Top 10 for Boiler Water Treatment

Western Regional Boiler Association

March 11, 2015

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Ultra Low Range Hardness Testing

#11

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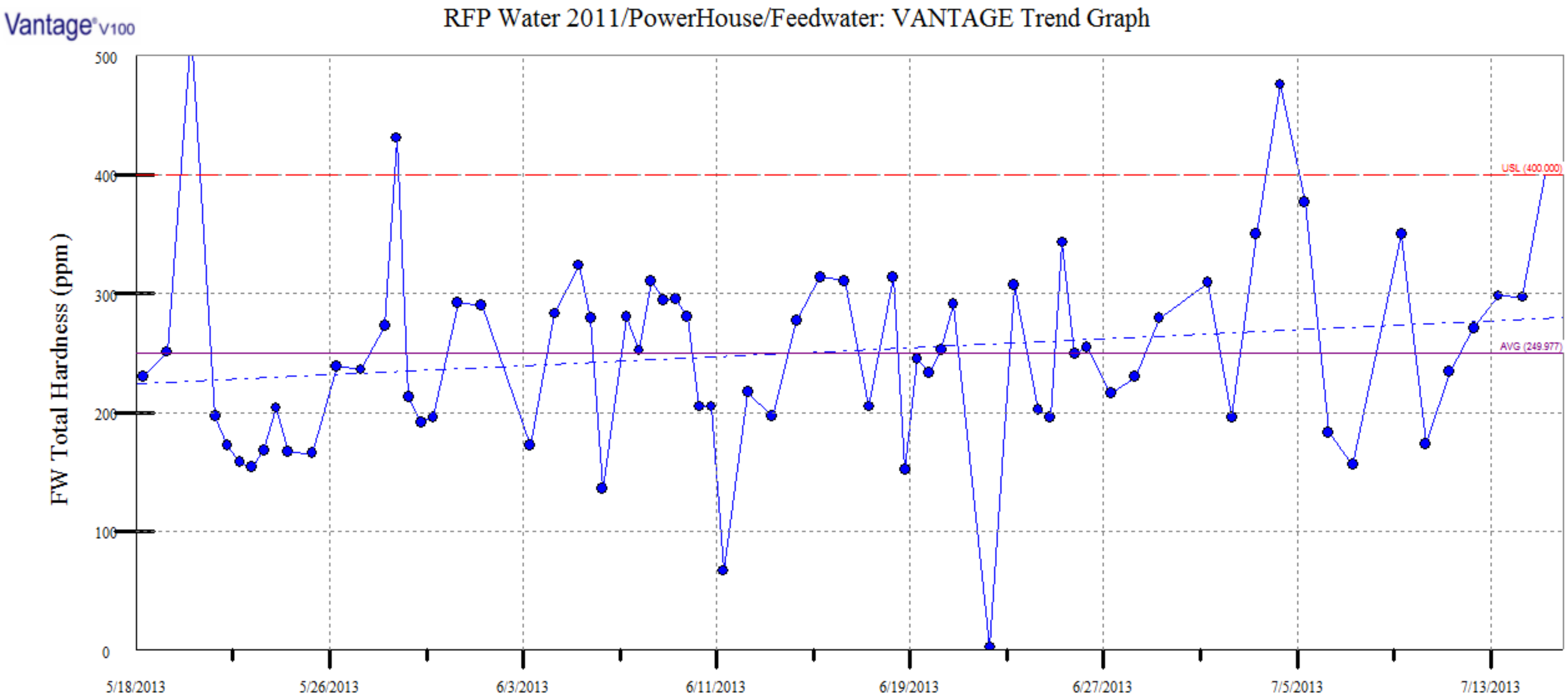
Continued Increase in Boiler Feedwater Hardness



275 PPB (0.275 PPM) Average hardness
Nexguard dosage recommendation: **9.5 PPM**

Feedwater Hardness (ppm)	Feedwater Hardness (PPB)	NexGuard (ppm)
0.00	0	0.0
0.05	50	1.8
0.10	100	3.5
0.15	150	5.3
0.20	200	7.0
0.25	250	8.8
0.30	300	10.5
0.35	350	12.3
0.40	400	14.0

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Temperature Correction for “High Purity” pH Testing

#10

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Condensate Testing

- Dedicate IRON test glassware. False high iron. Expect <0.025 ppm
- Do not adjust sample flow
- Replace pH meter as required, once/6 months
- Adjust for temperature

	Kiln Cond.	HB Cond.
Total Iron (ppm)	0.01	0.01
Conductivity	28	6.2
pH	9.61	9.2

High Purity pH Correct Chart
(Condensate, Feedwater Only)

Deg F	Deg C	+/-
113	45	0.6
111	44	0.57
109	43	0.54
108	42	0.51
106	41	0.48
104	40	0.45
102	39	0.42
100	38	0.39
99	37	0.36
97	36	0.33
95	35	0.3
93	34	0.27
91	33	0.24
90	32	0.21
88	31	0.18
86	30	0.15
84	29	0.12
82	28	0.09
81	27	0.06
79	26	0.03
77	25	0
75	24	-0.03
73	23	-0.06
72	22	-0.09
70	21	-0.12

Table 3 - Purge Times Required for Representative Sampling of Water

Line Size (inches)	Wall Thickness; (inches)	ID (inches)	For Soluble components(1) Recommended Purge Time at 500 ml/min (Sec/ft)	For Particulate Components(2) Recommended Flow Required to Achieve 5 ft/sec (ml/min)	For Particulate Components(2) Recommended Flow Required to Achieve 5 ft/sec (gal/min)
1/4 Tubing	0.035	0.180	1.8	1,501	0.40
	0.042	0.166	1.5	1,277	0.34
	0.049	0.152	1.3	1,070	0.28
	0.058	0.134	1.0	832	0.22
	0.065	0.120	0.8	667	0.18
3/8 Tubing	0.035	0.305	5.2	4,310	1.14
	0.042	0.291	4.7	3,924	1.04
	0.049	0.277	4.3	3,555	0.94
	0.058	0.259	3.7	3,108	0.82
	0.065	0.254	3.6	2,989	0.79
1/2 Tubing	0.035	0.430	10.3	8,567	2.26
	0.042	0.416	9.6	8,018	2.12
	0.049	0.402	9.0	7,488	1.98
	0.058	0.384	8.2	6,832	1.81
	0.065	0.370	7.6	6,343	1.68
	0.072	0.356	7.0	5,872	1.55
	0.083	0.334	6.2	5,169	1.37
1/2 Pipe	Schedule 40	0.622	21.5	17,926	4.74
3/4 Pipe	Schedule 40	0.824	37.8	31,459	8.31
1 Pipe	Schedule 40	1.049	61.2	50,985	13.47

