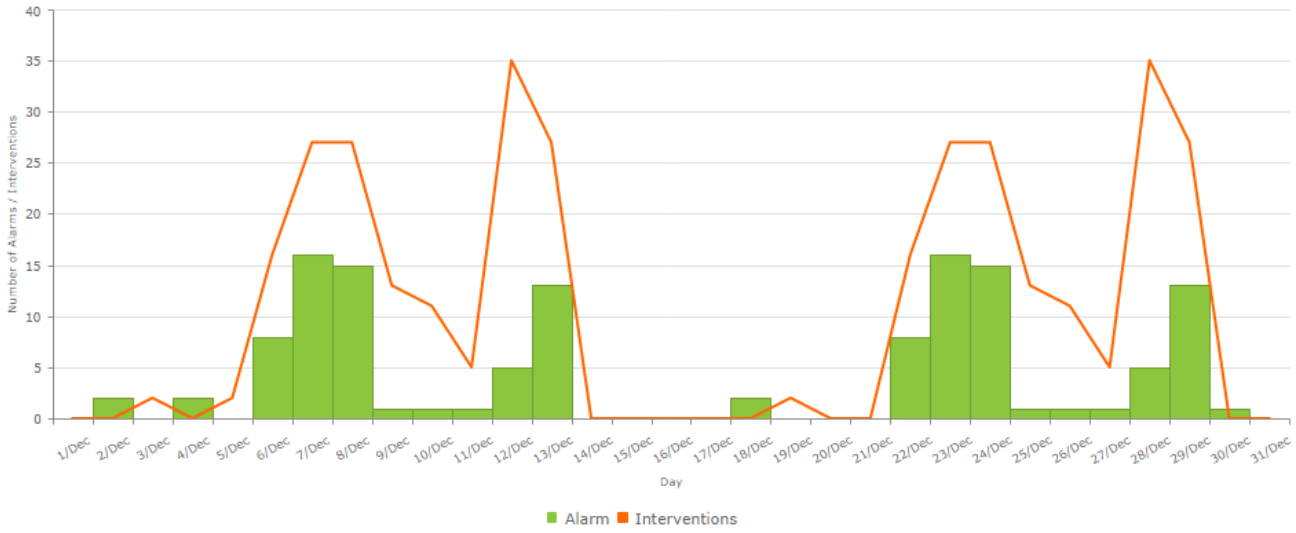


The interventions per day chart is displayed again, but with the count from worst interventions highlighted in blue to show what the counts would be with these removed.

