



# **Alarm Management Optimization (AMO) at Saudi Aramco**

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# AMO Program Business Driver

AMO Program sprang from a survey conducted on 2004 to measure the alarm management system performance level at Saudi Aramco Facilities.

Most sites were aware that operator overload and alarm floods are common during disturbances and abnormalities of operations.

As we analyzed the issues around alarm management, we concluded that operator problems with the alarm system were outcomes of an inappropriateness of the design, implementation, and maintenance of alarm systems as well as improper alarming practices.

# Program Purpose and Objective

- **Purpose**

**To outline a five-year corporate plan to improve the alarm management system at each plant in Saudi Aramco that will enable the consol operator effectively manage alarms being generated during normal operation and/or abnormal situation.**

- **Objective**

**To achieve the higher Alarm System performance level that delivers higher plant safety, reliability and availability.**



# Program Strategy

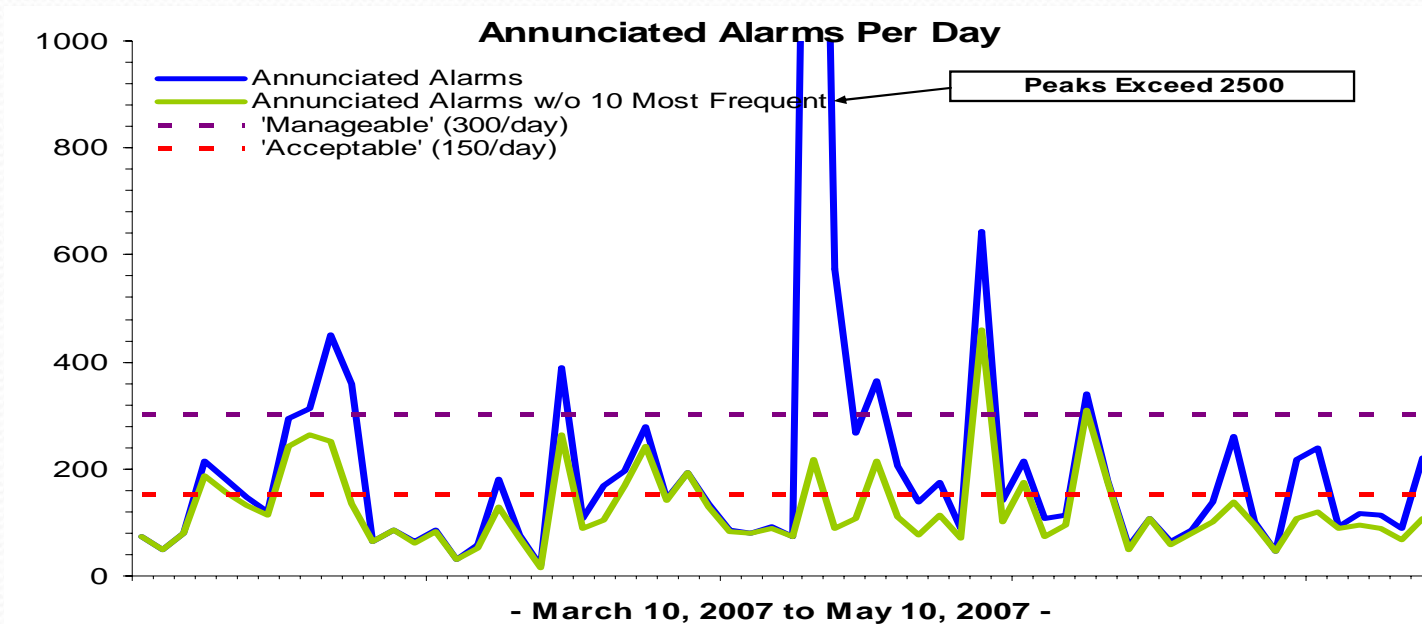
- **Conduct Site Survey**
- **Develop/use Alarm System Management Standard/Procedure**
  - SAER-5895 Alarm Management Guidelines for Process Automation Control
  - SAEP-368, Alarm System Management **(New)**
  - EEMUA, Publication 191 Alarm Systems: A Guide to Design, Management and Procurement
  - ANSI/ISA-18.2 Management of Alarm Systems for the Process Industries
- **Develop Alarm Philosophy**
- **Evaluate AMO Technology Applications**
- **Conduct AMO Training Courses**
- **Conduct Alarm Management Performance Study**
- **Perform Alarm Documentation & Rationalization**
- **Implement the Rationalized Alarms**
- **Implement Real Time Alarm Management**
- **Sustain the Improved Alarm Management System**

