

Improvements in Transmission Control Center Alarm Management Practices

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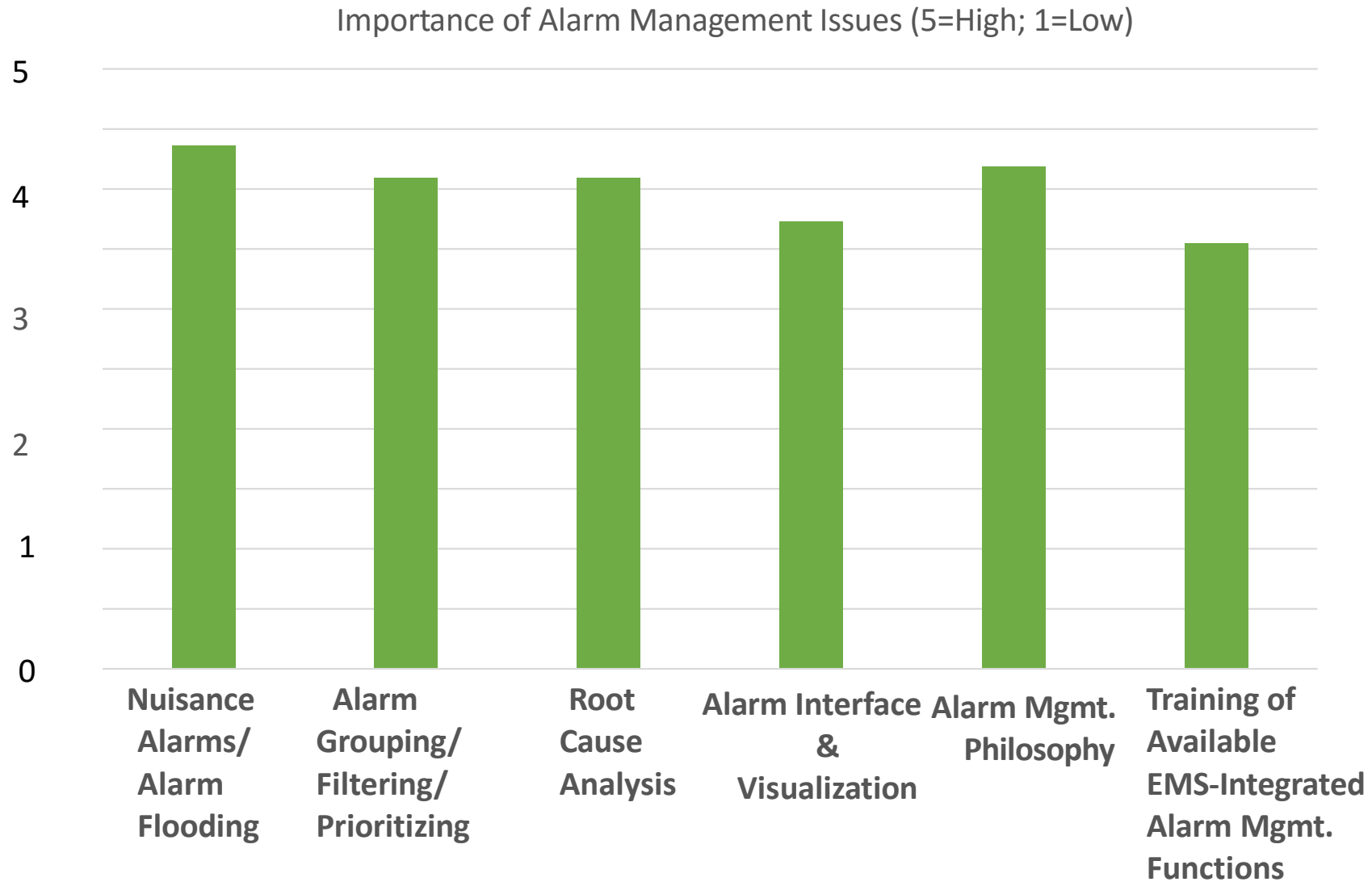


Alarm Management in Control Centers

- Volume & complexity of alarms have been increasing
- Operators interested in better alarm management processes and tools
- EPRI R&D During 2014-2016:
 - 2 Workshops, 2 Surveys, 3 Site Visits, Literature Search
 - Made observations and identified improvement opportunities
 - Prepared a guide to develop an Alarm Management Philosophy document
 - Initiated case studies (to address improvement opportunities)

