IMPROVING WOOD KILN BOILER RELIABILITY VIA A NEW WATER TREATMENT CONTROL TECHNOLOGY

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Here’s what we’ll be covering this morning

- Purpose of the boiler in a wood products plant
- Challenges associated with operating a boiler in a wood products mill
  - Operational
  - Resources
  - Personnel work load
- Boiler chemical treatment, its application and evolution
- New developments in boiler feedwater scale and corrosion control
- Wood products plant application of the new technologies
- Outcome and benefits of the application

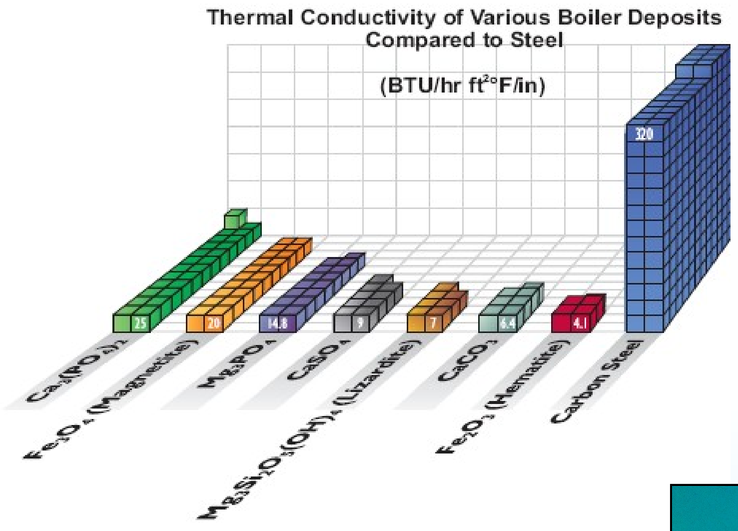
The boiler is crucial for wood products manufacturing

- Controls the drying process
  - Kiln coil heating
  - Steam humidification
- Optimum Moisture Content is Crucial
  - Higher end-use product value
  - Better material usability
  - Increased product strength
  - Lower shipping costs
  - Better insulating and finished material properties
- Drying too fast / too slow - both are bad

As much as 80% of a mill's energy requirement can be for the drying process

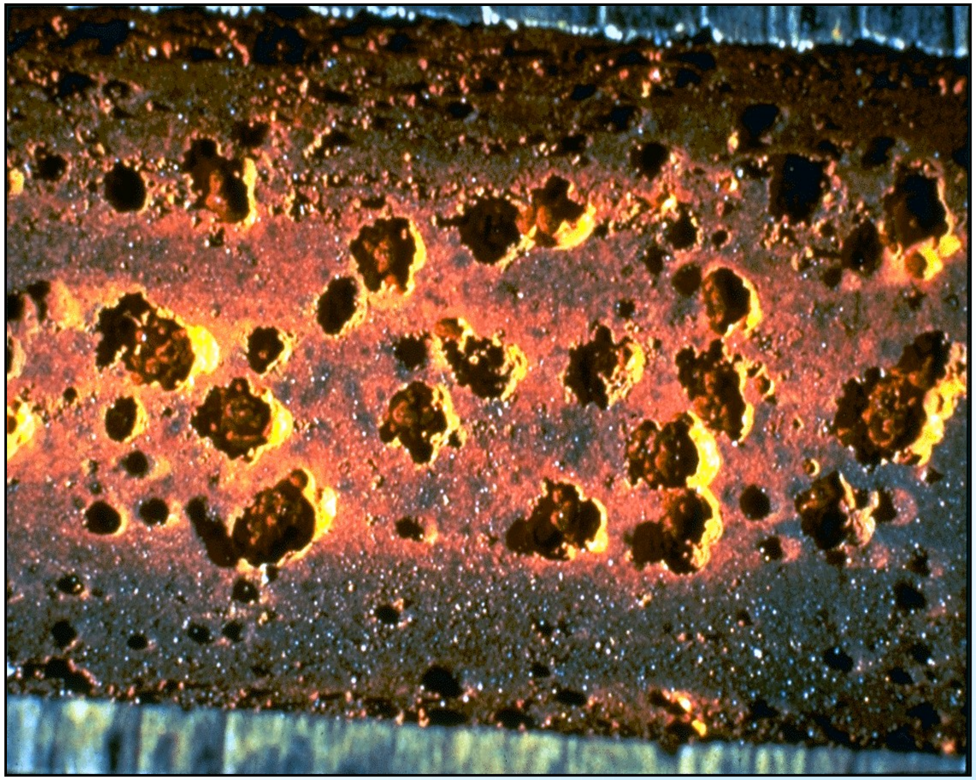
There are two major water related challenges encountered in operating a boiler – scale and corrosion

- **Mineral Scale**
  - Forms as a result of dissolved minerals in the feedwater exceeding solubility
  - Forms insulating material
  - Impedes heat transfer
  - Can result in equipment damage / boiler shutdown / loss of production



Corrosion is nature's way of reclaiming refined metals…

- **Corrosion**
  - Two primary types in boilers systems
    - Carbonic acid (condensate)
    - Oxygen
  - Reduce asset life
    - Pitting corrosion
    - General corrosion
  - Cause iron deposits on boiler tubes (energy losses)
  - Shutdown, production loss and safety issues



Over time, chemical treatment of boiler feedwater to prevent or reduce the impact of these challenges has changed

For scale control, many advancements have taken place in chemistry over the last century