# Alarm System key Performance Indicators

KPIs	Interim Target	Long Term Target
Average process Alarm rate	<300 per day	<150 per day
Percentage of time alarm rate exceeds target	5%	0%
Alarm Event Priority Distribution	~80% Low, ~15% High, ~5 Emergency	~80% Low, ~15% High, ~5 Emergency
Suppressed Alarms	Zero (Unless as part of defined Shelving, Flood Suppression, or State-based Strategy)	Zero (Unless as part of defined Shelving, Flood Suppression, or State-based Strategy)
Chattering Alarms	Not more than 10 occurrences/week	0 per day
Stale/Standing Alarms (more than 24 hours old)	Not more than 20 occurrences/week	0 per day
Floods (10 to 20 alarms in a 10 minute period)	Not more than 5 per day	Not more than 3 per day
Floods (>20 alarms in a 10 minute period)	Not more than 3 per day	0 per day
Changes in Alarm Priority, Alarm Trip Point, Alarm , Alarm Suppression	None that are unauthorized	None that are unauthorized

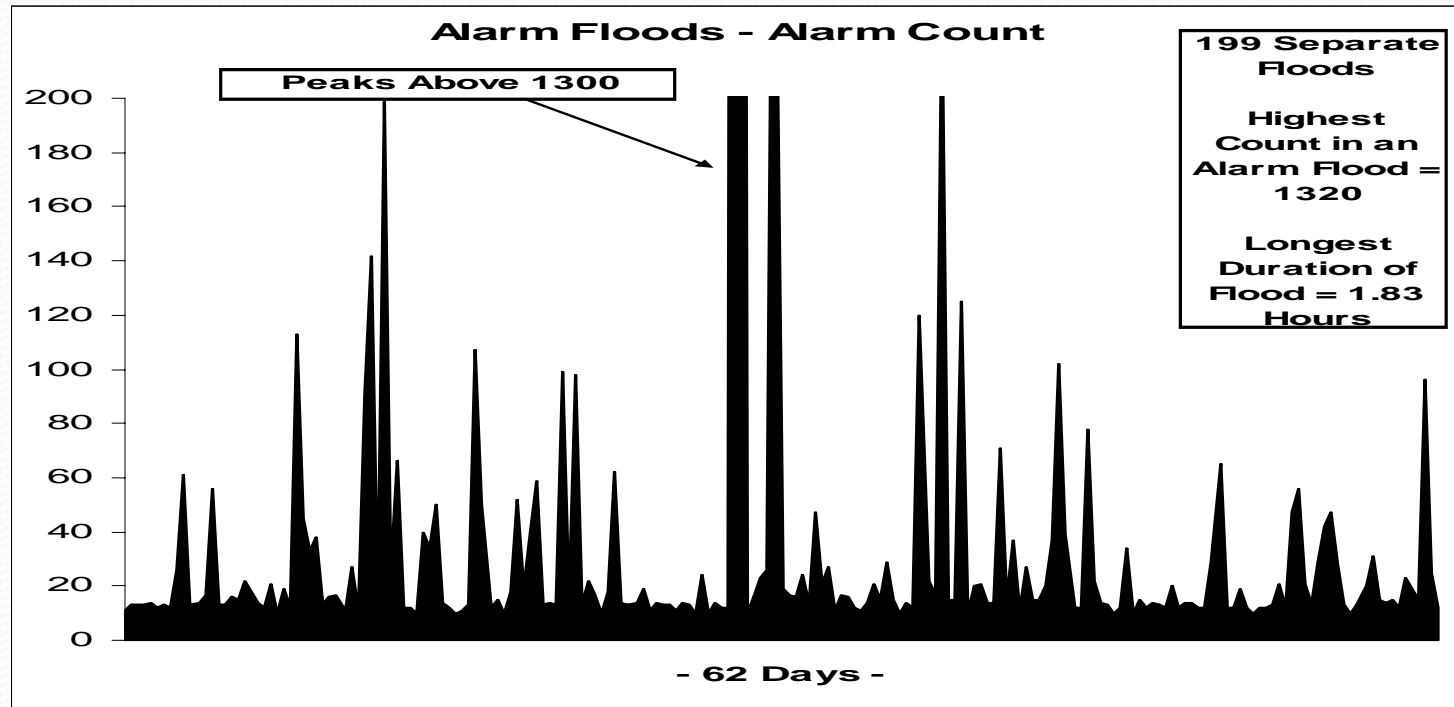


# Alarms Per Day (Annunciated)



	Total Alarms	Average Alarms per Day	Median Alarms per Day	Maximum Alarms per Day	% Of Days More Than 300 Alarms per Day	% Of Days More Than 150 Alarms per Day
<b>Annunciated Alarms</b>	<b>12,979</b>	<b>209</b>	<b>136</b>	<b>2,585</b>	<b>15%</b>	<b>42%</b>
<b>Annunciated Alarms without 10 Most Frequent</b>	<b>7,677</b>	<b>124</b>	<b>101</b>	<b>461</b>	<b>3%</b>	<b>24%</b>