Alarm Summary											ACK ALL	SILENCE	UNIT A	UNIT C	SysA1G Con MG	10:04:45 02/12/16
											ACK SELECTED	RE-SORT	UNIT B	UNIT D	System Alarms	SUPPRESSION
TIME	EVENT	POINT	DESCRIPTION	TYPE	PRI	AREA	UNITS	TIA	STATE	INDEX						
02/10/16 15:44:12	ALM	477C01C02F	CO2 DO TG BATERIA 1	OFFNRM	2	M5	STATE	0:00:00								
02/10/16 15:44:11	ALM	142D1103	DENSIDADE SODA DILUIDA	PVLO	3	M8	PSI	0:00:01								
02/10/16 15:44:10	ALM	DMDINTA	DEMAND INTERVAL FLAG A	OFFNRM	4	N11	DEGC	0:00:02								
02/10/16 15:44:09	ALM	TLCPILOT	TLC ENERGY PLOT POINT	LOGIC-A	3	K14	AMPS	0:00:03								
02/10/16 15:44:08	ALM	142D1103	DENSIDADE SODA DILUIDA	PVHI	3	L27	PSI	0:00:04								
02/10/16 15:44:07	ALM	170F118	GN PARA COP599	BADPV	3	T78		0:00:05								
02/10/16 15:44:06	ALM	47PH02	PH AGUA SERVICO P/ CEMAP	PVLO	2	H77	PPH	0:00:06								
02/10/16 15:44:05	ALM	148LH20	14870LSEM ESCORVA	OFFNRM	1	BH71	STATE	0:00:07								
02/10/16 15:44:04	RTN	AL5_S01MMFR	SCIMA AJUMPTADCR 5 F 9	PHH	1	Y77	GPH	0:00:08								
02/10/16 15:44:03	ALM	42PAL04	AGUA CLARIFICADA	OFFNRM	3	87N	STATE	0:00:09								
02/10/16 15:44:02	ALM	148LH24	14880LSEM ESCORVA	OFFNRM	2	CC34	STATE	0:00:10								
02/10/16 15:44:01	ALM	42PH02	PH AGUA SERVICO P/ CEMAP	PVHI	3	N11	GPM	0:00:11								
02/10/16 15:44:00	ALM	42AI104	PH AGUA DESCARBONATADA	PVLO	3	K14	MMHG	0:00:12								
02/10/16 15:43:59	ALM	42PH03	PH AGUA CLARIFICADA	PVLO	5	L27	F13/S	0:00:13								
02/10/16 15:43:58	ALM	42PH01	PH AGUA POTAVEL	PVHI	3	T78	MKS	0:00:14								
02/10/16 15:43:57	RTN	148LUC11	NIVEL DO 148V03A	PVLO	2	E077	PSI	0:00:15								
02/10/16 15:43:56	ALM	42PH06	PH 42 TQ 14B	PVHI	2	BH71	PSI	0:00:16								
02/10/16 15:43:55	ALM	74PAL11	FECHA MINIFLUX 74PV20/21	OFFNRM	2	Y77	STATE	0:00:17								
02/10/16 15:42:55	ALM	170PK22	CONDUTIV 42V05AA	BADPV	3	87N		0:01:17								
02/10/16 15:41:55	ALM	42PI101	ENTRADA O.R.	PVLO	4	CC34	FTS/S	0:02:17								
02/10/16 15:40:55	ALM	42PH0117	PHYS DR AL 1A SHG ESTAG	OFFNRM	4	N11	STATE	0:03:17								
02/10/16 15:39:55	ALM	42PH06	PH 42 TQ 14B	PVLO	4	K14	DEGC	0:04:17								
02/10/16 15:38:55	ALM	42PH01	PH AGUA POTAVEL	PVLO	4	L27	PSI	0:05:17								
02/10/16 15:37:55	ALM	42PH03	PH AGUA CLARIFICADA	PVHI	1	T78	DEGC	0:06:17								
02/10/16 15:36:55	ALM	42CIT02C	CONDUTIV 42V05C	PVHI	3	L27	GPH	0:07:17								
02/10/16 15:35:55	RTN	148LH27	14880LSEM ESCORVA	OFFNRM	1	T78	STATE	0:08:17								
02/10/16 15:34:55	ALM	148ZAL05	DOSSANDO CLORO	OFFNRM	2	E077	STATE	0:09:17								
02/10/16 15:33:55	ALM	74PAL01	PRESSAO BAIXA AF RAMAL 1	OFFNRM	4	BH71	STATE	0:10:17								
02/10/16 15:32:55	ALM	47PAL18	PRESS M BAIXA EXTRACAO	OFFNRM	4	Y77	STATE	0:11:17								
02/10/16 15:31:55	ALM	180P1400	GN P/ DA SULGAS	PVHI	4	87N	GPH	0:12:17								
02/10/16 15:30:55	ALM	42PH0103	PHYS DR ALTA SHG ESTAG	OFFNRM	1	T78	STATE	0:13:17								
02/10/16 15:29:55	ALM	42CIT01D	CONDUTIV 42V05D	PVHI	2	E077	FTS/S	0:14:17								
02/10/16 15:28:55	ALM	174PALC02	PARTIDA AUTO 88A DIESEL	OFFNRM	3	BH71	STATE	0:15:17								
02/10/16 15:27:55	ALM	42XAL35A	DESLEGADO SKID A	OFFNRM	3	Y77	STATE	0:16:17								
02/10/16 15:26:55	RTN	AL5_S01MMFR	SCIMA AJUMPTADCR 5 F 9	PHH	3	X7N	F13/S	0:17:17								
02/10/16 15:25:55	ALM	174PALC01	PARTIDA AUTO 88A DIESEL	OFFNRM	3	T78	STATE	0:18:17								
02/10/16 15:24:55	ALM	148LH22	14880LSEM ESCORVA	OFFNRM	2	H77	STATE	0:19:17								
02/10/16 15:23:55	ALM	42XAL35C	DESLEGADO SKID C	OFFNRM	2	BH71	STATE	0:20:17								
02/10/16 15:22:55	ALM	42A4H104	CONDUTIV ALTA SKID	OFFNRM	2	Y77	STATE	0:21:17								
02/10/16 15:21:55	ALM	42PV117	DESCARGA 42B05A/B/C/D/E	PVHI	2	87N	DEGC	0:22:17								