Program	Developed / used	Advantages	Disadvantages
Coagulant / Soda Ash	1900 - 1950	Reduced and easier to remove scale	Still forms scale, program adds solids, increases blowdown requirements. Soda ash can result in increased condensate corrosion
Phosphate	1930's	Reduced $CaCO_3$ scale Reduced solids addition	Still potential for PO_4 scale
Chelants	Early 1960's	Comparatively lower solids contribution	Corrosion potential if overfed Potential for $MgSiO_3$ scale
Phosphonates	Late 1970's		Could result in scale if feedwater hardness not very well controlled
Polymer overlay for phosphates or chelants	Late 1970's	Conditioned specific types of suspended solids - Fe_3O_4, Fe_2O_3, $Ca_3(PO_4)_2$, $MgSiO_3$ to make them less adherent to boiler surfaces	Still potential for PO4 scale Corrosion potential if overfed Potential for $MgSiO_4$ scale
Polymer only (1st gen - polyacrylic acid)	Early 1980's	Maintains hardness in soluble state Reduces solids contribution to boiler water Reduced corrosion potential compared to chelant programs Disperses iron	Could complex with boiler metal if overfed High hardness could cause polymer / hardness complex to deposit
Polymer only (2nd gen - sulfonated polymer)	2001	Maintains hardness in a soluble state. Less corrosive than chelant. Increased thermal and oxygen stability Keeps suspended solids dispersed Does not precipitate or form precipitates Reduces iron deposition rate.	Could be corrosive if greatly overfed

For control of oxygen corrosion in preboiler equipment, we have developed effective chemical oxygen scavengers …

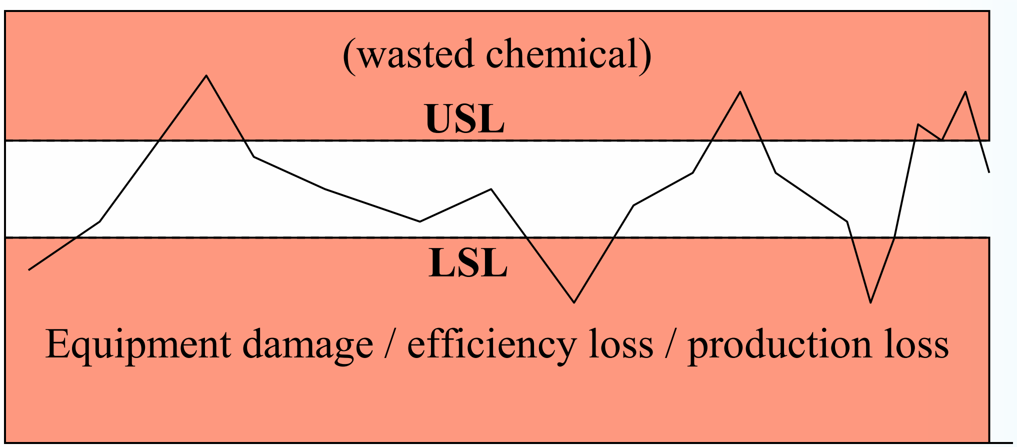
Indirect → **Direct**

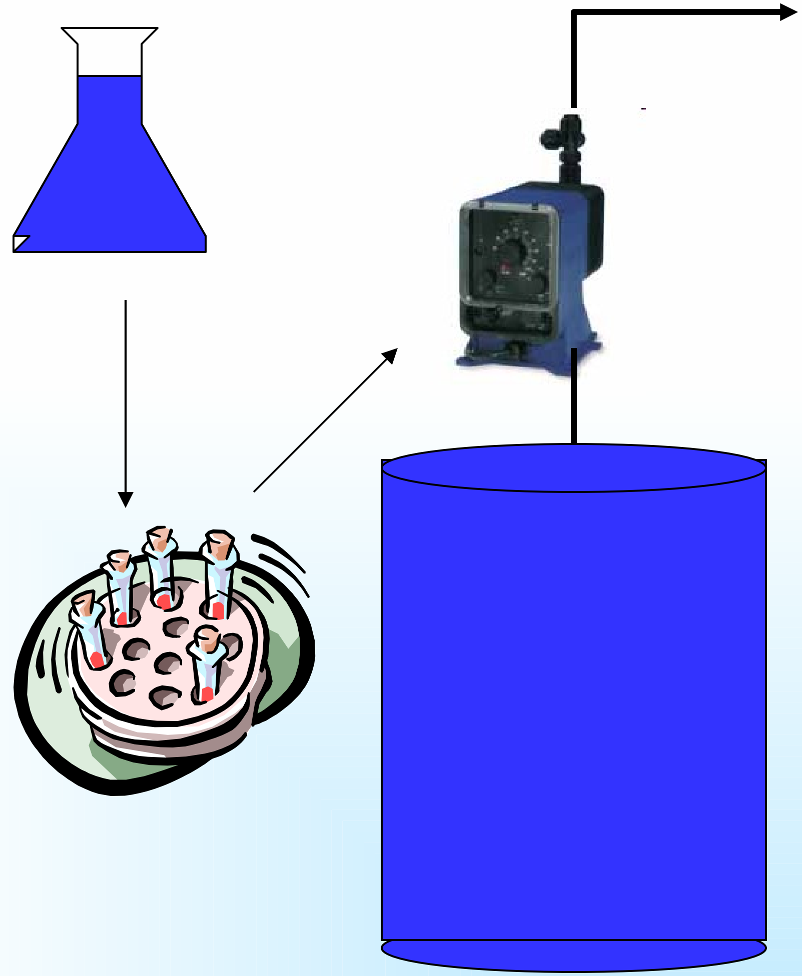
Measuring Chemical Residuals ►	**Dearator Inspections** ►	**Monitoring Dissolved Oxygen** ►	**Iron Testing** ►	**?**

… but we have still lacked technology that could reliably monitor and control changes in that environment!