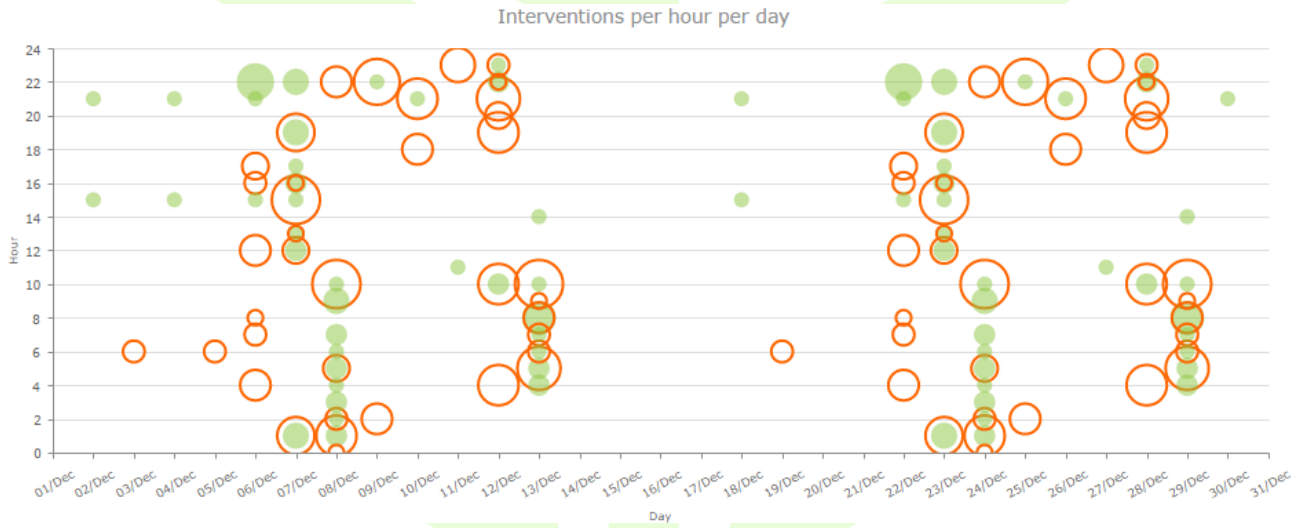


3.8 Intervention Detail

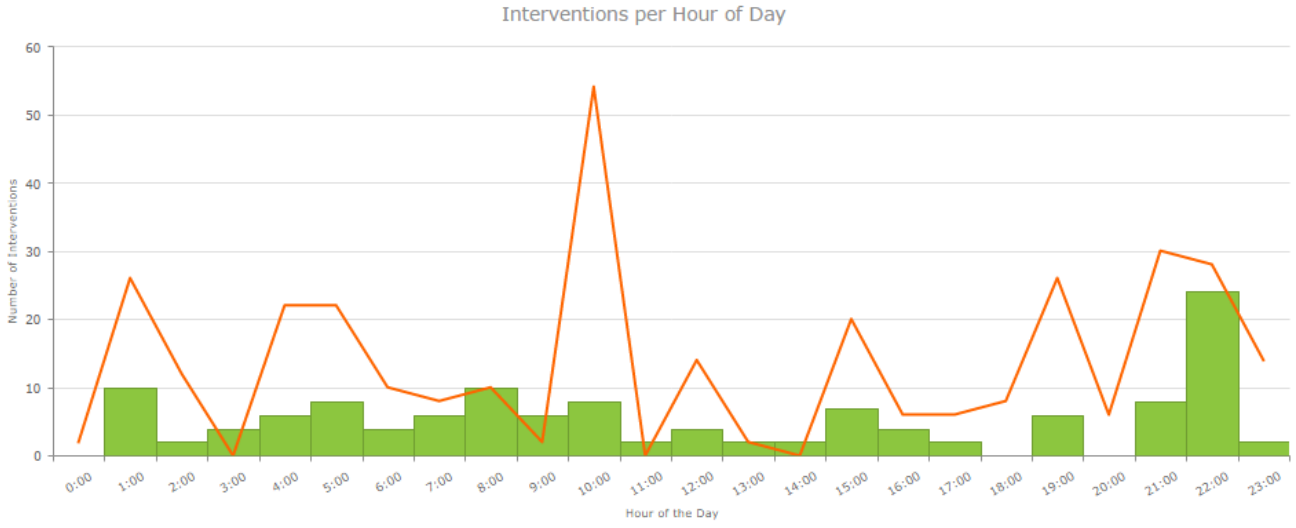
This section shows the individual intervention behaviour in detail. First are the alarm and interventions over time:



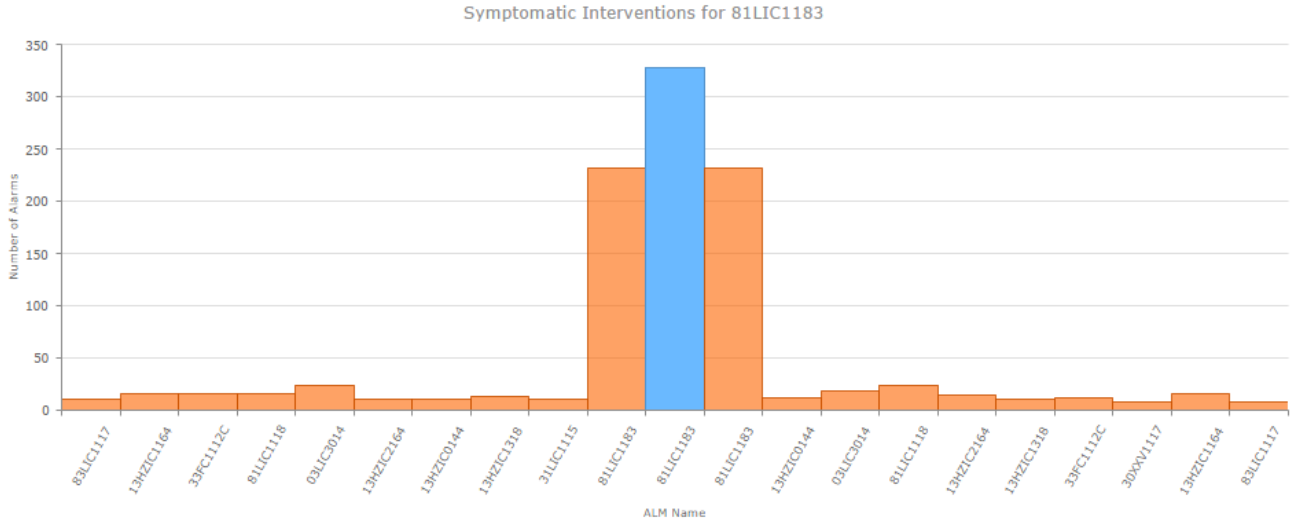
3.8.1 Intervention Detail – Bubble Chart