Aug. 2015 Alarm Management Workshop and Follow-Up Survey



Transmission Control Center Alarm Management Practices – Observations and Improvement Opportunities

3002009925

- 3002009925 – **Free to public**
- 30-Page report published in March 2017
- Contents: Chapter 17 of 3002008274 published in November 2016

Improvement Suggestions

1. Develop and adopt an Alarm Philosophy Document
2. Segregate TCC alarm data. Isolate “true alarms.”
3. Assign alarm priorities based on accepted practices
4. Ongoing: Monitor alarm system performance using accepted key performance indices (KPIs)
5. Identify and resolve the most frequent and nuisance alarms
6. Develop new higher level graphics

Definition of An “Alarm”

- IEC/ISA: An alarm is “a visible and audible notification to the operator, of an **equipment malfunction, process deviation, or abnormal condition requiring a timely operator response.**”
 - An intentional interruption to the operator
 - ***Reserved*** only for notification of situations that require the operator to take action
 - Timely Response: Immediate to within 30 minutes

Observation: TCC Alarm System

- TCC “alarms” currently consist of scrolling data strings on operator consoles that can be segregated into 3 categories:
 1. **Alarm** - actionable in immediate timeframe
 2. **System Status Information** - for operators’ situational awareness
 3. **Pass Through Information** - that does not require any operator awareness or action (meant for equipment personnel).

Improvement Suggestion: Segregation of Alarm Data

1. TCC Alarm System

- A separate EMS window to display “true alarms”

2. System Status Indication System

- A different EMS window to display system status notifications (used for situational awareness)

3. Pass-Through Information

- Transmit directly to the interested staff (e.g. equipment SMEs)

This does not require EMS replacement or even upgrade.