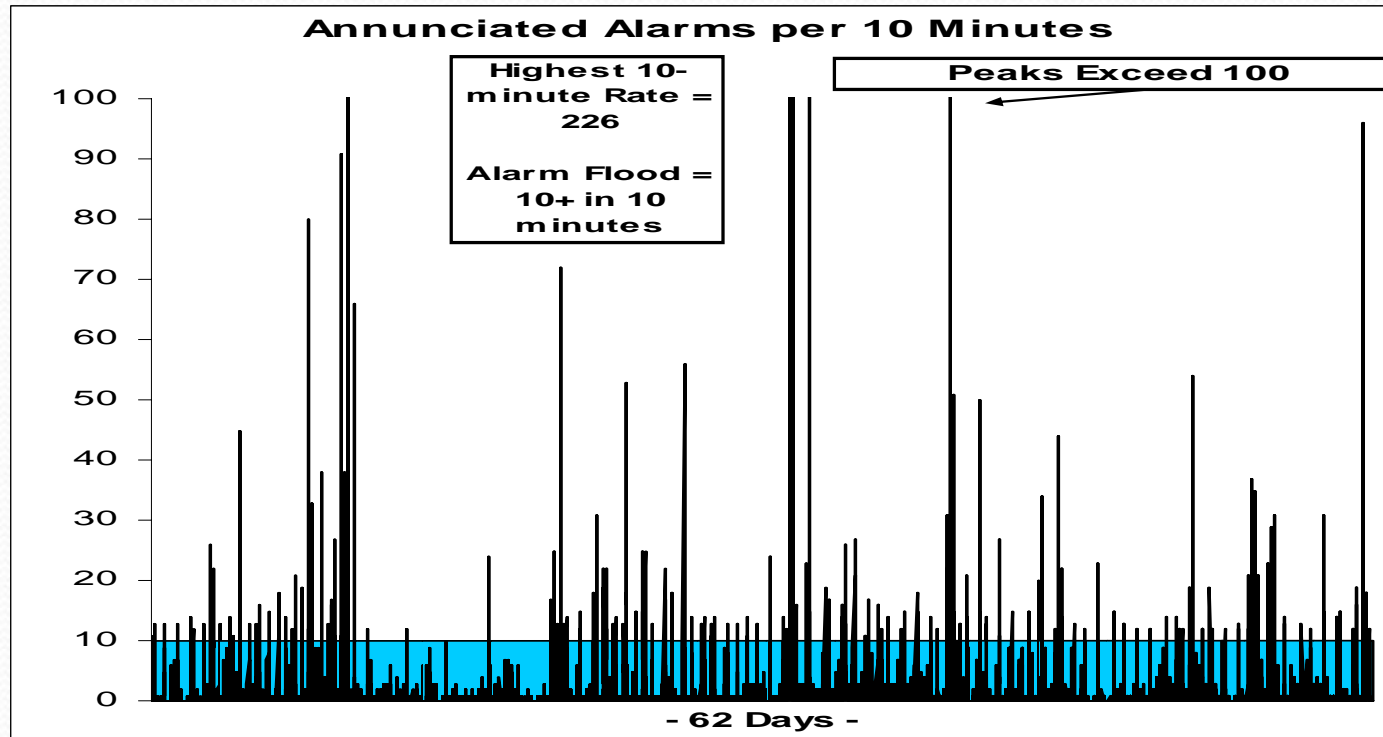
# Alarm Floods - Count



Alarm Flood Analysis			
Number of Floods	199	Highest Alarm Count in a Flood	1,320
Floods Per Day	3.2	Percentage of Alarms in Floods vs. All Annunciated Alarms	61.4%
Total Alarms in All Floods	7,971	Total Duration of Floods, in Hours	51.5
Average Alarms per Flood	40	Percentage of Time Alarm System is in a Flood Condition	3.5%