Myron 6P – Reliable pH and Conductivity Measurement

9

Replacement pH Probe

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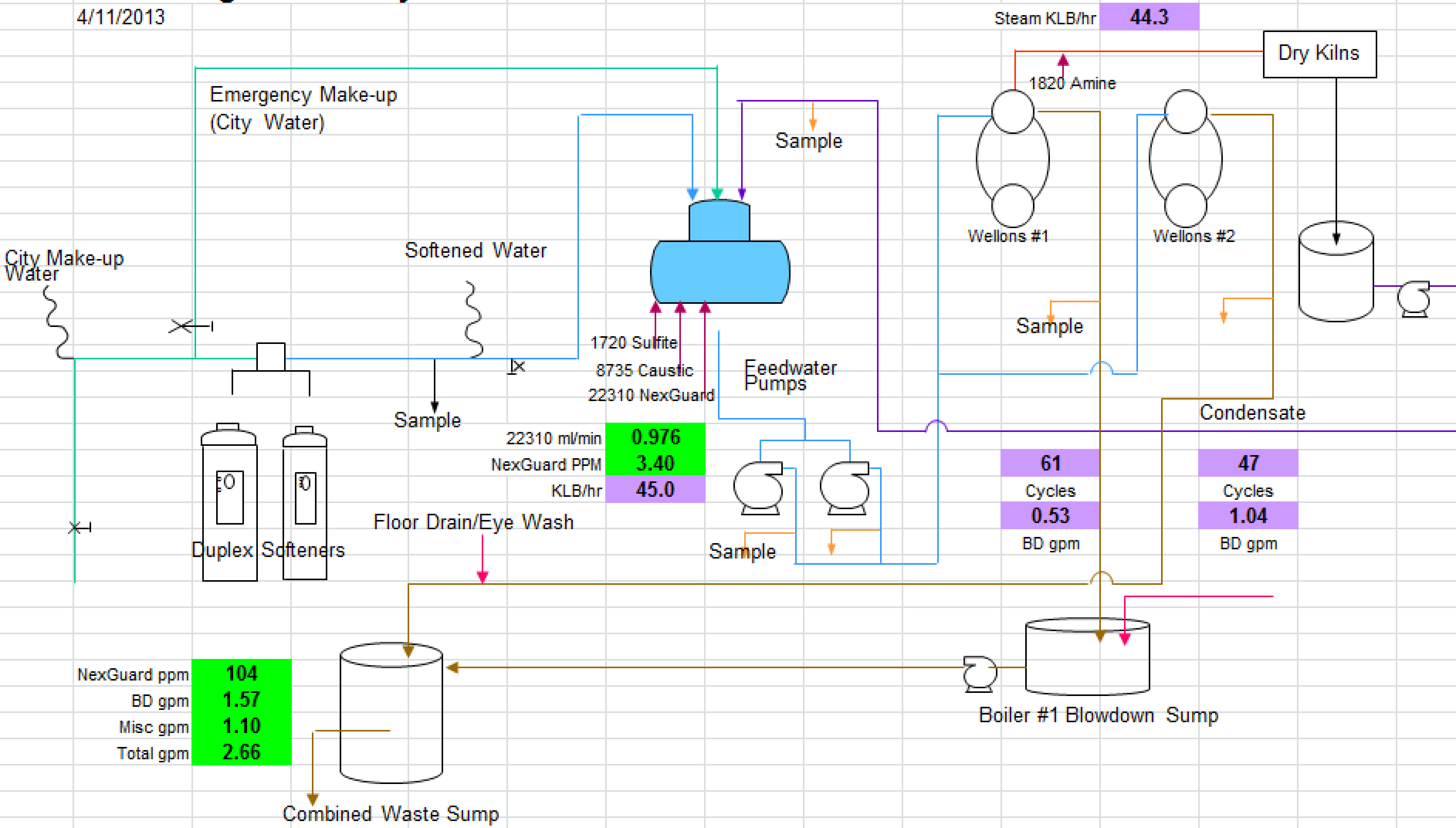
Know Your Boiler Mass Balance – Diagnostic Study

#8


GUARDIAN
EQUIPMENT

Boiler Diagnostic Study

4/11/2013



Boiler NexGuard	ppm	% of Load	Trasar % BD	Target % BD	Lost MM BTU
Boiler No. 1	208	36%	1.6%	2.0%	-0.61
Boiler No. 2	159	64%	2.1%	2.0%	0.41
				Total:	-0.20

Stimson Lumber Tillamook, OR	NALCO
Boiler System	

Sch-001-djt.ppt

Deposit Weight Differential - How Clean are your Boiler tubes?

#7

Nalco Analytical Resources
1601 West Diehl Road, Naperville, Illinois 60563-1198
Phone: (630) 305-2315, Fax: (630) 305-2946, Analytical.Lab.Naperville@Nalco.com

Customer Name		**Sample Number:**	NZ0400066
Anytown USA USA		**Date Sampled:**	1-Apr-2004
Sample Marked: Sampling Point		**Date Received:**	1-Apr-2004
Submitter: Karen L. Baumann		**Date Completed:**	1-Apr-2004

Deposit Weight Density

Sample Dimensions As-Received:

Length of Received Tube (inches):	8.5
Outside Diameter of Tube (inches):	2.0

Results From Hot Side:

Surface Area Examined:	7.7 in2
Wall Thickness (dirty):	0.096 inches
Wall Thickness (clean):	0.089 inches
Deepest Pit:	0 mils (0.001")
Deposit Weight Density:	83 g/ft2

Results From Cold Side:

Surface Area Examined:	7.6 in2
Wall Thickness (dirty):	0.094 inches
Wall Thickness (clean):	0.092 inches
Deepest Pit:	0 mils (0.001")
Deposit Weight Density:	28 g/ft2

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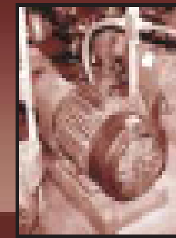
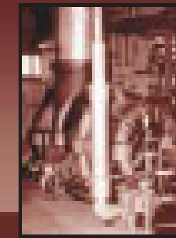
Energy Tips


Steam


Motors


Compressed Air

Monitor Flue Gas Temperature

An indirect indicator of scale or deposit formation is flue gas temperature. If the flue gas temperature rises (with boiler load and excess air held constant), the effect is possibly due to the presence of scale.

Perform Visual Inspections

Visually inspect boiler tubes when the unit is shut down for maintenance. Scale removal can be achieved by mechanical means, or acid cleaning. If scale is present, consult with your local water treatment specialist and consider modifying your feedwater treatment or chemical additives schedule.

Clean Boiler Water-side Heat Transfer Surfaces

Even on small boilers, the prevention of scale formation can produce substantial energy savings. Scale deposits occur when calcium, magnesium, and silica, commonly found in most water supplies, react to form a continuous layer of material on the waterside of the boiler heat exchange tubes.

Scale creates a problem because it typically possesses a thermal conductivity an order of magnitude less than the corresponding value for bare steel. Even thin layers of scale serve as an effective insulator and retard heat transfer. The result is overheating of boiler tube metal, tube failures, and loss of energy efficiency. Fuel wastage due to boiler scale may be 2% for water-tube boilers and up to 5% in fire-tube boilers. Energy losses as a function of scale thickness and composition are given in the table below.

Energy Loss Due to Scale Deposits*

Scale Thickness, inches	Fuel Loss, % of Total Use		
	Scale Type		
	"Normal"	High Iron	Iron plus Silica
1/64	1.0	1.6	3.5
1/32	2.0	3.1	7.0
3/64	3.0	4.7	-
1/16	3.9	6.2	-

Note: "Normal" scale is usually encountered in low-pressure applications. The high iron and iron plus silica scale composition results from high-pressure service conditions.
*Extracted from National Institute of Standards and Technology, Handbook 115, Supplement 1.