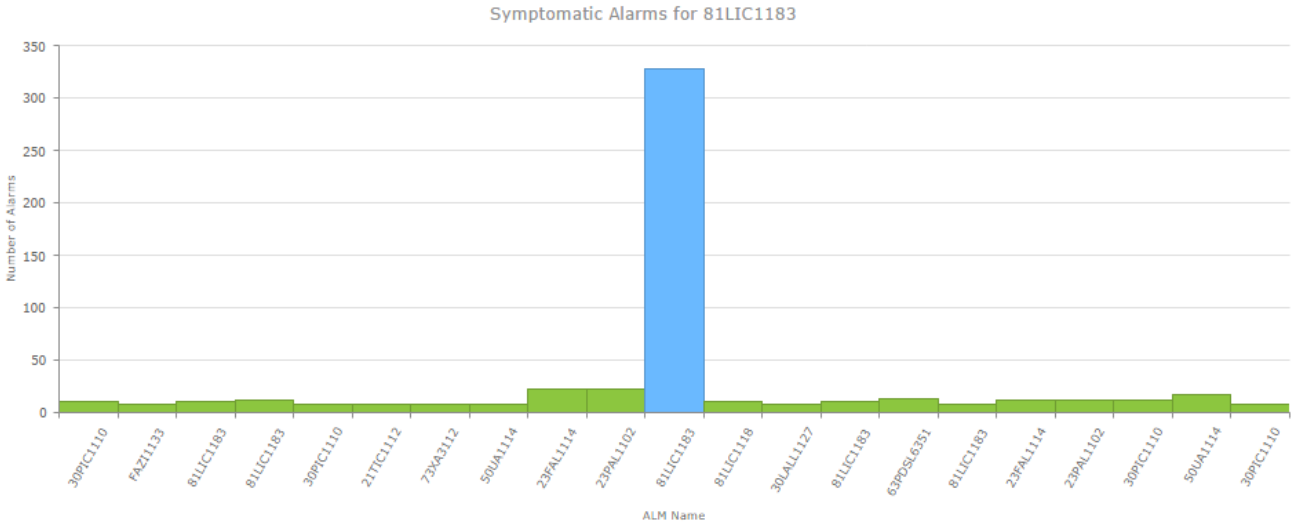
3.8.2 Intervention Detail – Each hour of the day



3.8.3 Intervention Detail – Symptomatic Interventions



3.8.4 Intervention Detail – Symptomatic Alarms



4 Alarm Analysis - Terminology

Absolute alarm	An alarm generated when the alarm trip point is exceeded. For example, a temperature controller may have a high alarm configured at 90 degrees C; the alarm will annunciate as the measured temperature exceeds 90.
Acknowledge	The operator action that confirms recognition of an alarm. Operators often do not Acknowledge alarms until after they dealt with them. They usually do this because if the alarm condition clears it will not disappear from the alarm display if it is not acknowledged. For this reason, the time to acknowledge the alarm is usually not relevant.
Activate	The process of enabling an alarm function within the alarm system. This can also refer to the act of the alarm coming on, which is more properly called "Annunciate".
Adjustable alarm (Operator-set alarm)	An alarm for which the trip point can be changed manually by the operator.
Advanced alarming	A collection of techniques (e.g., state-based alarming, and dynamic prioritization) that can help manage alarm rates in specific situations.
Alarm	An audible and/or visible means of indicating to the operator an equipment malfunction, process deviation, or abnormal condition requiring a timely response.
Alarm attributes (Alarm parameters)	The settings for an alarm within the process control system (e.g., alarm trip point, alarm priority).
Alarm class	A group of alarms with common alarm management requirements (e.g., testing, training, monitoring, and audit requirements).
Alarm deadband	The range through which an input is varied from the alarm trip point necessary to clear the alarm. For example, a temperature controller may have a high alarm configured at 90 degrees C; the alarm will annunciate as the measured temperature exceeds 90; if the deadband is 0.5 degrees C, it will clear when the measured temperature drops below 89.5.
Alarm flood (Alarm shower)	A condition during which the alarm rate is greater than the operator can effectively manage. A flood begins when the alarm rate exceeds 10 alarms per minutes, and clears when the rate drops below 5 alarms per 10 minutes.
Alarm group	A set of alarms with common association (e.g. process unit, process area, equipment set, or service.)
Alarm log (Alarm database, A&E archive).	The repository of alarm records.
Alarm historian	The device which creates the long-term repository for alarm records.
Alarm management (Alarm system management)	The processes and practices for determining, documenting, designing, operating, monitoring, and maintaining alarm systems

Alarm message	A text string displayed with the alarm indication that provides additional information to the operator (e.g., operator action).
Alarm off-delay (Debounce)	The time a process measurement remains in the normal state before the alarm is cleared.
Alarm on-delay	The time a process measurement remains in the alarm state before the alarm is annunciated.
Alarm philosophy	A document that establishes the basic definitions, principles, and processes to design, implement, and maintain an alarm system.
Alarm priority	The importance assigned to an alarm within the alarm system to indicate the urgency of response (e.g. seriousness of consequences and allowable response time).
Alarm summary	A display that lists alarms with selected information (e.g., date, time, priority, and alarm type).
Alarm system	The collection of hardware and software that detects an alarm state, communicates the indication of that state to the operator, and records changes in the alarm state.
Alarm system requirements specification	The document which specifies the details of the alarm system design which are used in selecting components of an alarm system.
Alarm trip point (Alarm limit, Alarm setpoint)	The threshold value of a process variable or discrete state that triggers the alarm indication.
Alarm type (Alarm condition)	The alarm on a process measurement (e.g., low process variable alarm, high process variable alarm or discrepancy alarm).
Alert	An audible and/or visible means of indicating to the operator an equipment or process condition that requires awareness, that is indicated separately from alarm indications, and which does not meet the criteria for an alarm. In some definitions, this would be inaudible.
Allowable response time	The time between the annunciation of the alarm and when the time the operator completes the corrective action to avoid the consequence.
Annunciate	The act of the alarm coming on, which is sometimes referred to as "Activate".
Bad Actor (Nuisance alarm)	An alarm that annunciates excessively, unnecessarily, or does not return to normal after the correct response is taken (e.g., chattering, fleeting, or stale alarms).
Bad measurement alarm (Bad PV)	An alarm generated when the signal for a process measurement is outside the expected range.
Bit-pattern alarm	An alarm that is generated when a pattern of digital signals matches a predetermined pattern.
Calculated alarm	An alarm generated from a calculated value instead of a direct process measurement.