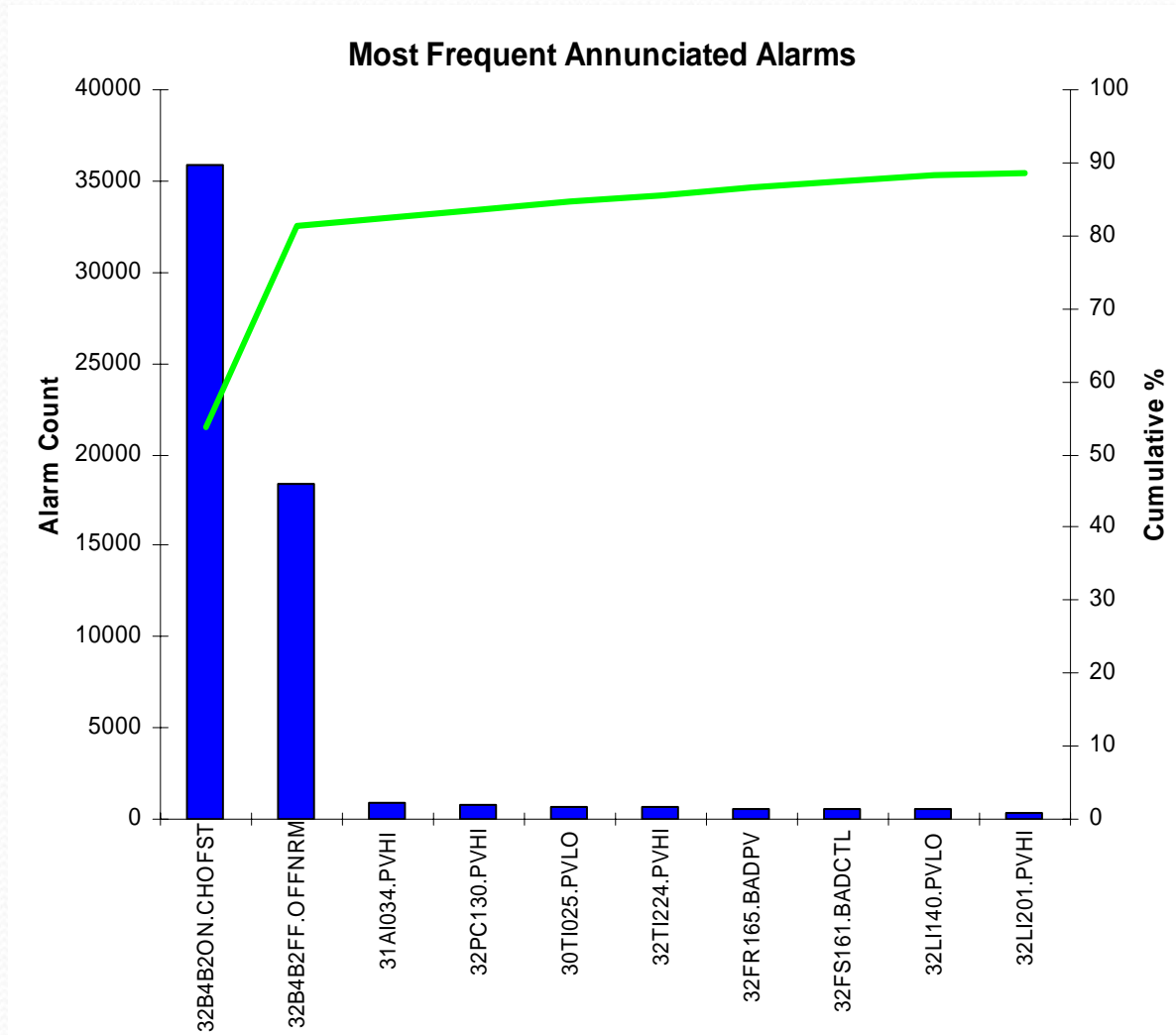


# Average Alarm Rates



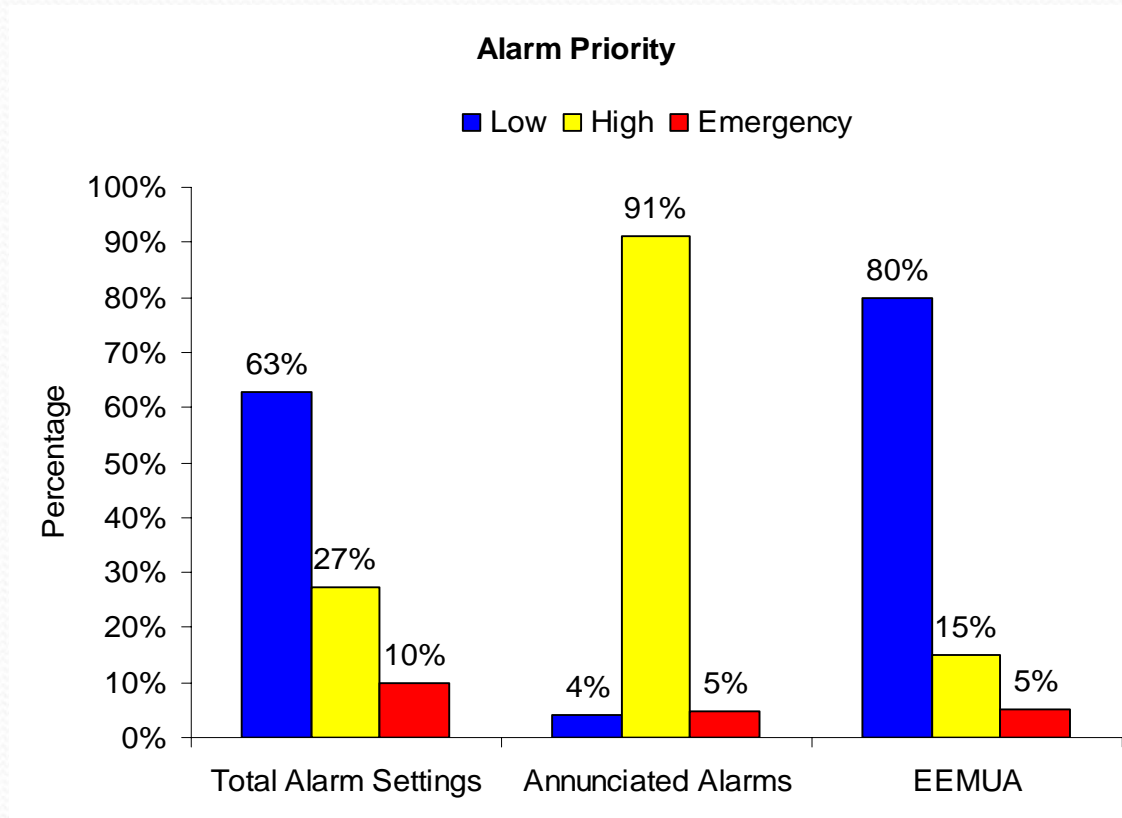
Annunciated Alarms per 10 Min.	= 0	>0	>=10	>20	>30	>50	>100
Cumulative	66.1%	33.9%	3.2%	1.0%	0.6%	0.4%	0.2%
			Flood	Flood	Flood	Flood	Flood
No. of Alarms	0	1-9	10-20	21-30	31-50	51-100	>100
Instances	5893	2744	194	38	21	16	16
% of time	66.1%	30.8%	2.2%	0.4%	0.2%	0.2%	0.2%
Avg. Alarms per 10 minute period:			1.45				