EMS Segregation:

Alarm Summary										ACK AB	SILENCE	UNIT A	UNIT C	SysA16 Con MS	10-04-45 02/12/16
										ACK SELECTED	RE-SORT	UNIT B	UNIT D	System Events	SUPPRESSION
TIME	EVENT	POINT	DESCRIPTION	TYPE	PRI	AREA	UNITS	ITA	STATE	INDEX					
02/10/16 15:44:11	ALM	4770ZC02P	CO2 DO TQ - MATERIA 1	OFFNRM	2	M8	STATE	0:00:00							
02/10/16 15:44:11	ALM	142D105	DENSIDADE SODA DILUIDA	PVLO	3	M8	PSI	0:00:01							
02/10/16 15:44:20	ALM	180M02A	DEMANDO INTERVAL FLAG A	OFFNRM	5	N11	DEGC	0:00:02							
02/10/16 15:44:20	ALM	180M02A	TLC ENERGY PLOT POINT	LOGIC-A	5	K14	AMPS	0:00:03							
02/10/16 15:44:28	ALM	142D105	DENSIDADE SODA DILUIDA	PVHI	5	L27	PSI	0:00:04							
02/10/16 15:44:28	ALM	148LH10	NIVEL DO 148V03A	BADPV	5	TT78	DEGC	0:00:05							
02/10/16 15:44:28	ALM	42PH02	PH AGUA SERVICO P/ CEMAP	PVLO	5	ED77	PPH	0:00:06							
02/10/16 15:44:28	ALM	148LH20	148B01A SEM ESCORVA	OFFNRM	2	BH71	STATE	0:00:07							
02/10/16 15:44:00	ALM	42A104	PH AGUA DESCARBONATA	PVLO	3	K14	MMHG	0:00:12							
02/10/16 15:45:59	ALM	42PH05	PH AGUA CLARIFICADA	PVLO	3	L27	FTS/S	0:00:13							
02/10/16 15:45:58	ALM	42PH01	PH AGUA POTAVEL	PVHI	3	TT78	MKS	0:00:14							
02/10/16 15:43:57	RTN	148LH11	NIVEL DO 148V04A	PSI	3	ED77	PSI	0:00:15							
02/10/16 15:43:56	ALM	42PH06	PH 42-TQ-148	PVHI	3	BH71	PSI	0:00:16							
02/10/16 15:43:55	ALM	74PALL1	FECHA MINIFLUX 74PV20/21	PVHI	3	Y77	STATE	0:00:17							
02/10/16 15:42:55	ALM	170PX22	CONDUTIV 42V05A	ROG+	3	87N	STATE	0:01:17							
02/10/16 15:40:55	ALM	42PDAM112	PRES DIF ALTA SEG ESTAG	BADPV	4	N11	STATE	0:03:17							
02/10/16 15:39:55	ALM	42PH06	PH 42-TQ-148	BADPV	4	K14	DEGC	0:06:17							
02/10/16 15:38:55	ALM	42PH01	PH AGUA POTAVEL	BADPV	4	L27	PSI	0:05:17							
02/10/16 15:37:55	ALM	42PH05	PH AGUA CLARIFICADA	BADPV	4	TT78	DEGC	0:06:17							

To Be:

The EMS ALARM SYSTEM

ALARM Summary										ACK AB	SILENCE	UNIT A	UNIT C	SysA16 Con MS	10-04-45 02/12/16
										ACK SELECTED	RE-SORT	UNIT B	UNIT D	System Events	SUPPRESSION
TIME	EVENT	POINT	DESCRIPTION	TYPE	PRI	AREA	UNITS	ITA	STATE	INDEX					
02/10/16 15:44:11	ALM	4770ZC02P	CO2 DO TQ - MATERIA 1	OFFNRM	2	M8	STATE	0:00:00							
02/10/16 15:44:11	ALM	142D105	DENSIDADE SODA DILUIDA	PVLO	3	M8	PSI	0:00:01							
02/10/16 15:44:20	ALM	180M02A	DEMANDO INTERVAL FLAG A	OFFNRM	5	N11	DEGC	0:00:02							
02/10/16 15:44:20	ALM	180M02A	TLC ENERGY PLOT POINT	LOGIC-A	5	K14	AMPS	0:00:03							
02/10/16 15:44:28	ALM	42PH02	PH AGUA SERVICO P/ CEMAP	PVLO	5	ED77	PPH	0:00:06							
02/10/16 15:44:28	ALM	148LH10	148B01A SEM ESCORVA	OFFNRM	2	BH71	STATE	0:00:07							
02/10/16 15:44:00	ALM	42A104	PH AGUA DESCARBONATA	PVLO	3	K14	MMHG	0:00:12							
02/10/16 15:45:59	ALM	42PH05	PH AGUA CLARIFICADA	PVLO	3	L27	FTS/S	0:00:13							
02/10/16 15:45:58	ALM	42PH01	PH AGUA POTAVEL	PVHI	3	TT78	MKS	0:00:14							
02/10/16 15:43:57	RTN	148LH11	NIVEL DO 148V04A	PSI	3	ED77	PSI	0:00:15							
02/10/16 15:43:56	ALM	42PH06	PH 42-TQ-148	PVHI	3	BH71	PSI	0:00:16							
02/10/16 15:43:55	ALM	74PALL1	FECHA MINIFLUX 74PV20/21	PVHI	3	Y77	STATE	0:00:17							
02/10/16 15:42:55	ALM	170PX22	CONDUTIV 42V05A	ROG+	3	87N	STATE	0:01:17							
02/10/16 15:40:55	ALM	42PDAM112	PRES DIF ALTA SEG ESTAG	BADPV	4	N11	STATE	0:03:17							
02/10/16 15:39:55	ALM	42PH06	PH 42-TQ-148	BADPV	4	K14	DEGC	0:06:17							
02/10/16 15:38:55	ALM	42PH01	PH AGUA POTAVEL	BADPV	4	L27	PSI	0:05:17							
02/10/16 15:37:55	ALM	42PH05	PH AGUA CLARIFICADA	BADPV	4	TT78	DEGC	0:06:17							

STATUS EVENT Summary										ACK AB	SILENCE	UNIT A	UNIT C	SysA16 Con MS	10-04-45 02/12/16
										ACK SELECTED	RE-SORT	UNIT B	UNIT D	System Events	SUPPRESSION
TIME	EVENT	POINT	DESCRIPTION	TYPE	PRI	AREA	UNITS	ITA	STATE	INDEX					
02/10/16 15:44:11	ALM	4770ZC02P	CO2 DO TQ - MATERIA 1	OFFNRM	2	M8	STATE	0:00:00							
02/10/16 15:44:11	ALM	142D105	DENSIDADE SODA DILUIDA	PVLO	3	M8	PSI	0:00:01							