Call-out alarm	An alarm that notifies and informs an operator by means other than, or in addition to, a console display (e.g., pager or telephone).
Chattering alarm	An alarm that repeatedly transitions between the alarm state and the normal state in a short period of time. Specifically, an alarm that annunciates 3 times in one minute.
Clear	An alternate description of the state of an alarm that has transitioned to the normal state.
Console	The interface for an operator to monitor and/or control the process, which may include multiple displays or annunciators, and defines the boundaries of the operator's span of control.
Control & instrumentation system alarm	An alarm generated from faults within the control system hardware, software or components (e.g., a bad field device or communication error).
Control system	A system that responds to input signals from the equipment under control and/or from an operator and generates output signals that cause the equipment under control to operate in the desired manner. Note: The control system may include both Basic Process Control Systems (BPCS) and Safety Instrumented Systems (SIS).
Decommission	The change process to remove an alarm from the alarm system.
Deviation alarm	An alarm generated when the difference between two analog values exceeds a limit (e.g., deviation between primary and redundant instruments or a deviation between process variable and trip point).
Designed suppression	A mechanism to prevent the transmission of the alarm indication to the operator based on process conditions or other condition and implemented within the alarm system.
Discrepancy alarm (Feedback Alarm)	An alarm generated by error between the comparison of an expected plant or device state to its actual state (e.g., when a motor fails to start after it is commanded to the on state).
Dynamic alarming	The automatic modification of alarms based on process state or conditions.
First-out alarm (First-up alarm)	An alarm method, in a multiple-alarm scenario, of determining which alarm occurred first.
Highly managed alarm	An alarm belonging to a class with more requirements than general alarms (e.g., a safety alarm).
Implementation	The transition stage between design and operation during which the alarm is initially put into service.
Latching alarm	An alarm that remains in alarm state after the process has returned to normal and requires an operator reset before it will clear.

Manual safety function alarm (Safety related alarm)	A safety function alarm that indicates an operator action is required to complete a safety function (operator initiated instrumented function).
Master alarm database	The authorized list of rationalized alarms and associated attributes.
Operator	The person who initiates and monitors the operation of a process.
Out-of-service	The state of an alarm during which the alarm indication is suppressed, typically manually, for reasons such as maintenance.
Plant state (Plant mode)	A defined state of operation of a process plant (e.g., shutdown, start-up, operating).
Prioritization	The process of assigning to an alarm a level of importance which can be implemented within the alarm system.
Rate-of-change alarm	An alarm generated when a limit value for the rate of change of a process variable, dPV/dt, is exceeded.
Rationalization	The process to review a potential alarm against the principles of the alarm philosophy to establish and document the rationale and design requirements for the alarm.
Recipe-driven alarm	An alarm with limits that depend on the recipe that is currently being executed.
Remote alarm	An alarm from a remotely operated facility or a remote interface.
Reset	The operator action that unlatches a latched alarm.
Return to normal	The alarm system indication that an alarm condition has transitioned to the normal state.
Re-alarming alarm (Re-triggering alarm)	An alarm that is automatically re-annunciated to the operator under certain conditions.
Safety alarm	An alarm that is classified as critical to process safety or the protection of human life.
Safety diagnostic alarm	An alarm that indicates a fault in a safety function.
Safety function	A function to be implemented by an SIS, other technology safety related system or external risk reduction facilities, which is intended to achieve or maintain a safe state for the process, with respect to a specific hazardous event.
Safety function alarm	An alarm that indicates a demand on a safety function. ISA 18.02 – 2008 CDR 11/2008 17
Shelve	A mechanism, typically initiated by the operator, to temporarily suppress an alarm.
Silence	The operator action that terminates the audible alarm indication.

Stale alarm	An alarm that remains in the alarm state for an extended period of time (e.g., 24 hours).
Standing alarm	An alarm in an active alarm state (e.g., new alarm, ack alarm)
State-based alarm (Mode-based alarms)	An alarm that is automatically modified or suppressed based on process state or conditions.
Station	A single human machine interface within the operator console.
Statistical alarm	An alarm generated based on statistical processing of a process variable or variables.
Suppress	Any mechanism to prevent the indication of the alarm to the operator when the base alarm condition is present (i.e., shelving, designed suppression, out-of-service).
Tag (Point)	The unique identifier assigned to a process measurement, calculation, or device within the control system.
Unacknowledged	A state in which an alarm has not been acknowledged by the operator.