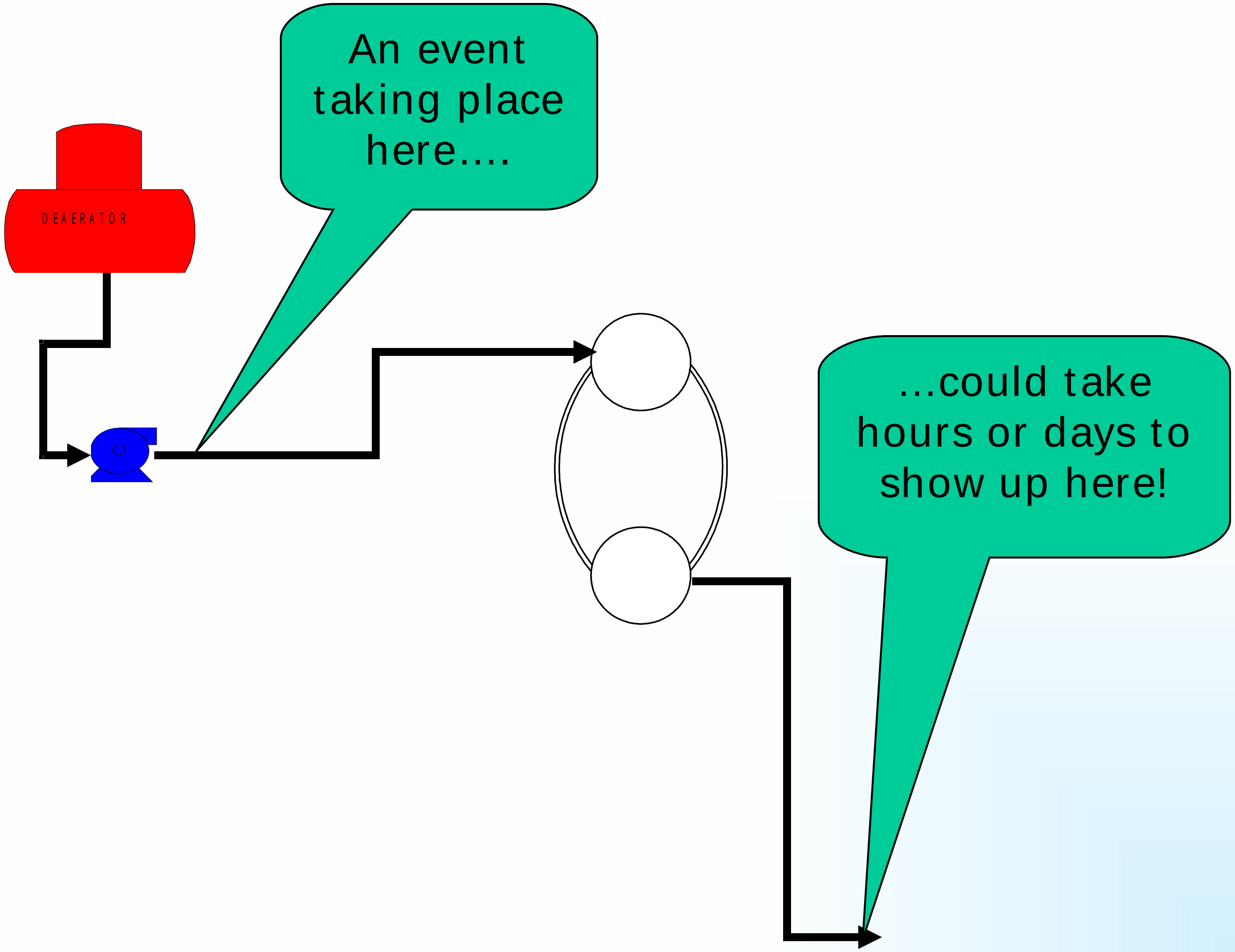
…however, the basic approach to controlling boiler water chemistry has always revolved around a "test and adjust" approach…

- Gather sample
- Test
- Adjust chemical feed
- "Repeat as necessary"





…and is still largely centered around testing the water **after** it is in the boiler



By then, its far too late to detect or remedy

We'll be talking about 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

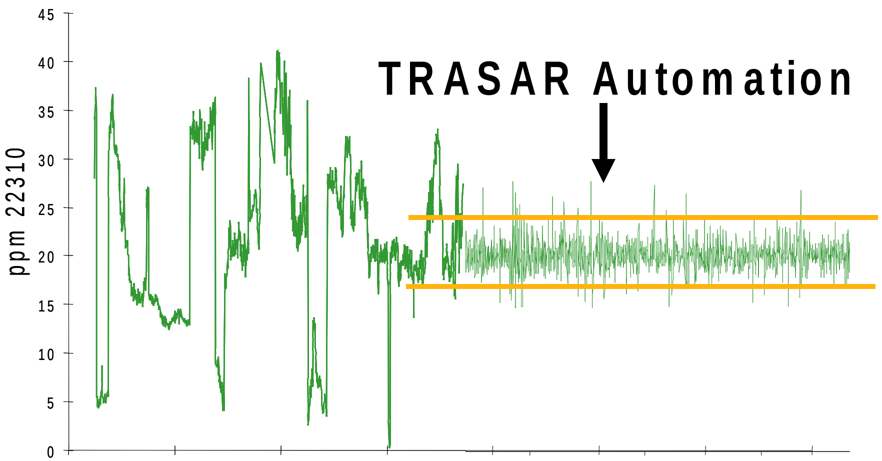
- Real time, on-line control 24/7
- Process visibility for these areas
- Assurance of asset protection
- Optimized chemical usage
- Improved energy savings opportunities