02/10/16 15:44:20	ALM	180M02A	DEMANDO INTERVAL FLAG A	OFFNRM	5	N11	DEGC	0:00:02							
02/10/16 15:44:20	ALM	180M02A	TLC ENERGY PLOT POINT	LOGIC-A	5	K14	AMPS	0:00:03							
02/10/16 15:44:28	ALM	42PH02	PH AGUA SERVICO P/ CEMAP	PVLO	5	ED77	PPH	0:00:06							
02/10/16 15:44:28	ALM	148LH10	148B01A SEM ESCORVA	OFFNRM	2	BH71	STATE	0:00:07							
02/10/16 15:44:00	ALM	42A104	PH AGUA DESCARBONATA	PVLO	3	K14	MMHG	0:00:12							
02/10/16 15:45:59	ALM	42PH05	PH AGUA CLARIFICADA	PVLO	3	L27	FTS/S	0:00:13							
02/10/16 15:45:58	ALM	42PH01	PH AGUA POTAVEL	PVHI	3	TT78	MKS	0:00:14							
02/10/16 15:43:57	RTN	148LH11	NIVEL DO 148V04A	PSI	3	ED77	PSI	0:00:15							
02/10/16 15:43:56	ALM	42PH06	PH 42-TQ-148	PVHI	3	BH71	PSI	0:00:16							
02/10/16 15:43:55	ALM	74PALL1	FECHA MINIFLUX 74PV20/21	PVHI	3	Y77	STATE	0:00:17							
02/10/16 15:42:55	ALM	170PX22	CONDUTIV 42V05A	ROG+	3	87N	STATE	0:01:17							
02/10/16 15:40:55	ALM	42PDAM112	PRES DIF ALTA SEG ESTAG	OFFNRM	5	N11	STATE	0:03:17							
02/10/16 15:39:55	ALM	42PH06	PH 42-TQ-148	PVLO	3	K14	DEGC	0:04:17							
02/10/16 15:38:55	ALM	42PH01	PH AGUA POTAVEL	PVHI	3	L27	PSI	0:05:17							
02/10/16 15:37:55	ALM	42PH05	PH AGUA CLARIFICADA	PVHI	3	TT78	DEGC	0:06:17							
02/10/16 15:36:55	ALM	42C102C	CONDUTIV 42V05C	PVHI	3	L27	GPH	0:07:17							
02/10/16 15:35:55	RTN	148LH12	TANQUE 148V04	OFFNRM	5	TT78	STATE	0:08:17							
02/10/16 15:34:55	ALM	148ZAL06	DOSANDO CLORO	OFFNRM	5	ED77	STATE	0:09:17							
02/10/16 15:33:55	ALM	74PALL1	PRESSAO BAIXA AF BAMA 1	OFFNRM	5	BH71	STATE	0:10:17							
02/10/16 15:32:55	ALM	180F400	PRESSAO BAIXA EXTRACAO	OFFNRM	5	Y77	STATE	0:11:17							
02/10/16 15:31:55	ALM	180F400	GN P/ DA SUGLAS	PVHI	5	87N	GPH	0:12:17							
02/10/16 15:30:55	ALM	42PDAM103	PRES DIF ALTA SEG ESTAG	OFFNRM	5	TT78	STATE	0:13:17							
02/10/16 15:29:55	ALM	42C102D	CONDUTIV 42V05D	PVHI	5	ED77	FTS/S	0:14:17							
02/10/16 15:28:55	ALM	17APALC02	PARTIDA AUTO BBA DIESEL	OFFNRM	3	BH71	STATE	0:15:17							