Operator Procedures

#6

RFP Dillard

Boiler Testing Summary

Rev. 9/29/2011

Titration Chemistry	Sample Size	Reagent 1	Reagent 2	Titrant	Multiplier	Range
Low Level Total Hardness	100 mL in casserole dish	2 mL H-2 Buffer	Two shakes H-3 Indicator	Titrate with LH-3 until Pink/Purple to Blue	mL's of LH-3 used = ppm of hardness	

Trasar	TRASAR	Product	Product Factor	TRA Value	Calibration Value	Calibration Solution
Boiler NexGuard™	TRASAR 3	22300	PF = 40	TRA = 0.0 %	C - Value = 1.0	460-SO980

DR 2800 Chemistry	AP Procedure	Step 1	Step 2	Step 3	Step 4	Range
Silica Low Range	Program 651 Silica LR	Mix 10 mL sample w/ 40 mL DI water Prepared = 10 mL Blank = 10 mL	Add 14 drops of SIL-1 to EACH cell Press "TIMER" 4-minutes	Add SIH-2/ SIL-2 pillow to EACH cell Press "TIMER" 1-minute	Add SIL-3 pillow to ONE cell (prepared) Press "TIMER" 2-minute Zero w/ Blank Read w/ Prepared	0.01 to 1.60 ppm as SiO2 (Multiply reading x5)
Silica Ultra Low Range	Program 651 Silica LR	Prepared = 10 mL Blank = 10 mL	Add 14 drops of SIL-1 to EACH cell Press "TIMER" 4-minutes	Add SIH-2/ SIL-2 pillow to EACH cell Press "TIMER" 1-minute	Add SIL-3 pillow to ONE cell (prepared) Press "TIMER" 2-minute Zero w/ Blank Read w/ Prepared	0.01 to 1.60 ppm as SiO2
Iron	Program 265 Iron, HL	Prepared = 10 mL Blank = 10 mL	Add Fe-HL pillow to ONE cell (prepared)	Press "TIMER" 3-minute	Insert Blank Press "ZERO" Insert Prepared: Press "READ"	0.1 to 3.0 ppm as Fe (iron)
DEHA	Program 181 DEHA	Prepared = 25 mL of feedwater sample Blank = 25 mL of DI water	Add Reagent 1 pillow to EACH cell Add 0.5 mL of Reagent 2 to EACH cell	Press "TIMER" 10-minute Keep sample cells in the dark	Insert Blank Press "ZERO" Insert Prepared: Press "READ"	

Test	*To Order Call Nalco @ 800.288.0879 (use RFP Dillard Sold to #500067777)	Nalco Part #
	Round Glass Sample Cells w/ caps 10-20-25 mL (6 pack)	500-P2555
Silica LR	SIL-1 (50 mL)	460-S0626
	SIH-2/ SIL-2 (100 pillows)	460-S0623
	SIL-3 (100 pillows)	460-S617P
Silica ULR	Same reagents as Silica LR	
DEHA	ELIMIN-OX Reagent 1 (100 pillows)	460-S0195
	ELIMIN-OX Reagent 2 (100 mL)	460-S0196
Low Level Total Hardness	LH-3 titrate (1 L)	460-S0447.75
	H-2 buffer (1 L) *same as total hardness	460-S0275.75
	H-3 indicator (100 grams) *same as total hardness	460-S0277.82
Iron	Fe-HL (100 pillows)	460-S0466

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BOILER CONTROL

CONDUCTIVITY
2500 - 3500 µmhos

IN RANGE

OUT OF RANGE

LOW

1. Leaking blowdown valve
2. Manual blowdowns are too long/often
3. Decrease surface blowdown setting
4. Reduced steam production
5. Change in feedwater quality

HIGH

1. Conduct manual blowdown daily
2. Increase surface blowdown setting
3. Change in feedwater quality
4. Increased steam production

SOFT WATER
Hardness < 1.0 ppm

IN RANGE

OUT OF RANGE

HIGH

1. Regenerate softener
2. Check brine level
3. Check valve setting
4. Have resin analyzed
5. Run elution study

CONDENSATE
Amine 1820

pH
8.2 - 9.0

IN RANGE

OUT OF RANGE

LOW

1. Chemical pump malfunction or lost prime
2. Feed tank empty
3. Increase the chemical pump setting and record on log sheet
4. Process contamination

HIGH

1. Boiler water carryover
2. Chemical pump malfunction
3. Decrease the chemical pump setting and record on log sheet
4. Process contamination

Conductivity
< 25 µmhos

IN RANGE

OUT OF RANGE

HIGH

1. Boiler water carryover
2. Process contamination

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* Consult your Program Administration Manual for further guidance *

Automated Amine Feed

#5

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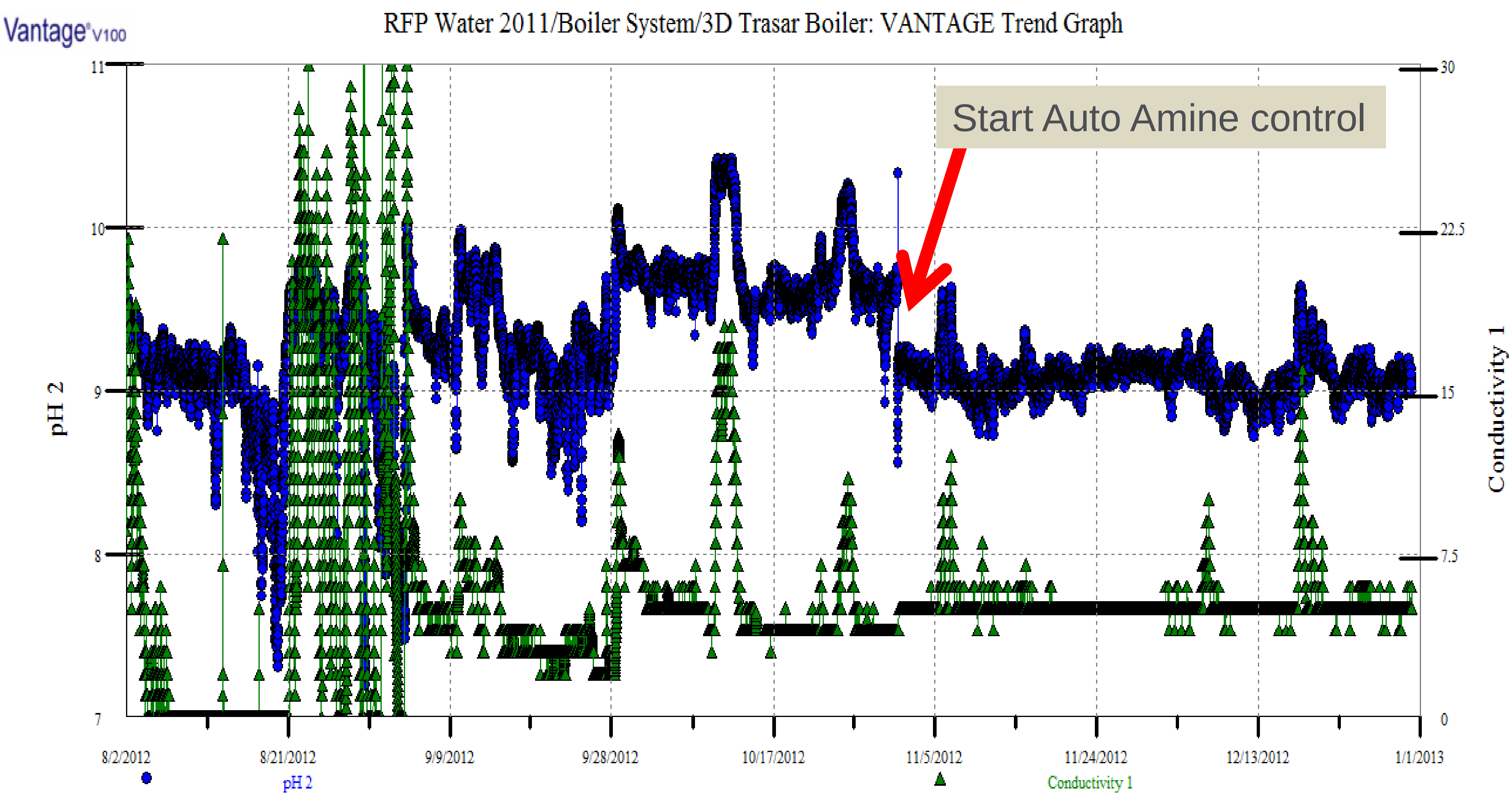

Before Auto
pH variation: 7.2-10.3

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Continuous Feedwater Corrosion Monitoring

#4

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Two New Technologies:

- 3D TRASAR Technology for Boilers™
  - Measures and controls scale inhibitor chemistry
- Nalco Corrosion Stress Monitor™
  - Measures and controls pre-boiler corrosion environment