New Boiler Automation Technology

Directly measures

Automatically responds

Maintain optimum treatment levels



Direct control of scale
Inhibitor chemistry

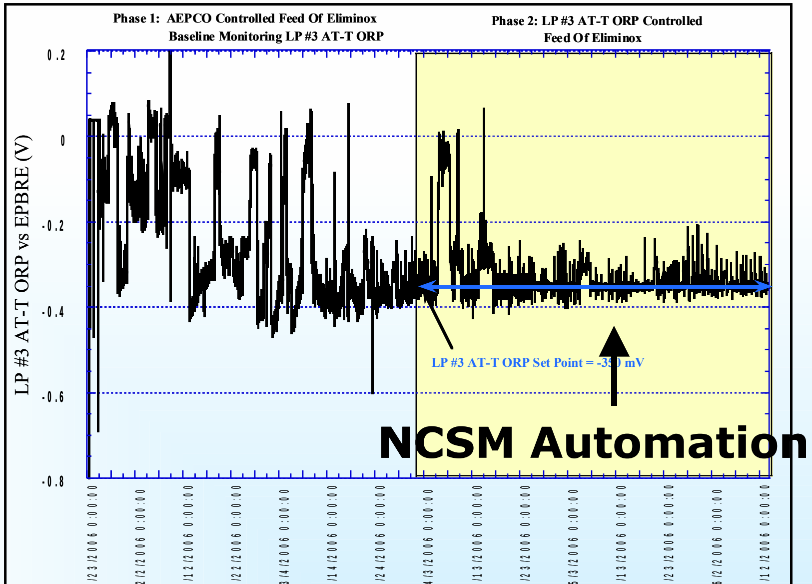


Figure 1: LP #3 AT-T ORP Results During Phase 1 and 2 of AEPCO Trial

Direct control of
preboiler corrosion

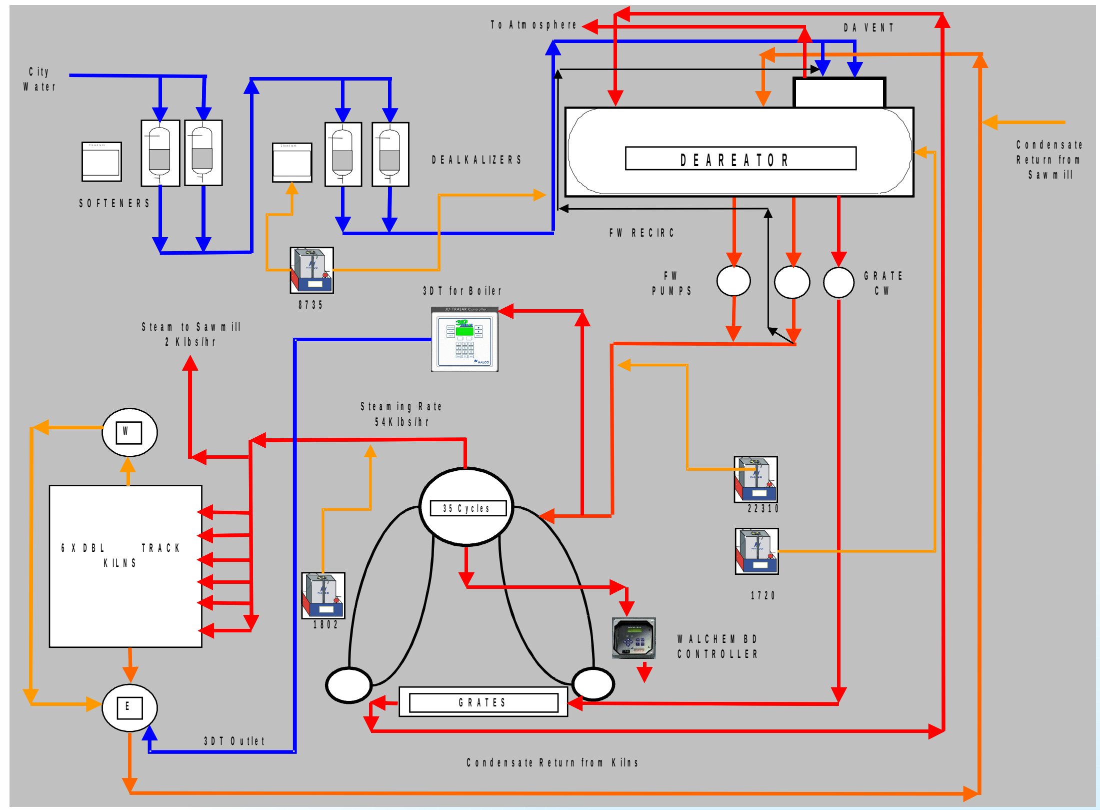
We implemented and evaluated these technologies at Boise Building Solutions, Manufacturing in Kettle Falls, WA

Results from on-site work

The boilerhouse at Kettle Falls is similar to many others

Background

- 150 psi boilers
- Average 30,000 lbs steam / hour
- Sodium zeolite, dealkalized make-up water
- Steam used primarily for controlling the drying process
- Chemistry is adjusted by daily testing