# Frequent Alarms (Annunciated)



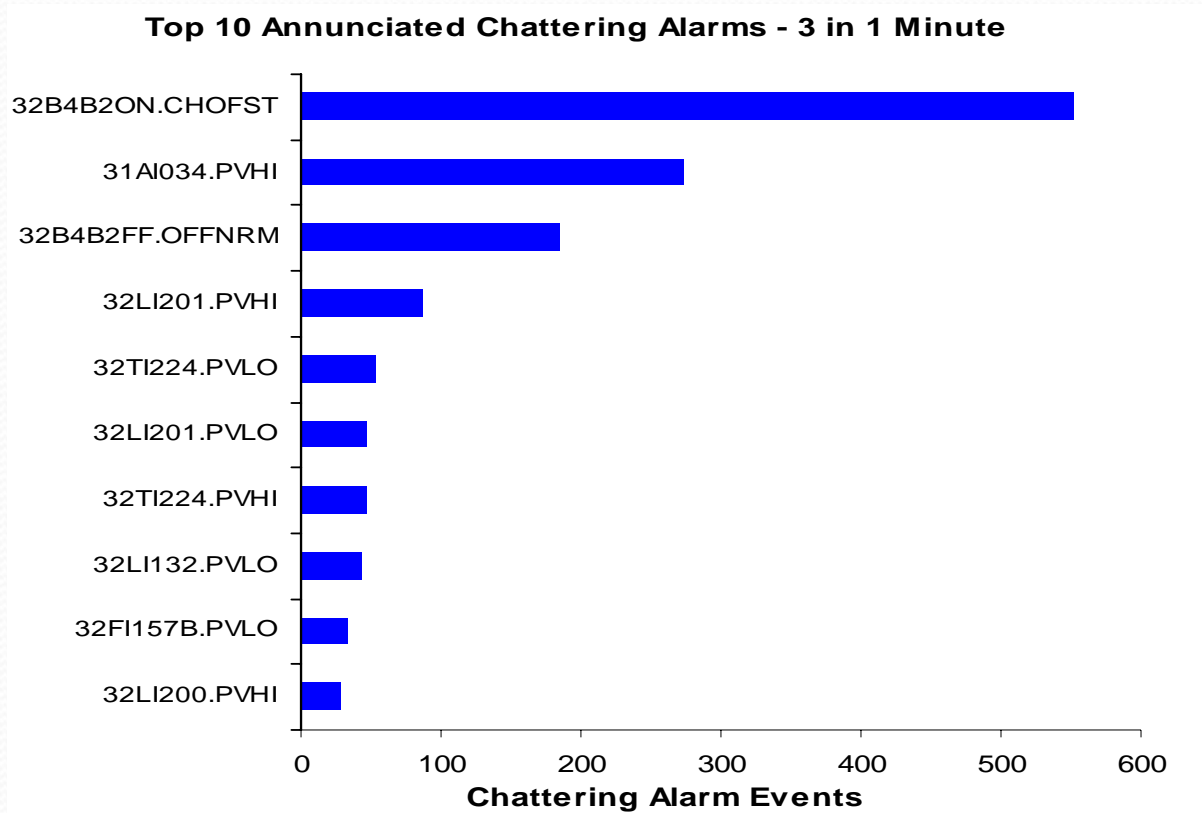


# Priority Distribution



Alarm Priority	Total Alarm Settings		Annunciated Alarms		EEMUA
	Counts	%	Counts	%	%
Journal	407	3%			n/a
Low	8,413	61%	516	4%	80%
High	3,675	27%	11,833	91%	15%
Emergency	1,324	10%	630	5%	5%
Total	13,819	100%	12,979	100%	100%