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May 1, 2009

How to Measure Corrosion Processes Faster and More Accurately

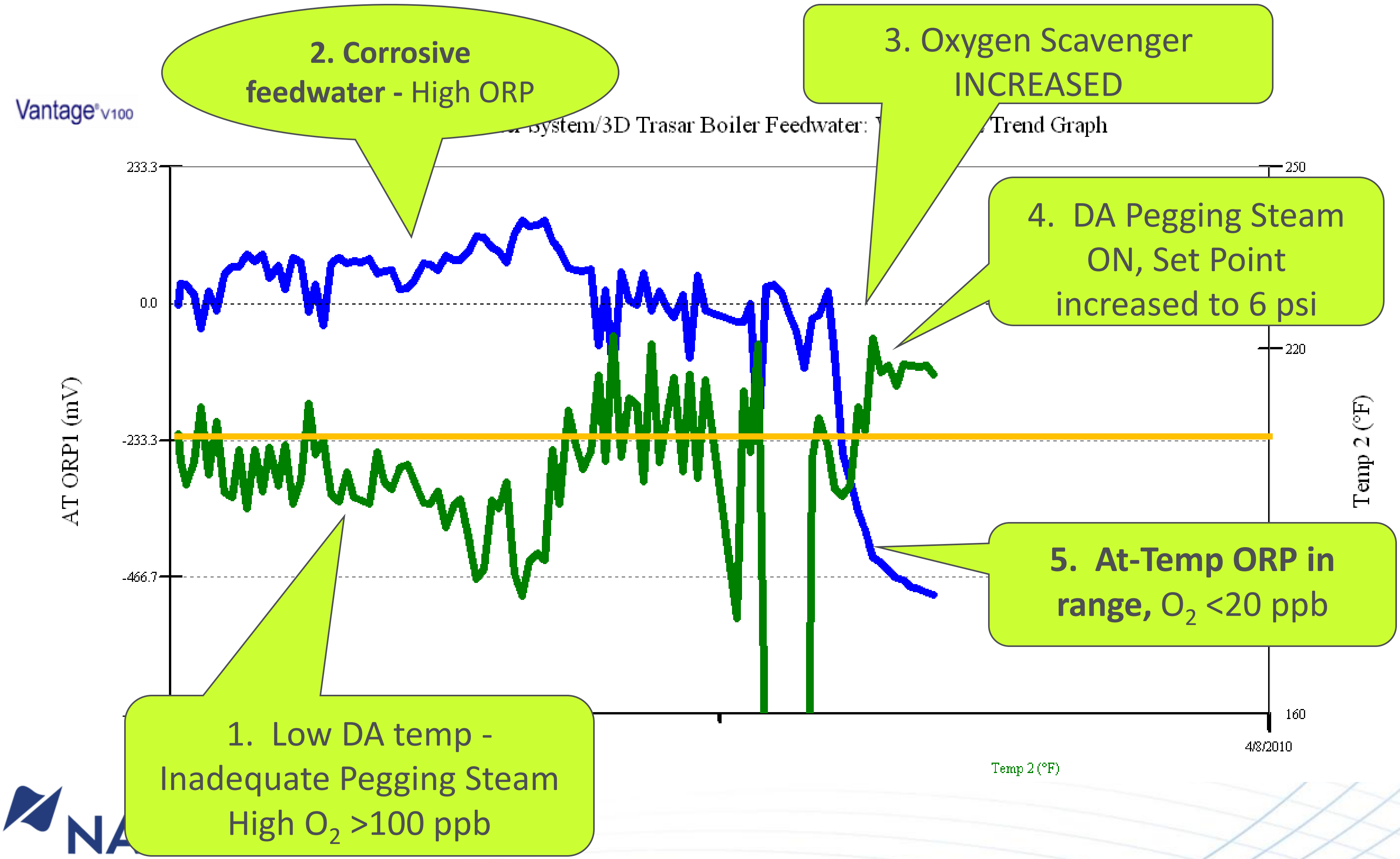
Daniel C. Sampson and Peter D. Hicks, Nalco

Case Study #1: A Small Problem with Reductant Feed?

The following example concerns a common occurrence at many power plants: a relatively small increase in DO concentration. Most plants might consider this a minor "blip" that can be ignored, but the corrosion environment at temperature tells a different story.

In this system (Figure 6), scavenger chemical feed rate was slaved to steam flow off a primary boiler. A

Stimson Start-up
Feedwater (DA) Temp vs. ORP



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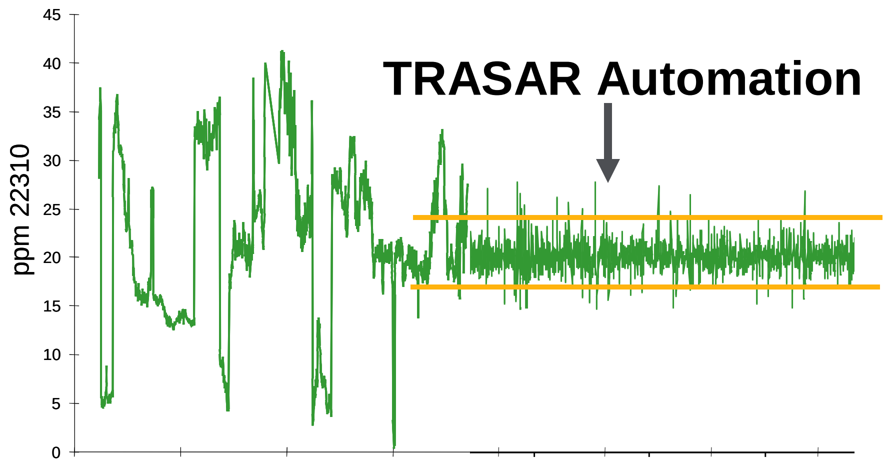
New Boiler Automation Technology

Directly measures

Automatically responds

Maintain optimum treatment levels



Direct control of scale
Inhibitor chemistry

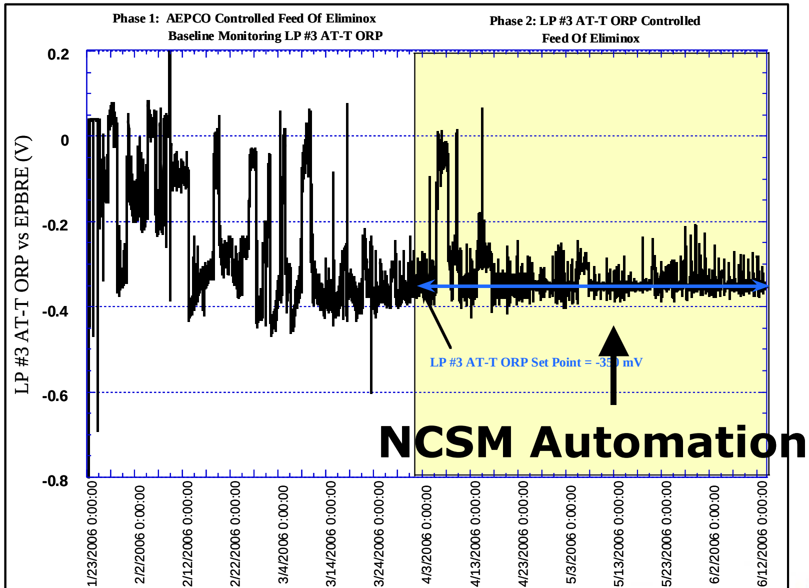


Figure 1: LP #3 AT-T ORP Results During Phase 1 and 2 of AEPCO Trial

Direct control of
preboiler corrosion

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Automated Chemical Inventory