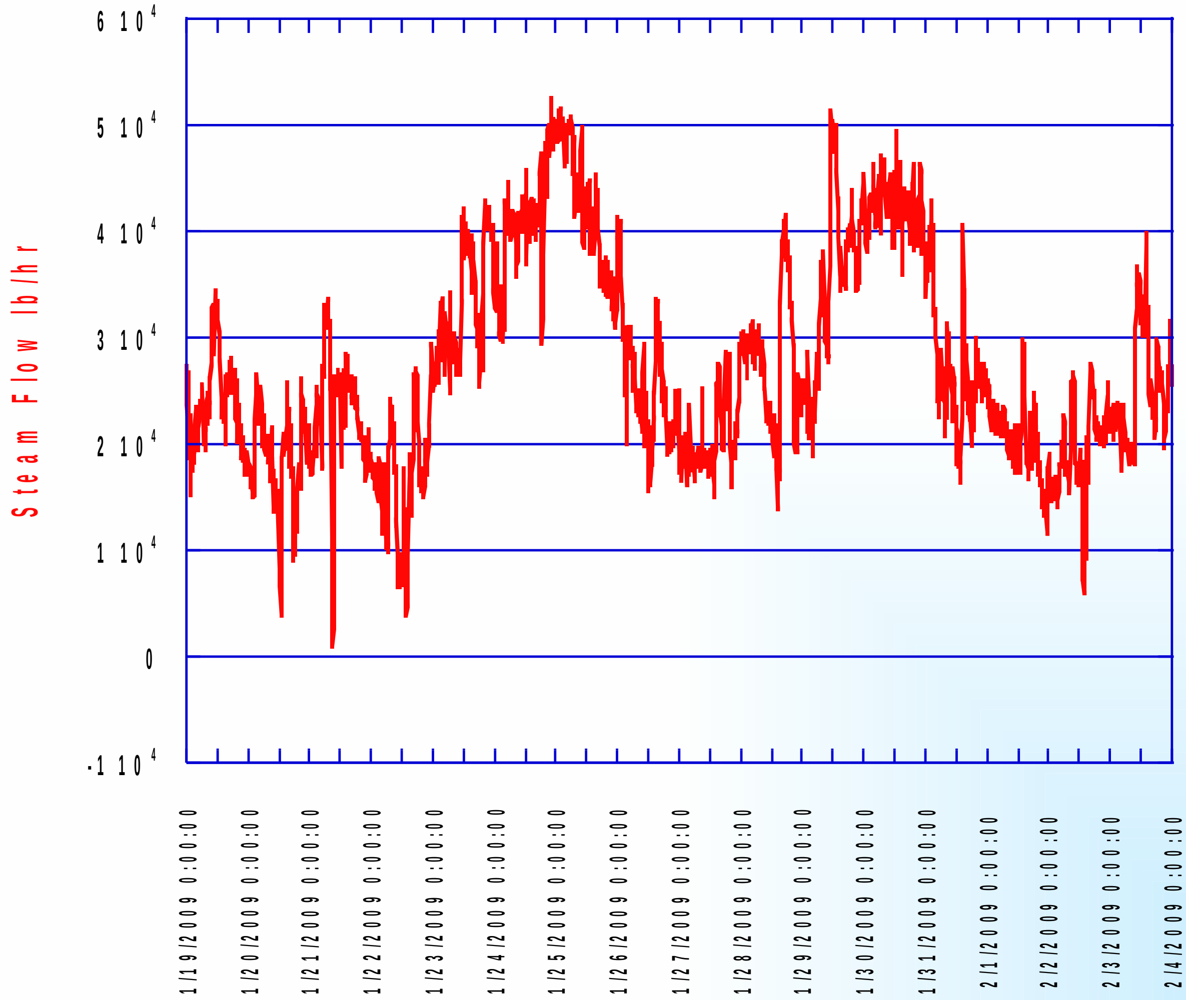


There were several objectives for the evaluation

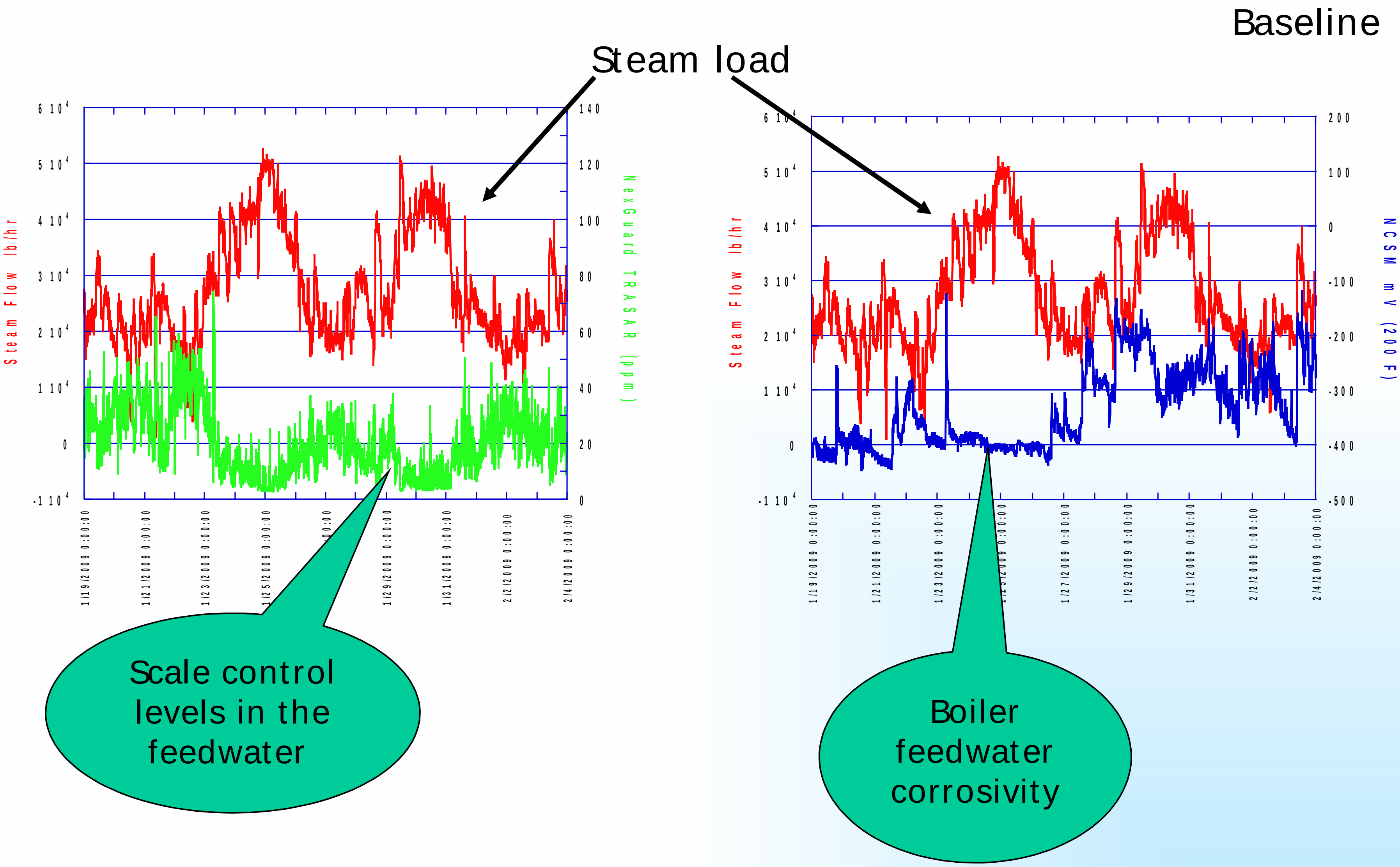
- Improved chemistry control
- Optimized operating costs
  - Reduced water costs
  - Reduced energy costs
  - Improved efficiency – avoiding iron deposits in the boiler

Like a lot of other mills and manufacturing plants, this plant has wide swings in steam load