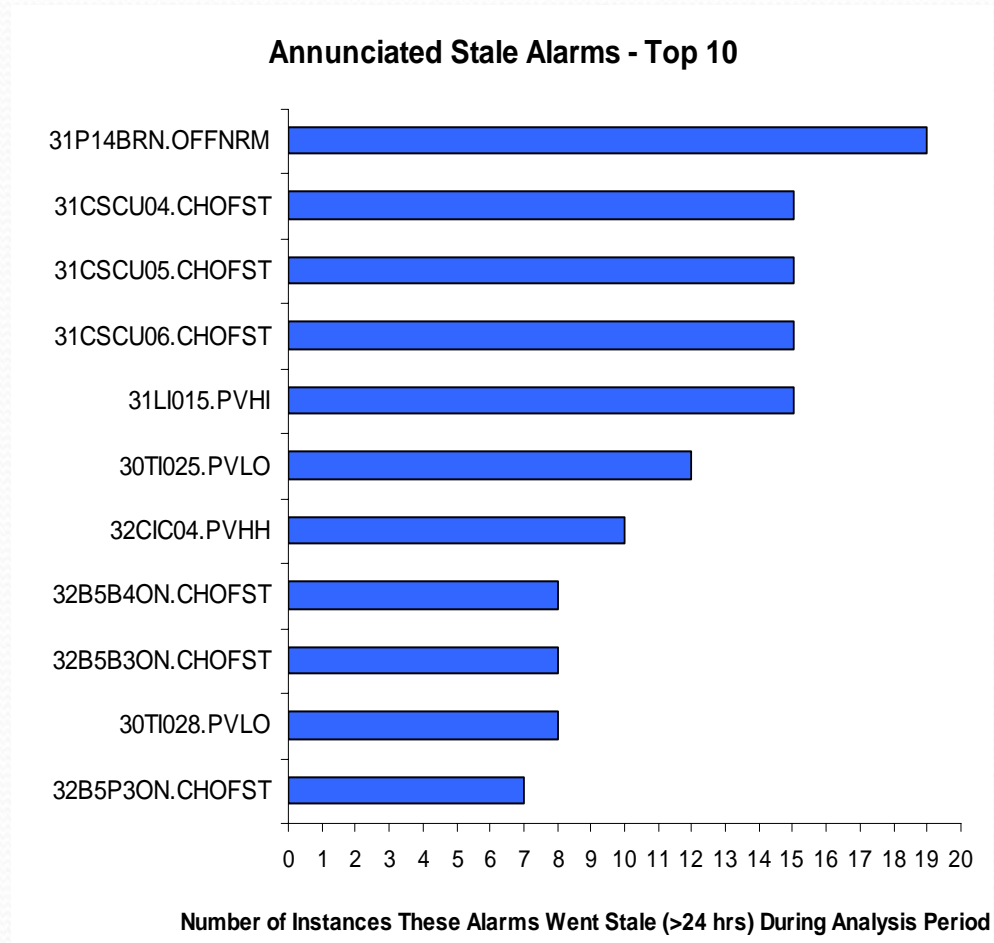
# Chattering Alarms (Annunciated)



Unique Annunciated Chattering Alarms (tag.parameter)	73
Produced These Annunciated Chattering Occurrences (of 3+ alarms in 1 minute)	1,661
Total Chattering Alarm Events:	4,983
Percentage of all Annunciated Alarm Events that are from Chattering Alarms	38.4%