#3

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Tank Level Monitoring

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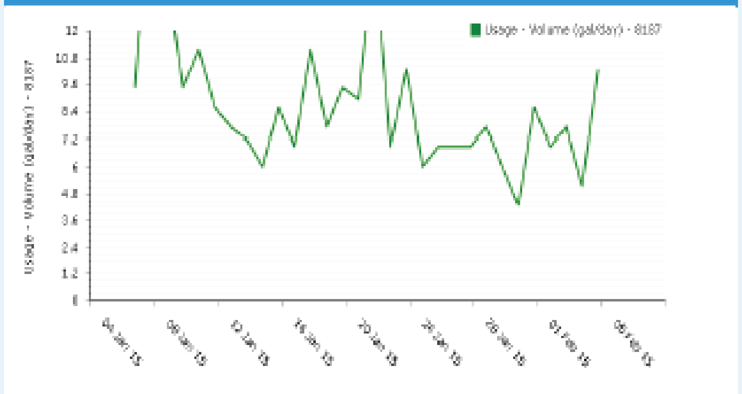
Dashboard Customer - Last 30 Days

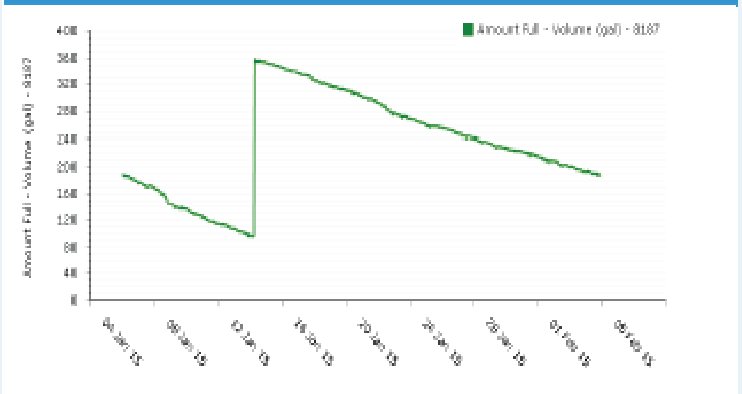
DARIGOLD INC - PORTLAND, OR - DAF Chemical Inventories

Inventory	Product Usage	Tank Name	Tank Serial	Last Update	Current Inventory (Gals)	Usage Ave.30 (GPD)	Usage Ave.7 (GPD)	Usage Ave.2 (GPD)	Days To Reorder Point	Days To Empty
		8187	120076	2/3/2015 3:53:00 AM	187.8	8.8	6.7	6.3	15.3	28
		8100		2/3/2015 3:53:00 AM	185.9	40.8	35.7	35.6	2.4	5.1

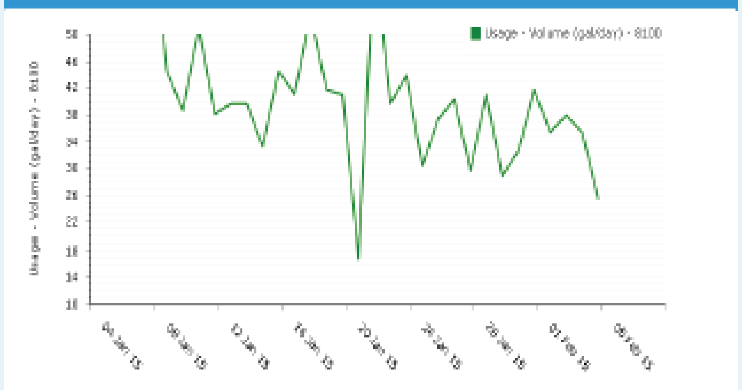
Usage - Volume (gal/day) - 8187- Last 30 Days



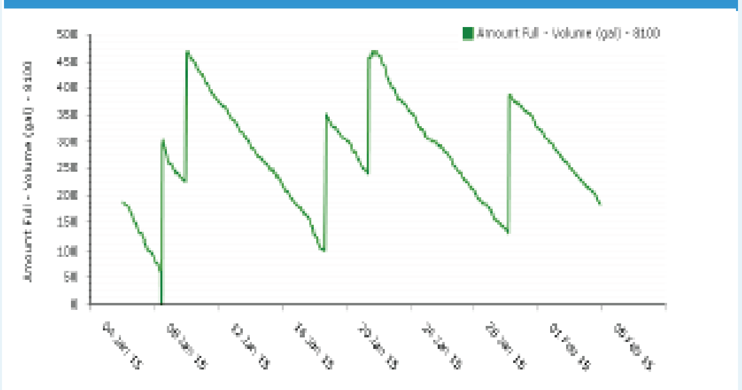
Amount Full - Volume (gal) - 8187- Last 30 Days



Usage - Volume (gal/day) - 8100- Last 30 Days



Amount Full - Volume (gal) - 8100- Last 30 Days



Blowdown Heat Recovery

#2

Blowdown/Condensate Heat Exchanger

2. Blowdown heat exchanger

Matt and I confirmed the efficiency of the blowdown heat exchanger. Blowdown Inlet temperature was 343 F, while the temperature of the blowdown outlet was 95 F. These results are excellent and show good heat recovery.

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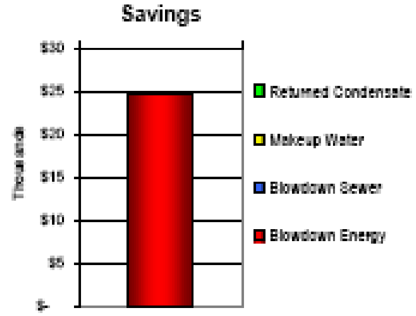
ENERGY STAR PARTNER

Boiler Energy & Water Savings

Company:	Neil Jones Food Company	Date:	3-Oct-07
Plant:	Northwest Packing/Cleaver Brooks Boiler	Prepared by:	Bob Reller
City:	Vancouver	NALCO Copy to:	John Zora
State:	Washington		
Attention:	Erich Blancaflor		
Copy:			

Input Values

Input	Units	Value
Sewer Cost	$/1000 gal.	$ 2.00
Make Up Water Cost	$/1000 gal.	$ 3.00
Makeup Water Temp.	°F	55.0
Return Condensate Temp.	°F	200.0
Fuel Cost natural gas	$/MMBtu	$ 7.00
Boiler Efficiency	%	80.0%
Operating Days per Year	Days	150



Boiler System Operation

		Current Operation	"What If" Analysis	Savings
		Value	Value	from Current
BD Heat Recovery	Yes or No	NO	YES	
Heat Recovery % Efficiency	%	80.0%	60.0%	
% Condensate Return	%	20.0%	20.0%	
Boiler Cycles	Cycles	7.0	7.0	
Steam Rate	lb/hr	25,000	25,000	
Steam Pressure	psig	142	142	
Steam Temperature	sat'd 362 °F		362	
Steam Enthalpy	BTU/lb	1,195	1,195	
Blowdown Enthalpy	BTU/lb	334	334	
Makeup Flow	lb/hr	23,333	23,333	-
Return Condensate Flow	lb/hr	5,833	5,833	-
Feedwater Flow	lb/hr	29,167	29,167	-
Blowdown Flow	lb/hr	4,167	4,167	-

Energy & Water Costs and Credits

		Current Operation	"What If" Analysis	Savings
Blowdown Energy Cost	$/year	$ 40,856	$ 16,342	$ 24,513
Blowdown Sewer Cost	$/year	$ 3,597	$ 3,597	$ -
Makeup Water Cost	$/year	$ 30,216	$ 30,216	$ -
Sub Total (Costs)	**$/year**	**$ 74,668**	**$ 50,156**	**$ 24,513**
Returned Condensate Fuel (Credit)	$/year	$ (26,644)	$ (26,644)	$ -
NET SAVINGS or (COSTS)	**$/year**			**$ 24,513**
Calculated Cost of Steam*	$/1000 lbs	$ 10.79	$ 10.52	$ 0.272