Background



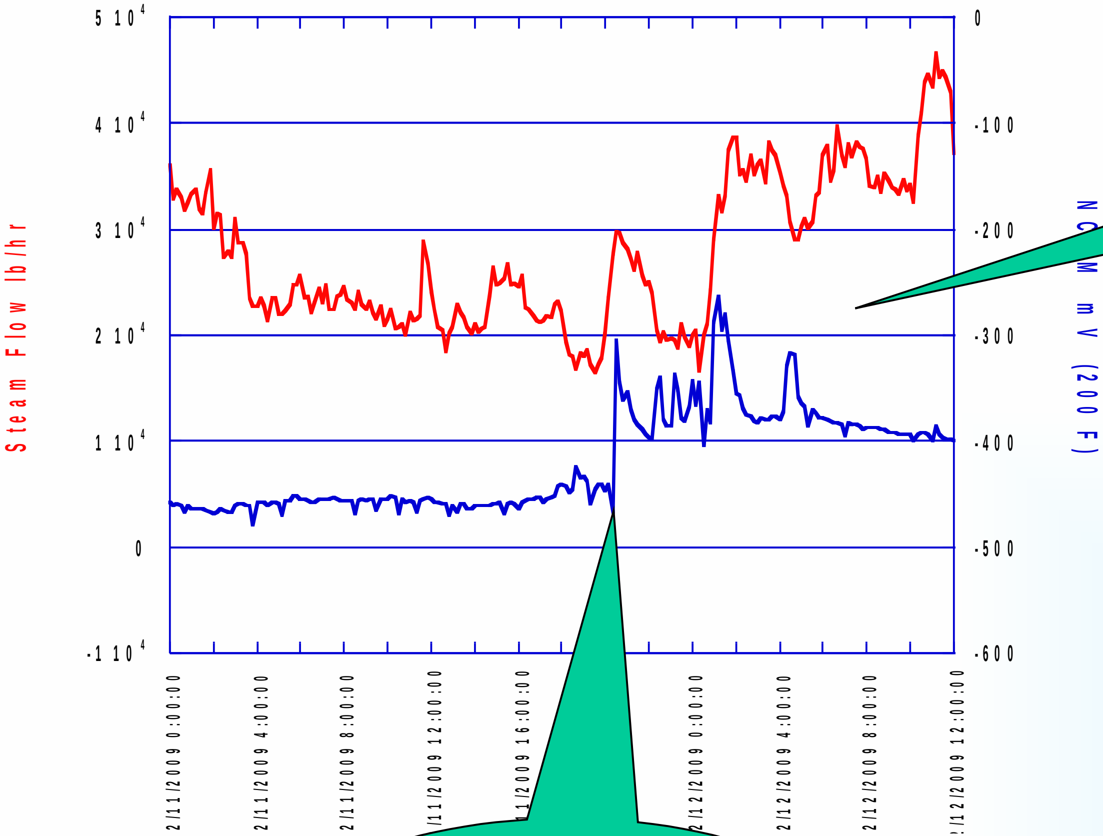
We began by establishing current control baseline – for both scale control and boiler feedwater corrosivity, there was extensive variability



Many useful discoveries occurred during the evaluation

A return condensate pump outage showed up as a large increase in feedwater corrosivity