Philosophy Document

- **A Comprehensive Set of Guideline for**
 - Alarm development, implementation, maintenance, treatment and modification
 - Roles & Responsibilities

- **Consistent and Optimum Basis for**
 - Alarm selection; Priority determination; Configuration

- **Basis for Performance Monitoring**
 - KPIs; Nuisance Alarm Resolution

Case Study 1: Baselining Alarm System Performance

- Purpose: Benchmark the performance of TCC alarm management system
- Scope:
 - Analyze historical data of at least 8 weeks
 - Measure performance using KPIs
 - Identify frequent and/or nuisance alarms
 - Identify chattering alarms
 - Identify alarm floods
 - Review the priority criteria
- Metrics (Targets) – IEC/ISA
 - 150 alarms / day (acceptable); 300 alarms / day (maximum manageable)
 - Priority Distribution: 1 (5%); 2 (15%); 3 (80%)

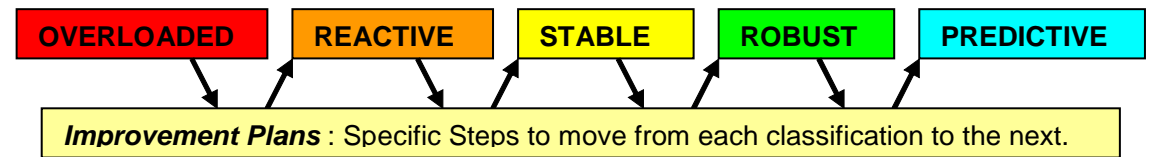
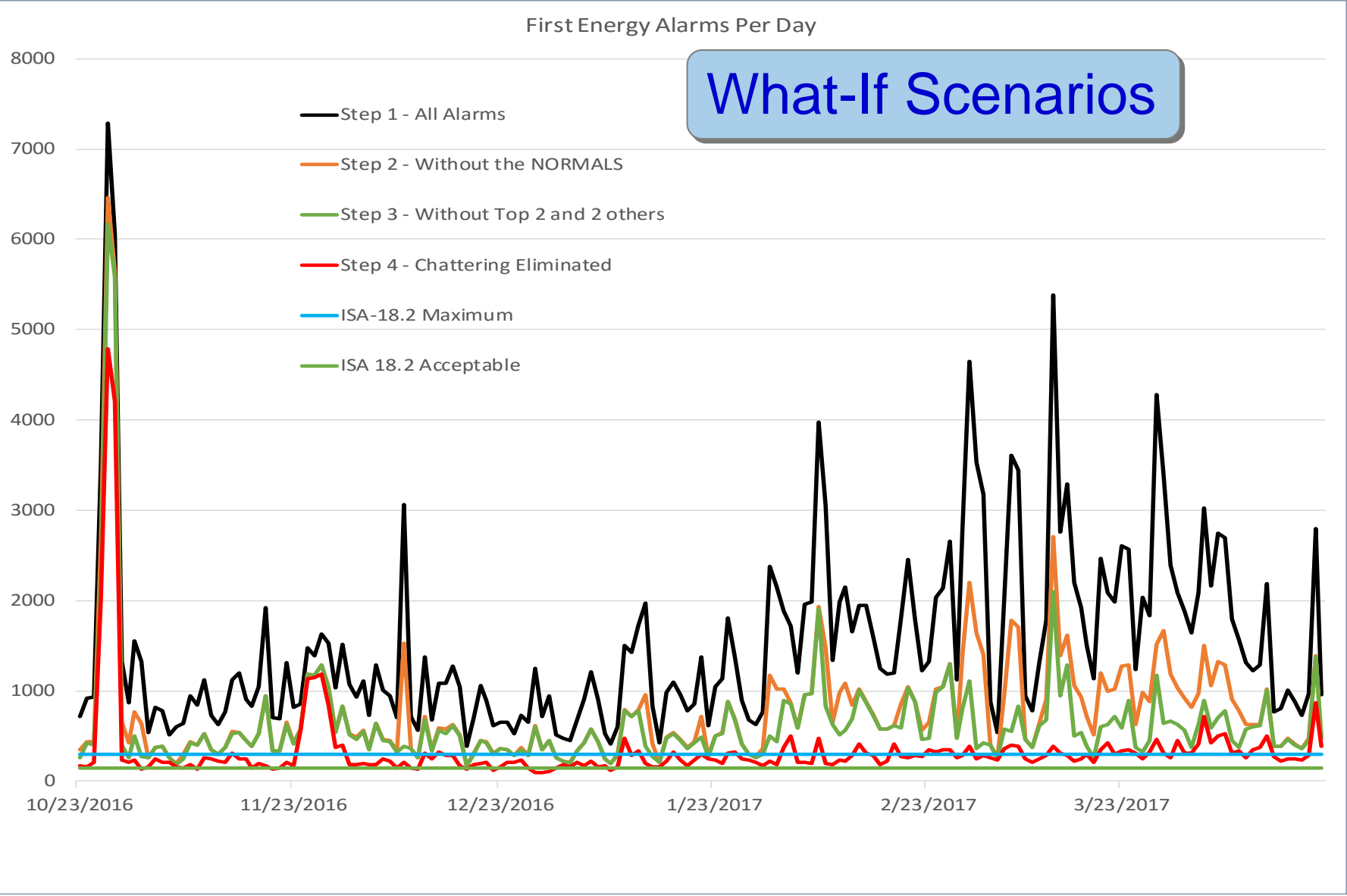


Figure 3-1 Alarm System Performance Levels

Baselining Analysis of FirstEnergy Alarm Data

- **Data for one Switching Desk in our Western Area**
 - 6 Months of Data (181 Days)
 - 275,565 Alarms received during the period
- **Alarms per day (Target: 150-300)**
 - Average: 786. Peak: 6467. Minimum: 170
- **Alarm Flooding (10 or more alarms in 10 minute period)**
 - 26.3% of the time
- **Top Ten most frequent Specific Alarms**
 - One device at one substation accounted for 11.4% (34,502) of all alarms
 - A transformer alarm accounted for 9% (24,772) of all alarms
- **Most Frequent Alarm Types**
 - Communication Non Critical -18.8%
 - All Voltage Alarms -18.1%
 - Other Communication Alarms - 17.1%

Baselining Analysis of FirstEnergy Alarm Data



Lessons Learned

- **Large percentage of alarms created by a few points**
- **We are asking Operators to decide which alarms to ignore, rather than only providing actionable alarms because of volume**
- **Cleaning up a few items can make a huge difference in number of alarms received**

Next Steps

- **Address Chattering Alarms**
 - 20% of alarms from two points
- **Evaluate the Need for return to normal as an alarm**
 - Almost 50% of alarms are return to normal
- **Are there better way to address certain alarms**
 - Voltage Monitoring
 - Door Alarms
- **Segregate Current Alarms**
 - Alarms
 - Situational Awareness Information
 - Pass Through Equipment Information
- **Develop Overall Alarm Philosophy**

Questions ?



Together...Shaping the Future of Electricity