NET CO_2 EMISSION SAVINGS (INCR) fuel is natural gas Tons CO2 / yr 203

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Blowdown Heat Recovery

Boiler Blowdown at 150 psig

1,000 lb/hr at 364° F

H_f = 336 BTU/lb

Heat Flow = 336M BTU/hr

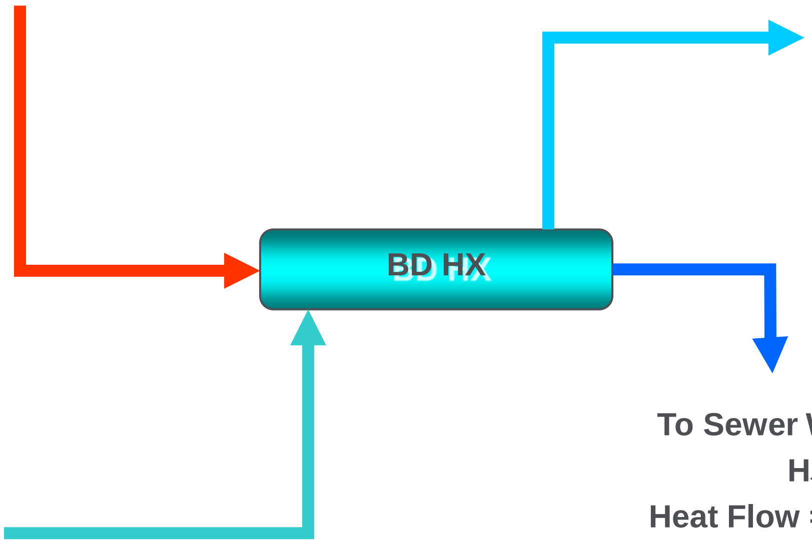
Useable Heat Flow = 308M BTU/hr

150 psig boiler

Make-Up water picks up

Heat Flow = 278M BTU/hr

Clean BD HX efficiency gives 90% removal of heat



To Sewer Waste at 86° F

H_{fg} = 58.2 BTU/lb

Heat Flow = 58.2M BTU/hr

Useable Heat Loss = 30.8M BTU/hr

90%

Energy Saved!

Make-Up at 60° F

27.4M BTU/lb

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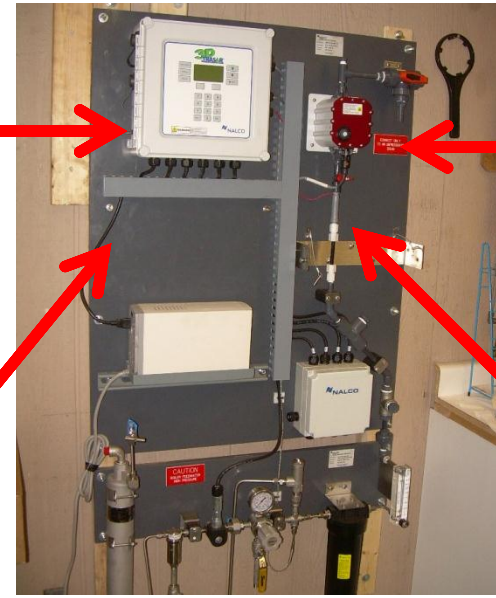
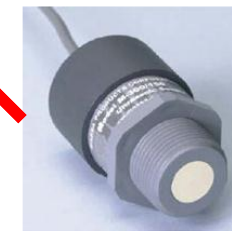
Managing your data

#1

3D Trasar – Stimson Forest Grove

- Scale Control
  - NexGuard Trasar
- Corrosion control
  - At-Temp ORP
- BFW pH
- BFW Conductivity
- Boiler Blowdown
- Turbidity
- Temperature
- Tank Level
- Amine Conductivity
- Softener Hardness





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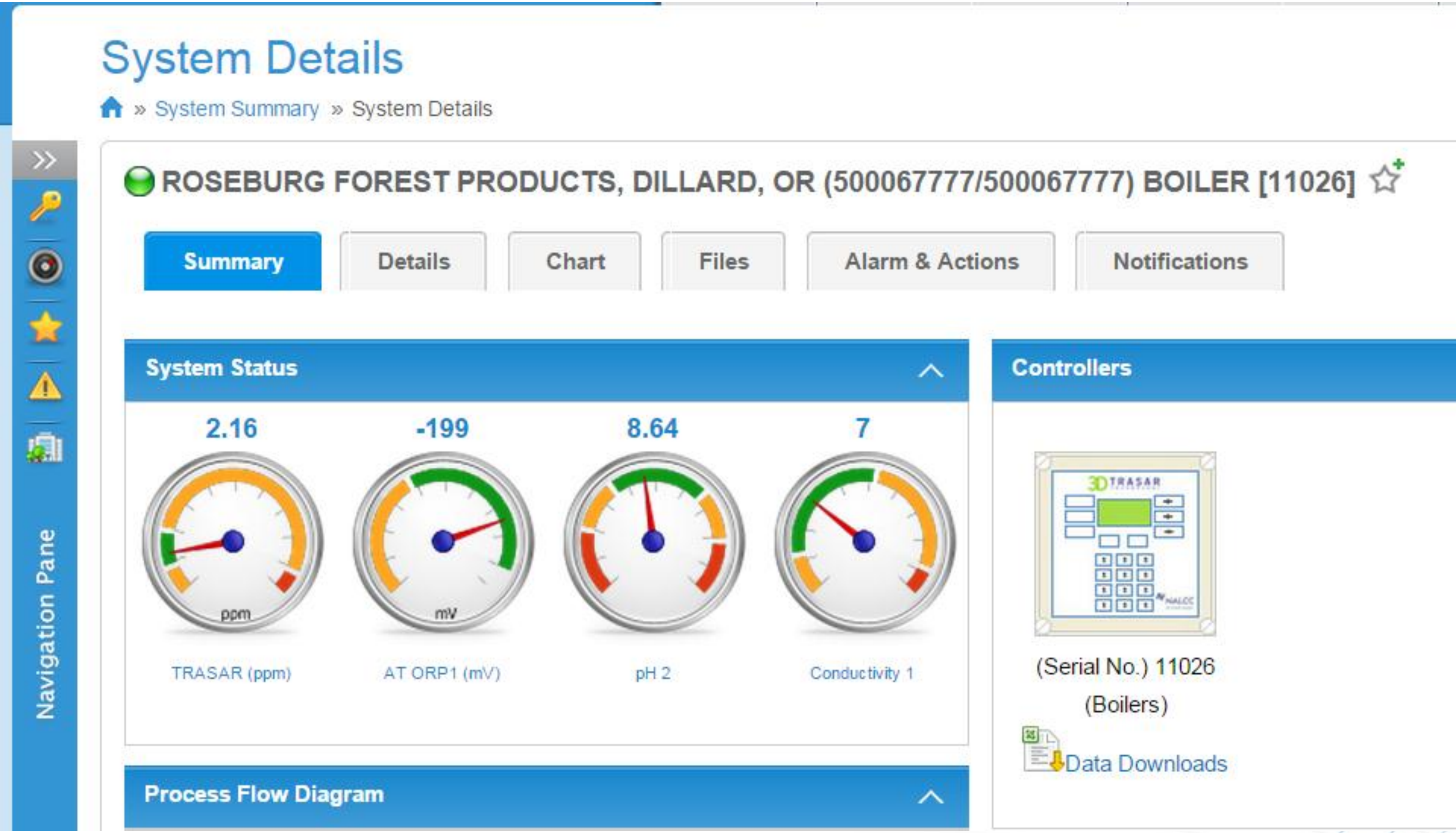

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System Details

» System Summary » System Details

ROSEBURG FOREST PRODUCTS, DILLARD, OR (500067777/500067777) BOILER [11026]