Monitoring mode



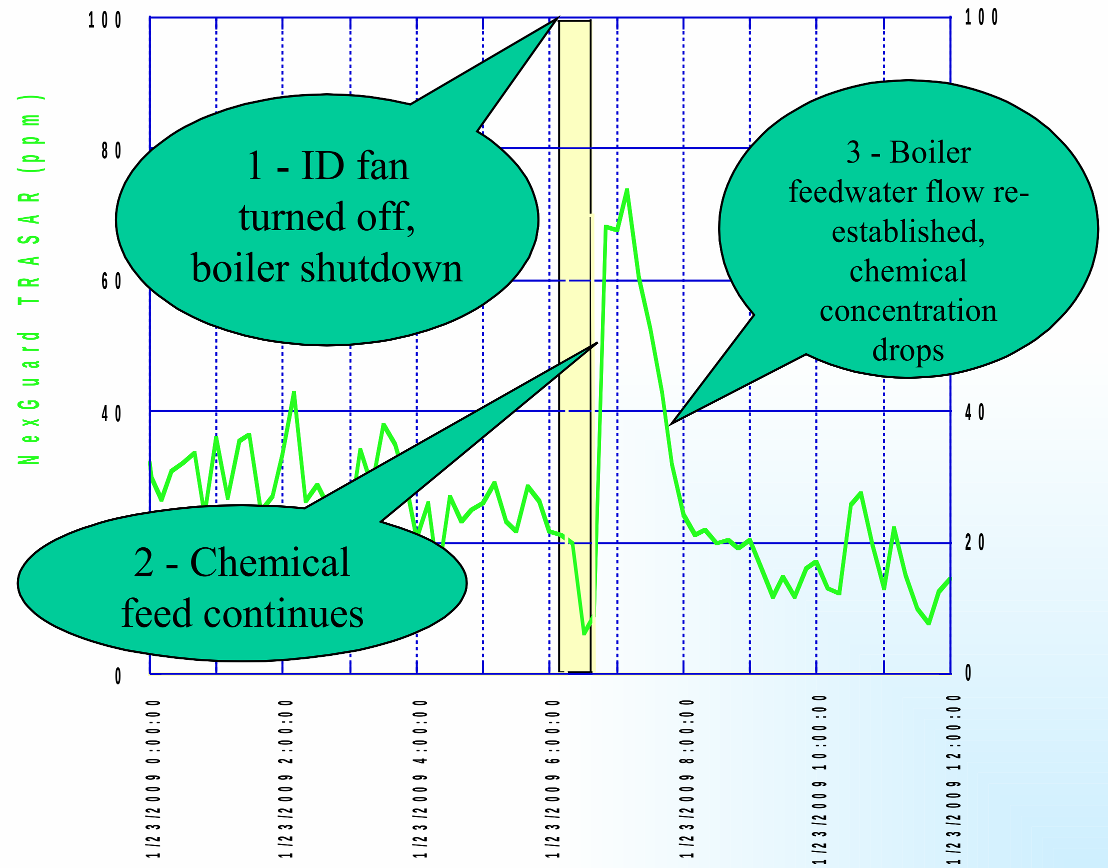
...which resulted in an increase in feedwater corrosivity

A condensate pump failure, resulting in a reduction in returned condensate...

In a control mode, this change in feedwater corrosivity would have automatically been addressed