5 Appendix A

EEMUA 191 Rev 2 defined a grid used to determine an alarm system's performance:

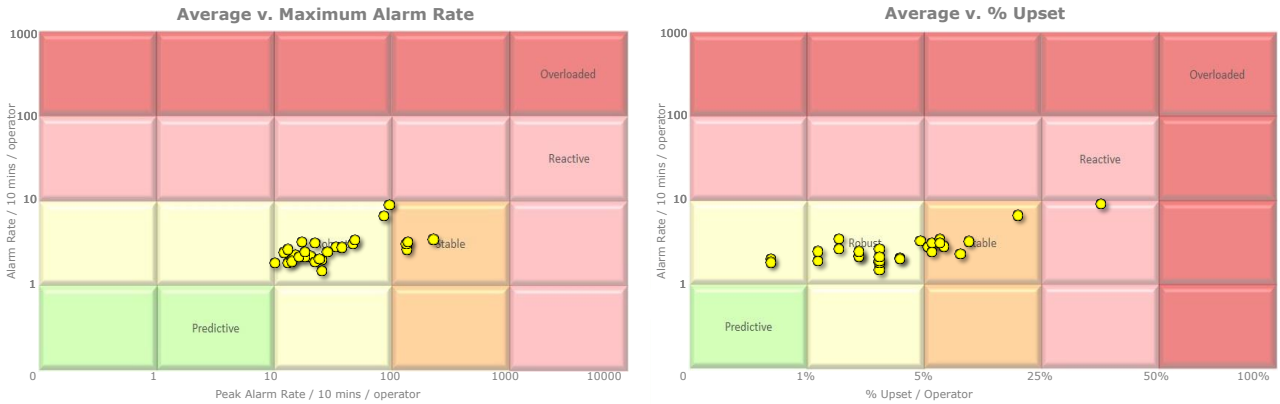


Figure 11 – Performance State Scatter Charts

In Rev 3 this grid has been considerably redefined to better cater for steady and upset behaviour:

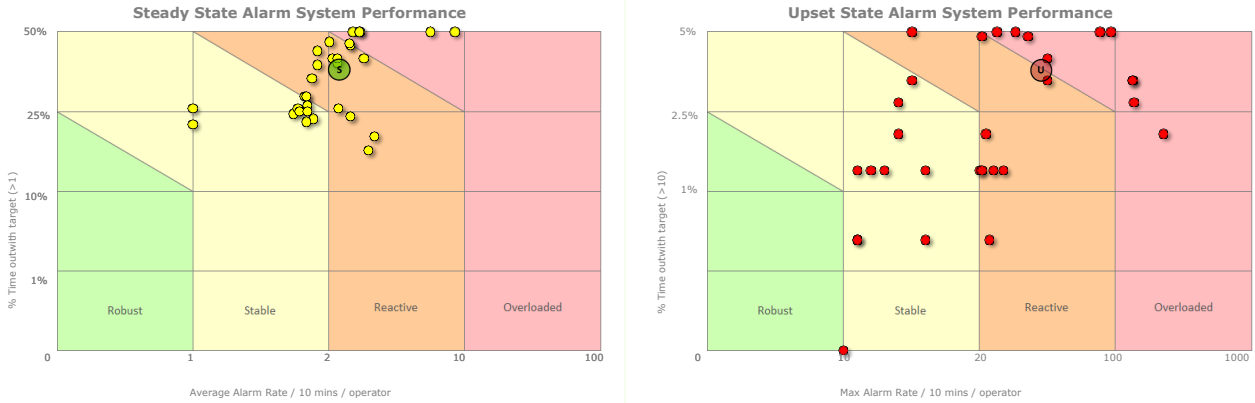


Figure 12 – Revised Performance State Scatter Charts

The same underlying alarm data is used for both pairs of grids.

As well as an overall monthly average, daily values are plotted to give a feel for the range of behaviour that the system exhibits. Two charts are used instead of one to make the pattern of the daily values clearer.

Figure 12 Steady State shows two days where there was a mean average of 1 alarm per 10 minutes, and one day with 9; we should be aware of this and should not hide it within an average.

Figure 12 Upset State similarly shows one day with a maximum alarm rate of 10, while on 3 days it was greater than 100.

There are now four levels of behaviour compared with the previous 5, so for this data the classification goes from mostly robust to reactive. This needs to be taken into account if comparing current performance with that documented in the past; it will only be meaningful if the past performance is measured in the same way.

The larger circle on each chart represents the overall average. It should be noted that the Upset average is not necessarily higher up the chart than the steady state; this is because the scales for each are different.

(Note: I think it was stated during the seminar that data should not be counted where the average alarm rate is greater than 10 alarms per 10 minutes for steady state chart – but this conflicts with the scale on the chart which includes a 10-100 range. It's not obvious that that would be any kind of meaningful number anyway).