Nalco 360 Connectivity

Summary | Details | Chart | Files | Alarm & Actions | Notifications

Critical/Warning Only 7 Days

Parameter Name	Status	Date/Time	Latest Value	Avg.	Min.	Max.	St. Dev.	Low Critical Limit	Low Limit	High Limit	High Critical Limit
	All										
TRASAR (ppm)		3/10/2015 1:00:00 AM	2.16	2.53	1.86	3.3	0.25	0	1	5	30
AT ORP1 (mV)		3/10/2015 1:00:00 AM	-199	-191.53	-228	-144	12.2	-900	-500	-50	0
pH 2		3/10/2015 1:00:00 AM	8.64	8.76	8.54	8.91	0.07	7	8	10	11
Conductivity 1		3/10/2015 1:00:00 AM	7	6.91	6	8	0.3	0	2	14	25
Temp 2 (°F)		3/10/2015 1:00:00 AM	213.11	211.08	204.04	215.79	1.99	50	150	300	400
[illegible]	[illegible]	3/10/2015 1:00:00 AM	67.87	61.56	57.33	70.12	3.9	35	50	110	140

alco.com/_layouts/envision/SystemDetails.aspx?ID=21311&PStatus=1#

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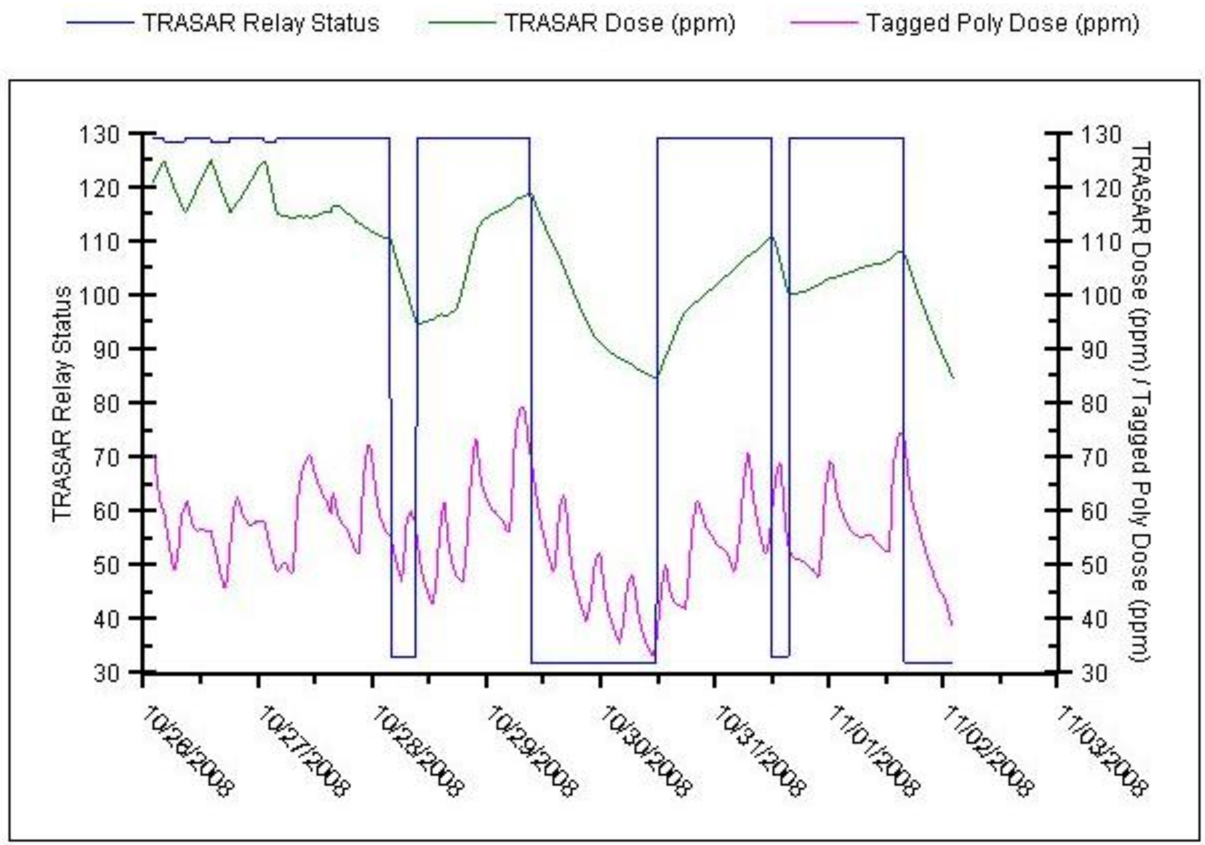
Nalco 360™



Possible root cause: Low inventory, blocked feed

Description: Relay has been under failsafe condition for a while. But even with30% relay duty concentration is still dropping. This indicates either the product container may be empty or a leak or blockage may exist in the feed line. Prior to this during normal operation (auto) concentration decreased less in 1400 minutes indicating reduced feed rate (conductivity is not dropping that much). Please check the above issues. Graph attached

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Basic Boiler Training Seminar

How to run a successful boiler water treatment program

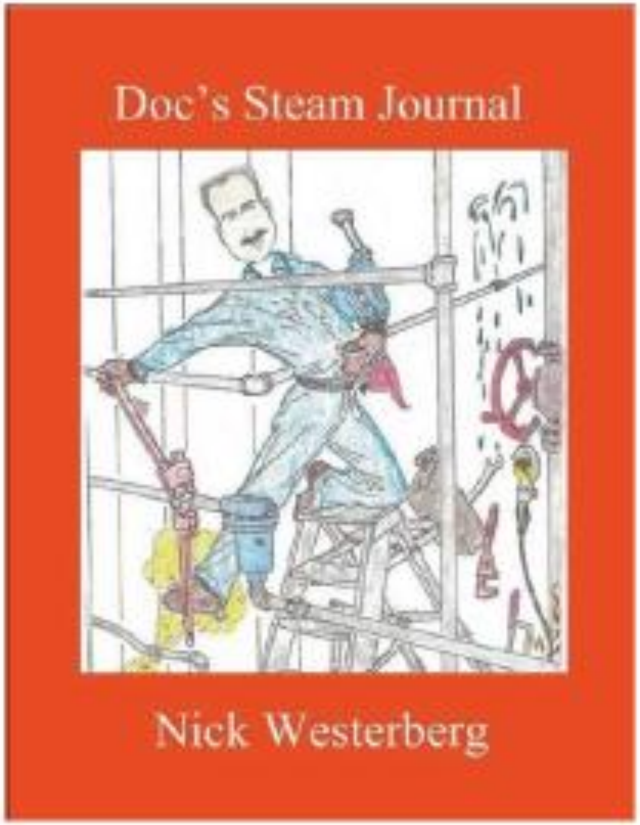
Presented by

NALCO
An Ecolab Company

McMenamin's Kennedy School
5736 NE 33rd Ave.
Portland, OR 97211

Key Topics

In addition to Nalco, Nick Westerberg, president of Westerberg and Associates, will present on optimization of steam and condensate systems. Nick is a motivational speaker and author of *Doc's Steam Journal* and *Doc's Pump Journal*.