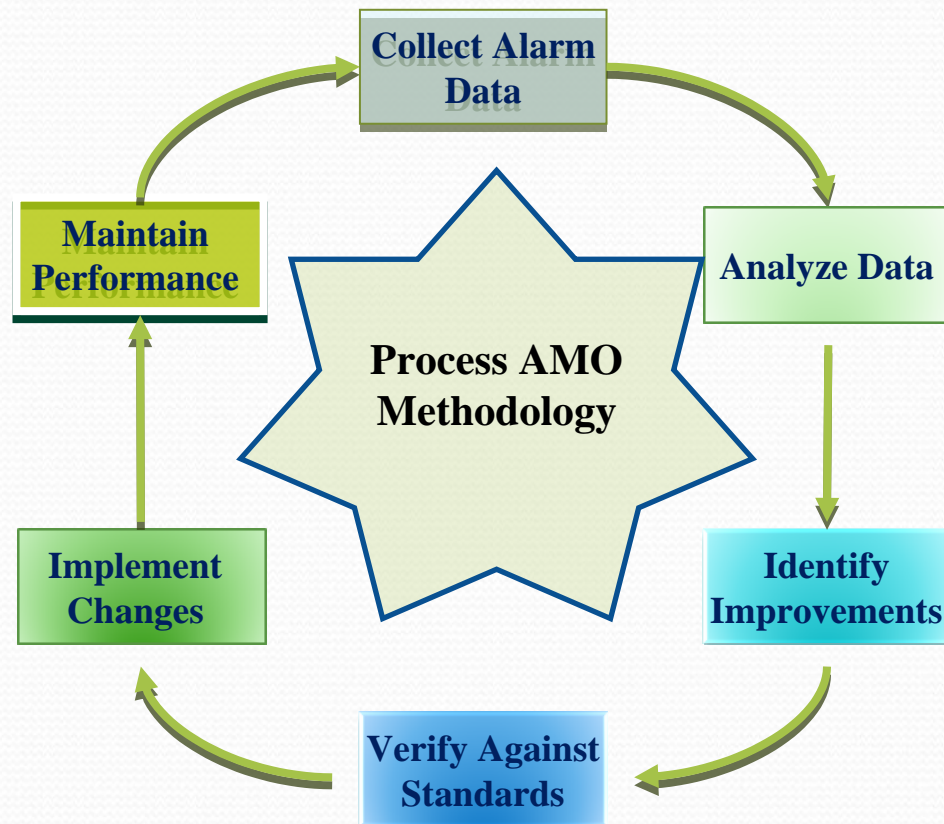


# Stale Alarms (Annunciated)



# Alarm Management Optimization Methodology

- **Conduct Alarm Management System Performance Assessment:**
  - Collect alarm data from existing system
  - Analyze the gathered data
  - Identify improvement
    - Bad Actors Resolutions
    - Rationalization
  - Verify against standards:
    - SAES/SAEP
    - EEMUA: Publication 191, Alarm Systems: A Guide to Design, Management and Procurement
    - ANSI/ISA-18.2: Management of Alarm Systems for the Process Industries
- **Implement Changes**
  - Unnecessary Alarms
  - Trip Points
  - Priorities
  - Calibrations
- **Maintain the Improved Performance:**
  - Conduct post implementation assessment
  - Repeat the same steps as necessary





# Alarm Management Optimization at Gas Plants

- **Berri Gas Plant**
  - Alarm Philosophy Document
  - Bad Actors Resolutions
  - Alarm Rationalization
- **Ju'amah Gas Plant**
  - Alarm Philosophy Document
  - Bad Actors Resolutions
  - Alarm Rationalization
- **Hawiyah Gas Plant**
  - Alarm Philosophy Document
  - Bad Actors Resolutions
  - Alarm Rationalization
- **Hawiyah NGL Recovery Plant**
  - Alarm Philosophy Document
  - Bad Actors Resolutions
- **Uthmaniyah Gas Plant**
  - Alarm Philosophy Document
  - Bad Actors Resolutions
- **Shedgum Gas Plant**
  - Alarm Philosophy Document
  - Bad Actors Resolutions
- **Yanbu Gas Plant**

# Conclusion

- **Evaluate new AMO software applications prior to application to ensure new versions meet SA requirements. AMO software is in a rapid development phase and it is anticipated that regular AMO package evaluations will be necessary.**
- **Target large value added facilities such as Gas Plants and Refineries first.**
- **Provide Corporate Training to users on a regular basis and on a site by site basis.**
- **Conduct annual AMO Roundtable discussion meeting.**
- **Maintain Engineering Guidelines for Alarm Management.**
- **Conduct a post-implementation analysis to measure the improvement of alarm system performance.**
- **Update Control System Standards to reflect the requirements of guidelines for AMO.**





Thank You

Questions