A different month with approximately half the number of alarms is shown below:

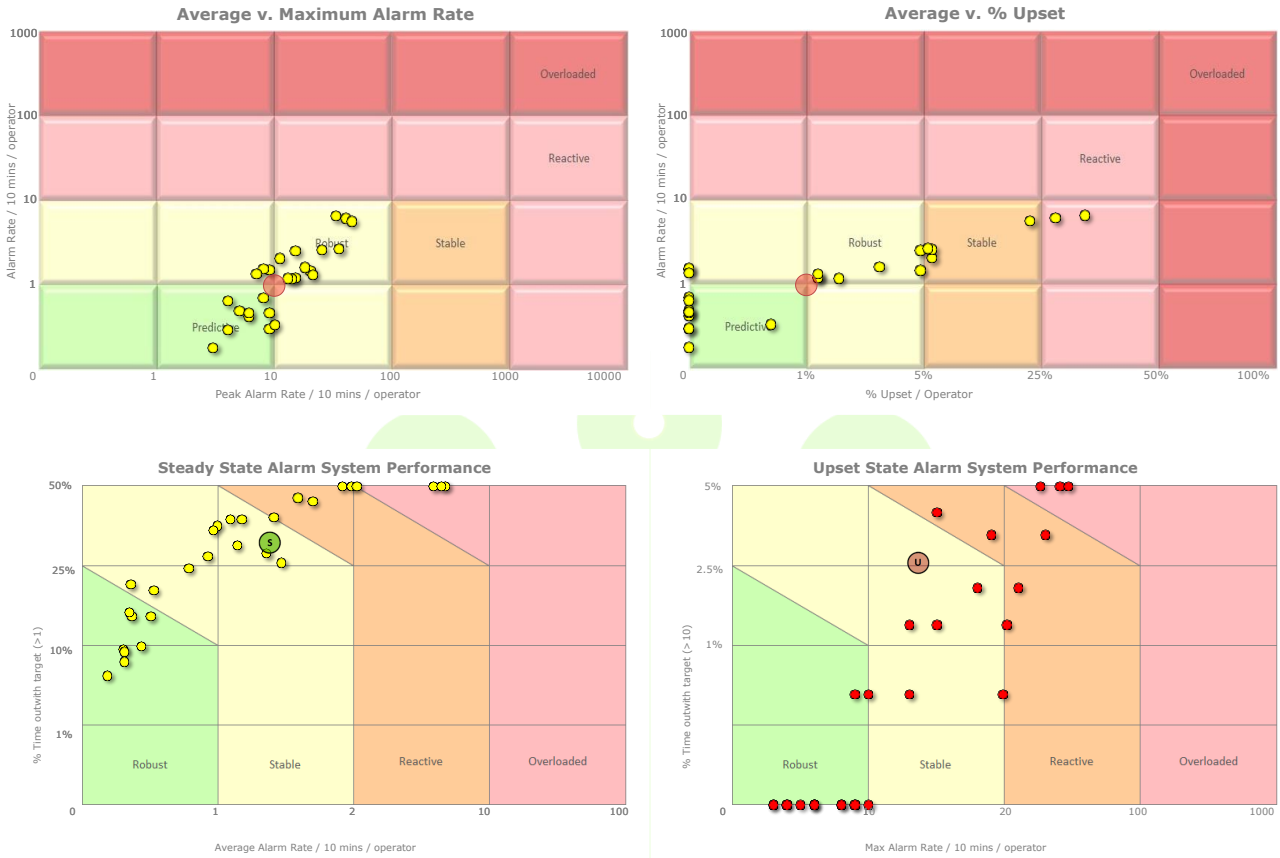


Figure 13 – Performance State Scatter Charts when system is Manageable

A clear shift can be seen on both old and new charts.

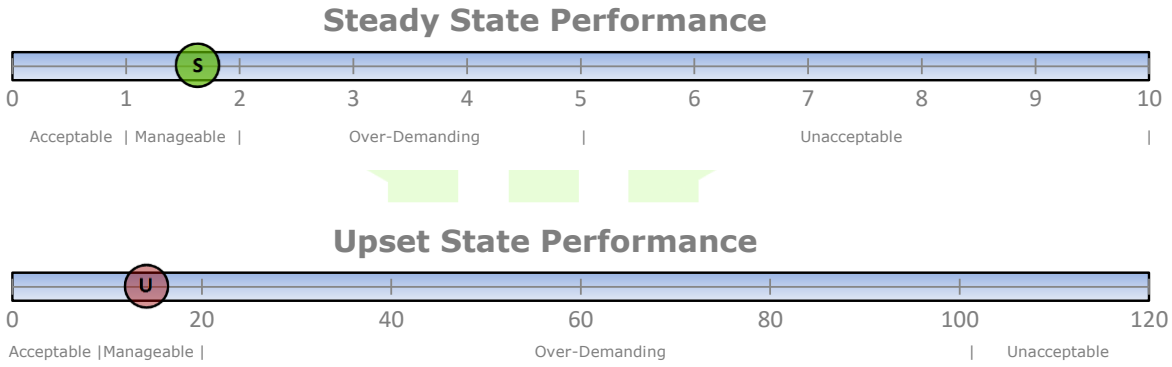


Figure 14 – State performance when system is Manageable

Data with an even lower alarm rate is charted, and discussed below:

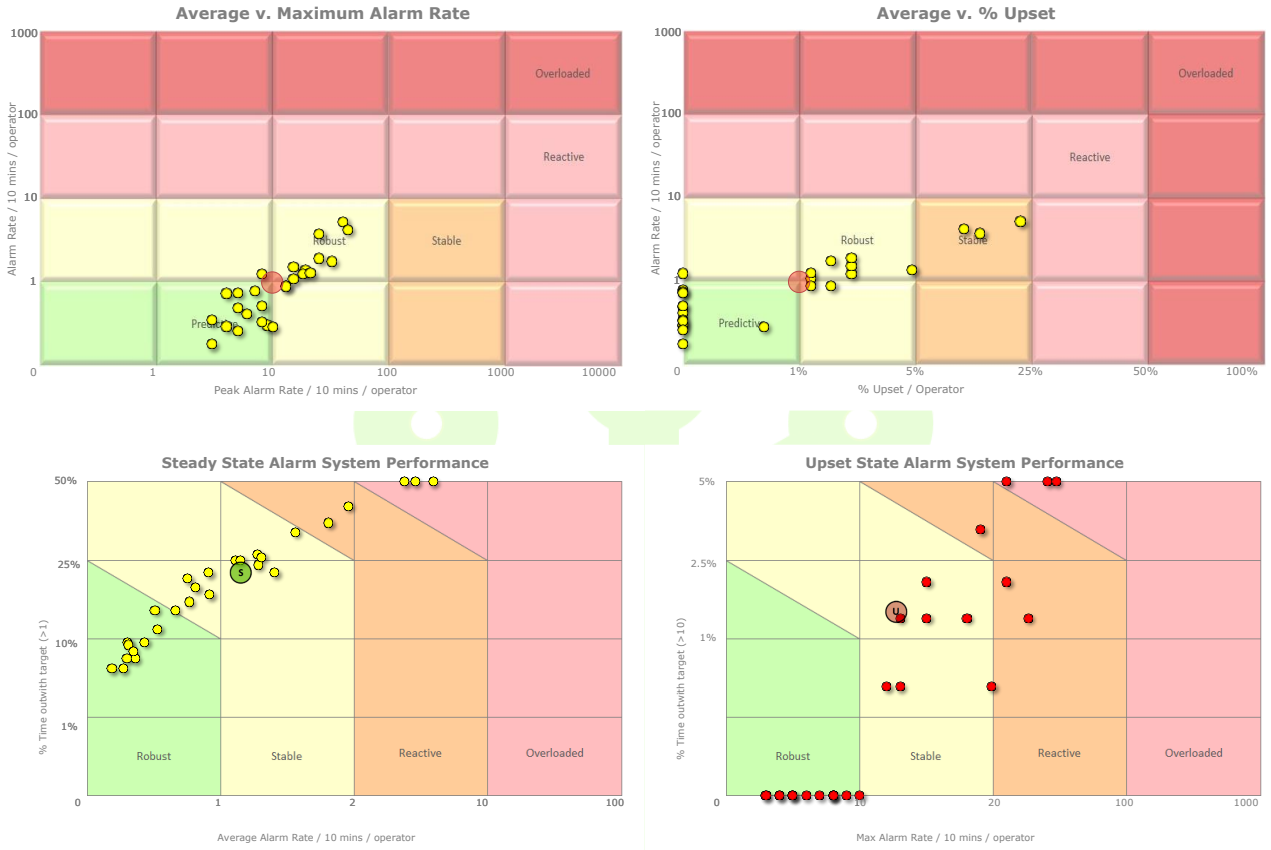


Figure 15 – Performance State Scatter Chart when system is performing well

The steady state scatter chart appears to follow a definite arc. This makes sense because as the average alarm rate rises, so will the % time above the target of 1.

To land in the bottom right square of the steady state chart there needs to be an average of >10 alarms per 10 minutes but less than 1% of the time is the alarm count > 1. This could only happen if there were a few spikes of very high values. 99 ten minute samples with a single 10 minute sample with more than one thousand would be required to achieve this. But this would mean that the steady state is good, it is the upset state that is bad, and that is indicated on the Upset State chart.

We have redefined the Steady State chart thus:

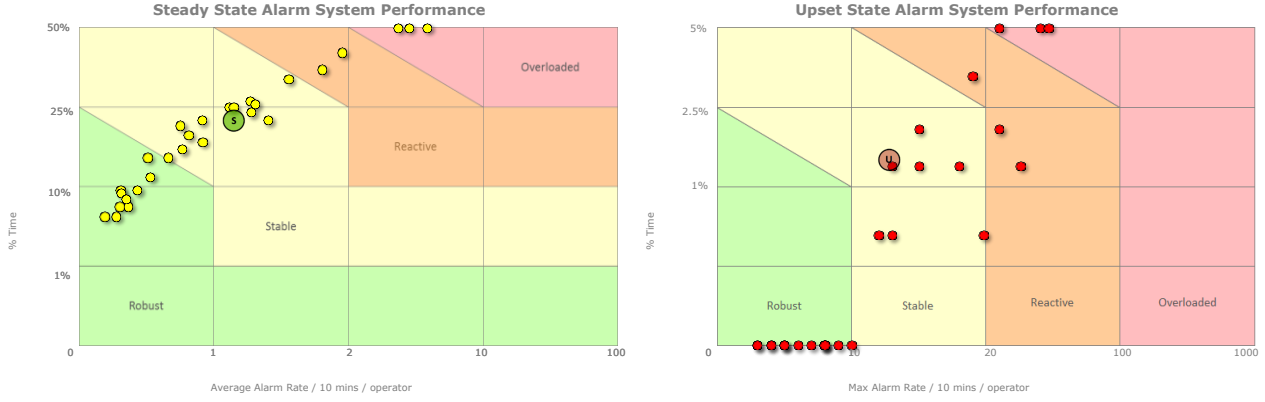
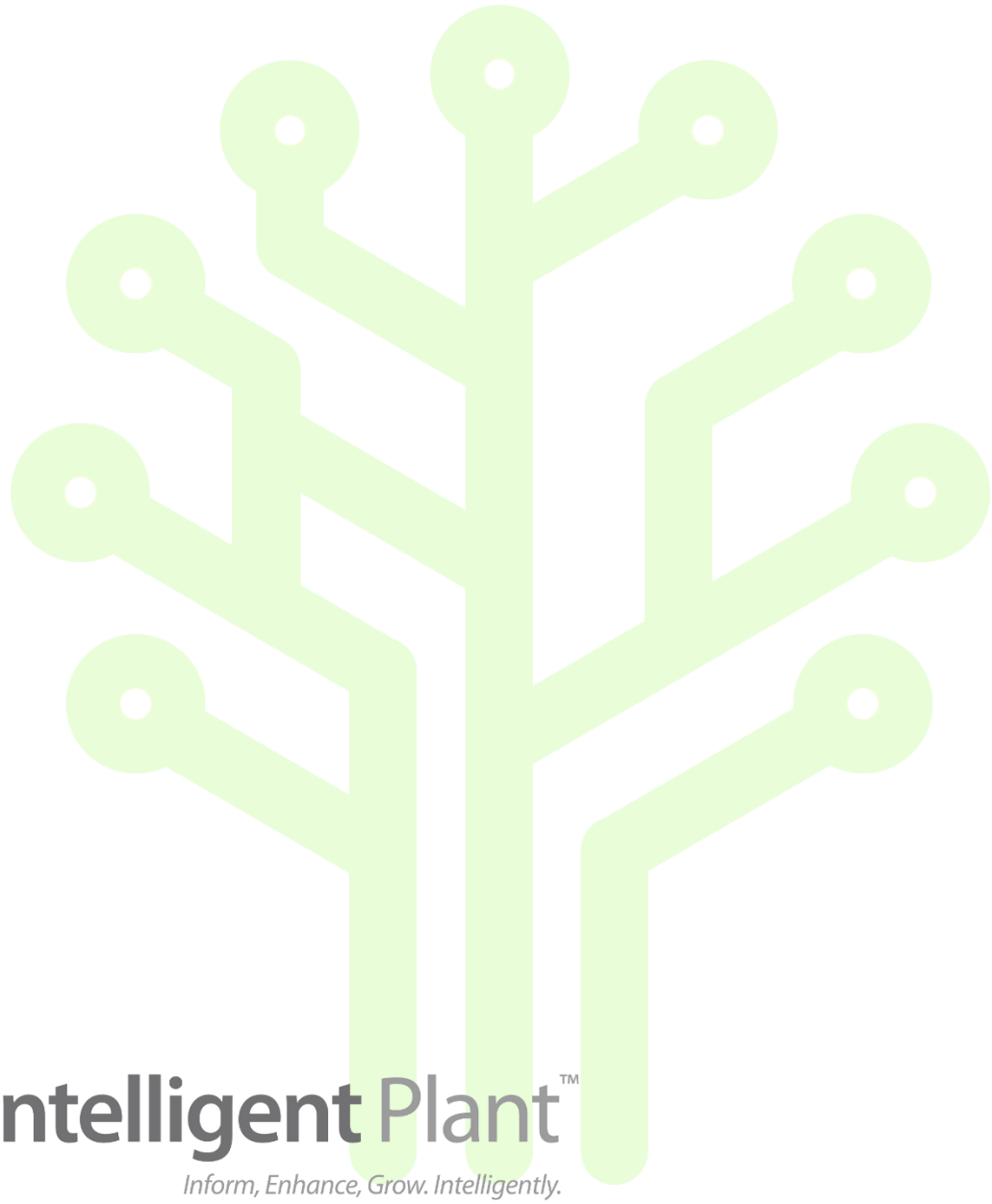


Figure 16 – Performance State Scatter Chart with redrawn Steady State

It should also be noted that in the Upset chart, the first column can only have scatters along the bottom line. This is because the maximum alarm rate is less than the target of 10 alarms per 10 minutes, therefore there is 0% of time above 10 alarms per 10 minutes.



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