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Basic Cooling Water Training

How to run a successful cooling water treatment program

Presented by

NALCO
An Ecolab Company

Thursday, April 23, 2015
9:00 AM - 3:30 PM

McMenamin's Kennedy School
5736 NE 33rd Ave.
Portland, OR 97211

Top 10 for Boiler Water Treatment

Western Regional Boiler Association

March 11, 2015

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LION CAM-3 SECURITY ALERT

ALERT LEVEL: 1A

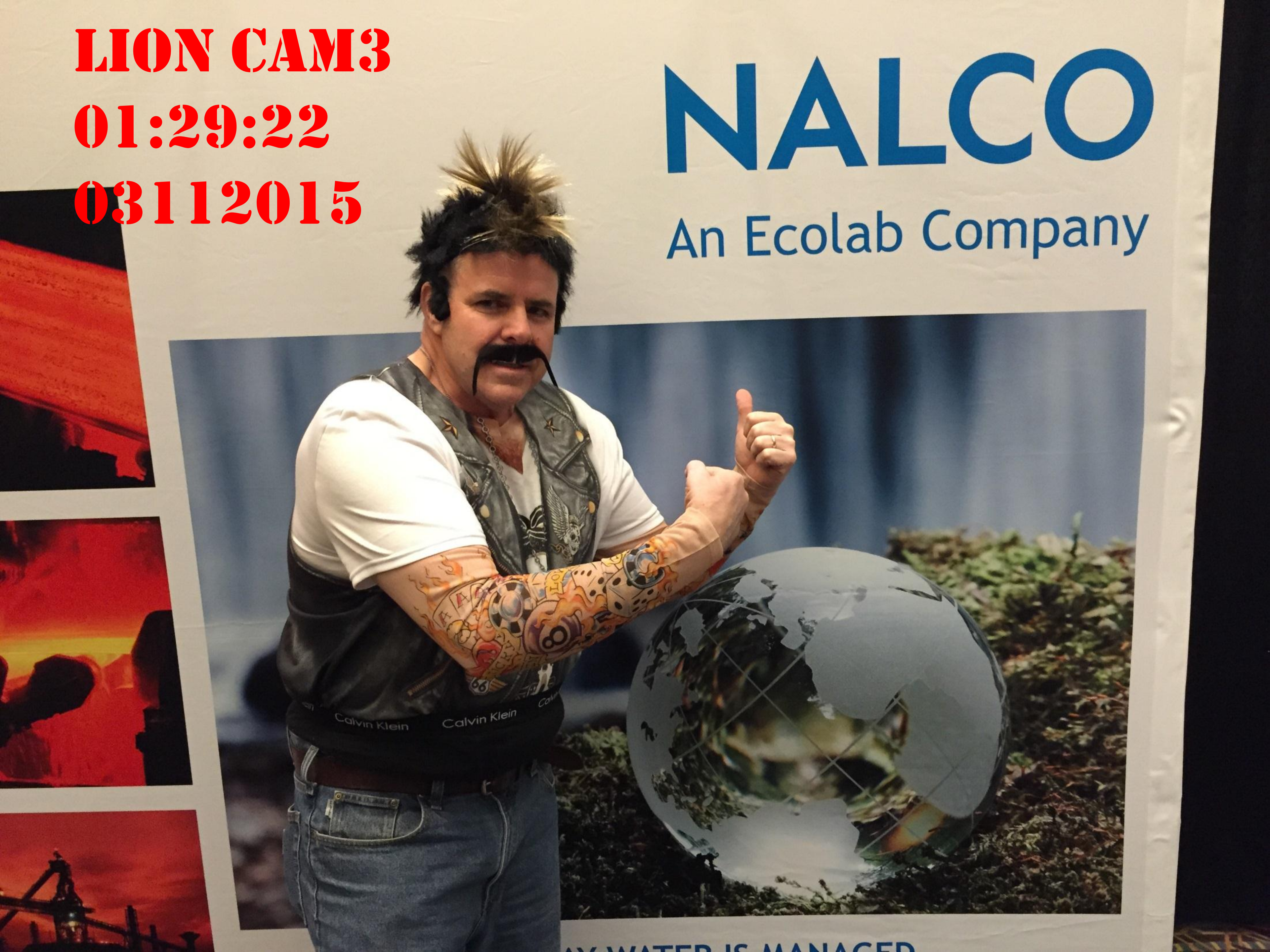
ACTION: IMMEDIATE

THREAT LEVEL: HIGH

AUTOMATED REPORT SUMMARY


LION SEC CAM 3A 17:21:56 03102105
STIHL

LION CAM3
01:29:22
03112015


LION CAM3
01:29:22
03112015
NALCO
An Ecolab Company
Calvin Klein
Calvin Klein

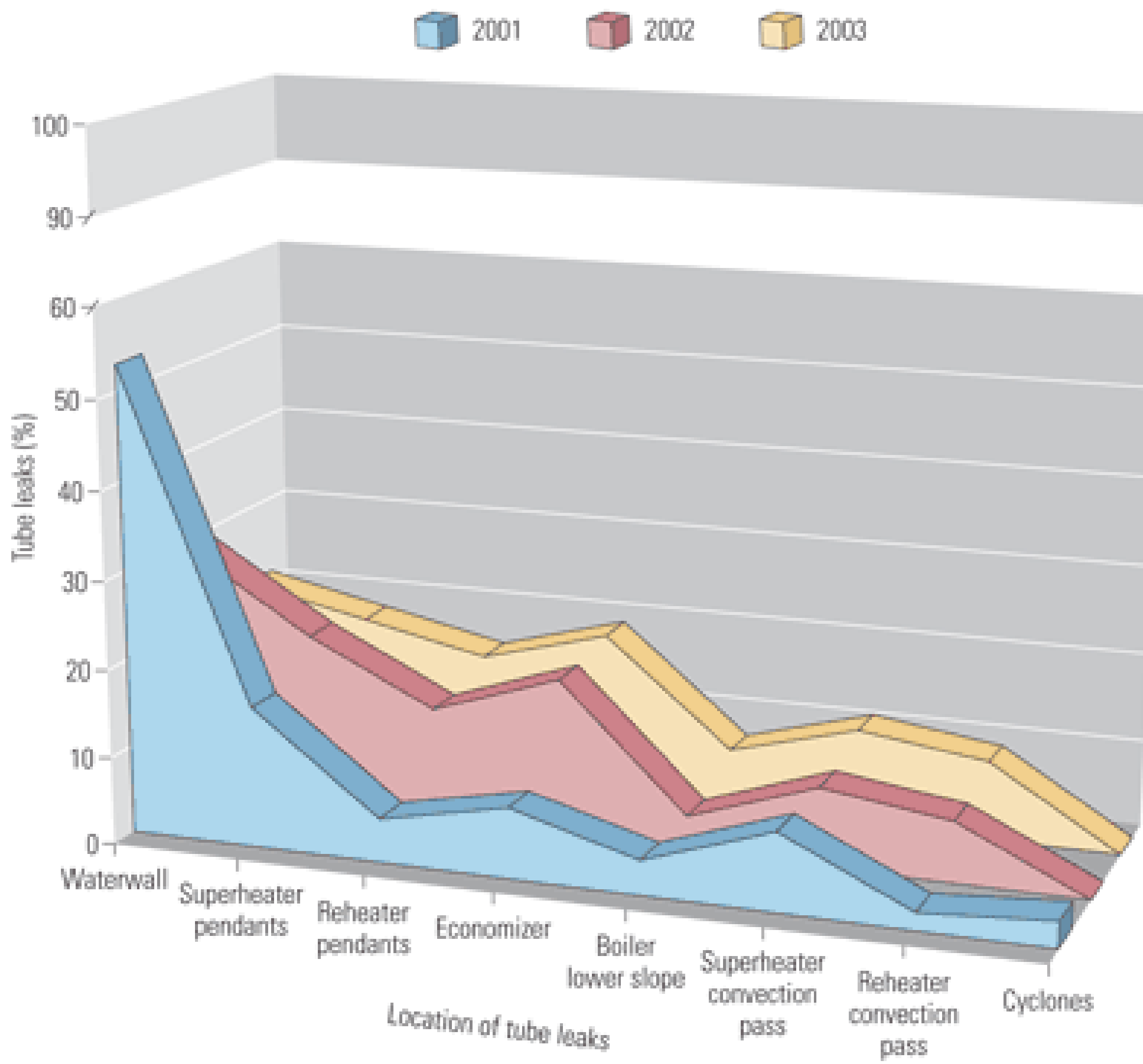
LION CAM-3 SECURITY ALERT

ALERT LEVEL: 1A

ACTION: IMMEDIATE

THREAT LEVEL: HIGH

AUTOMATED REPORT SUMMARY



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