A short term boiler outage showed how this technology could avoid an overfeed

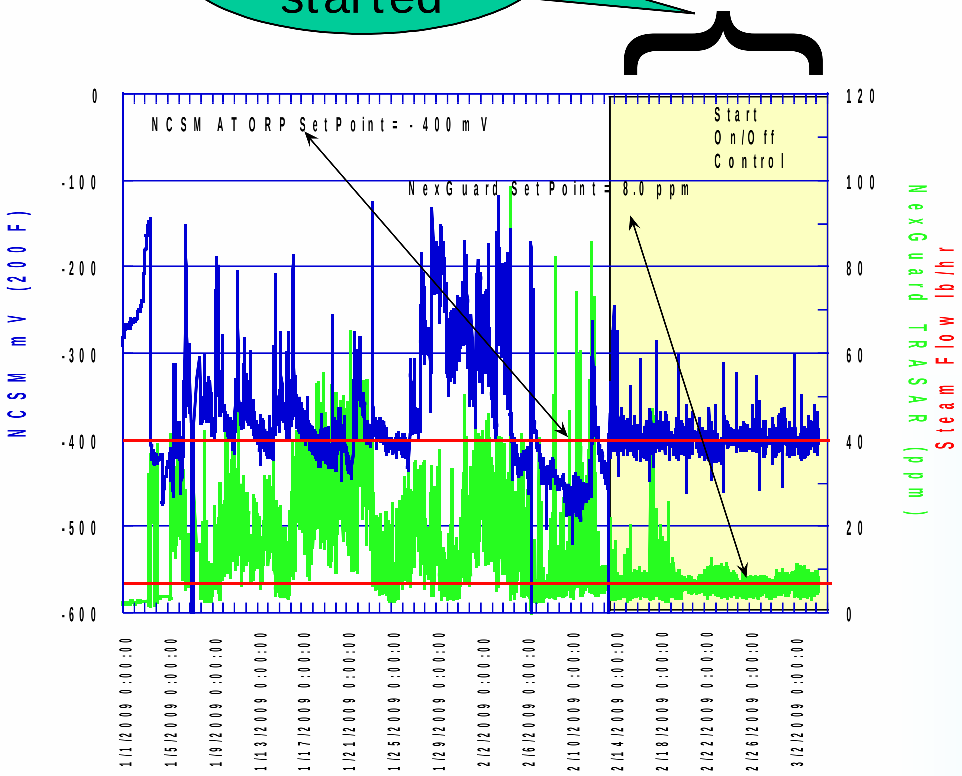
Monitoring mode

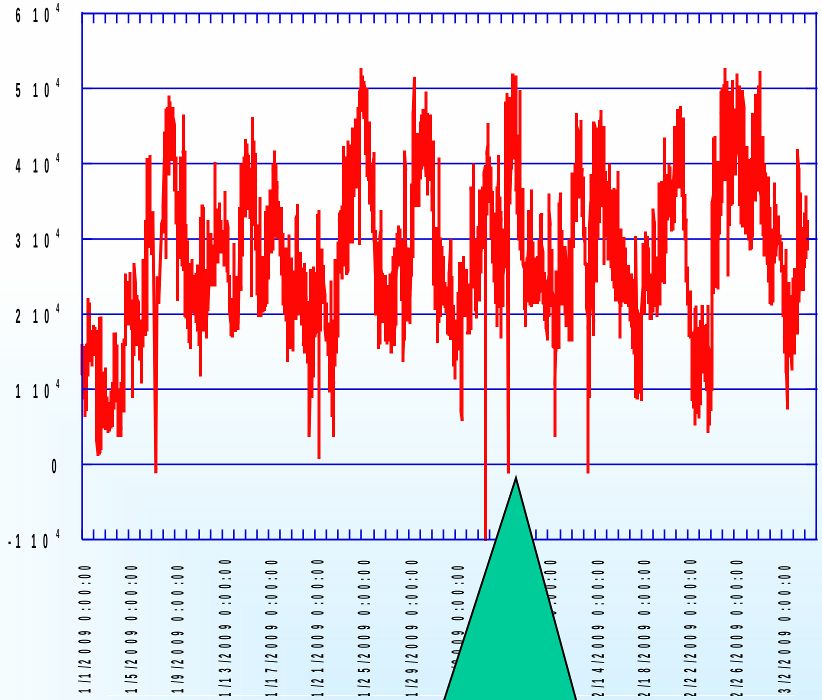


On Mid February, the technology was put into Phase 1 (on/off) control mode…

Control started

Control implementation





…and despite the wide variation in steam loads…

NALCO

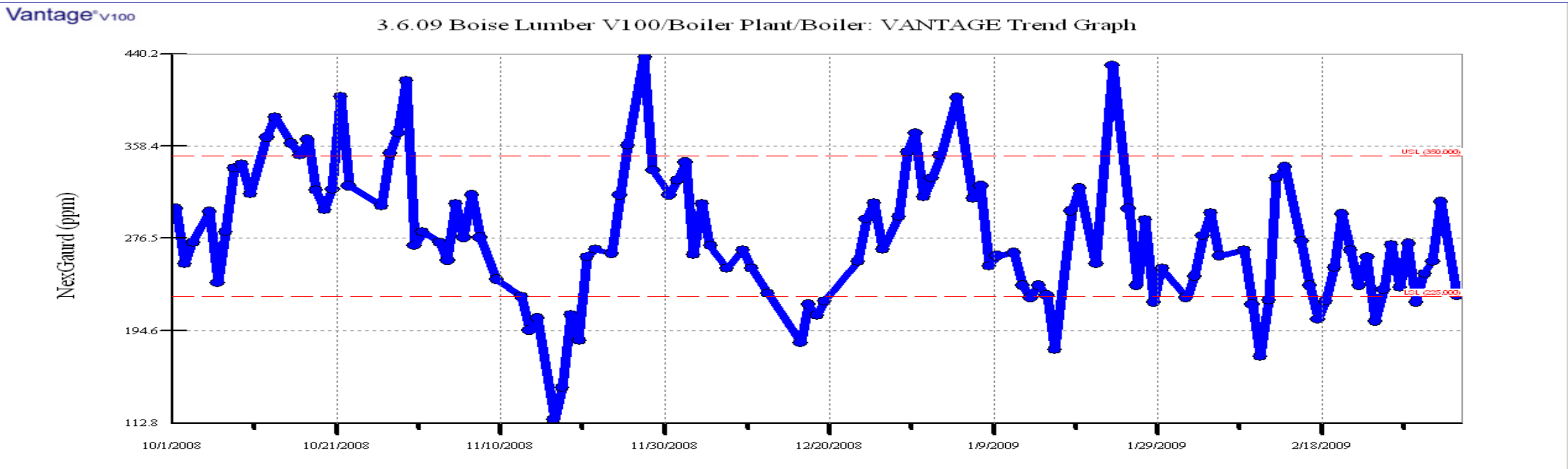
One of the other advantages of this technology is the ability to view the data on the web in real time to ensure control is maintained

Excellent improvement in control capability resulted

Outcome

Feedwater Scale Inhibitor Desired control range: 8 ppm +/- 0.5 ppm				***Pre-boiler Corrosivity*** Desired control range: -400mV +/- 10 mV			
	Before automation 1/9-2/12/09	**After initial automation 2/14 – 3/3/09**	**Comments**		**Before automation 1/9-2/12/09**	**After initial automation 2/14 – 3/3/09**	**Comments**
Average dosage	17.01 ppm	6.7 ppm	Operating above the control range wastes treatment chemicals; operating below the control range increases the risk of scale (wasted fuel), damage to the boiler and production losses	**Average reading**	-366 mV	-401 mV	Values approaching zero (more positive) indicate a more corrosive environment. Excessively negative numbers may mean excessive oxygen scavenger use, leading to higher blowdown levels
Standard deviation	+/- 23 ppm	+ /- 2.4 ppm	An 89.6% reduction in standard deviation	**Standard deviation**	+/- 71mV	+/- 13 mV	An 82% reduction in standard deviation

Wet Chemistry Results…



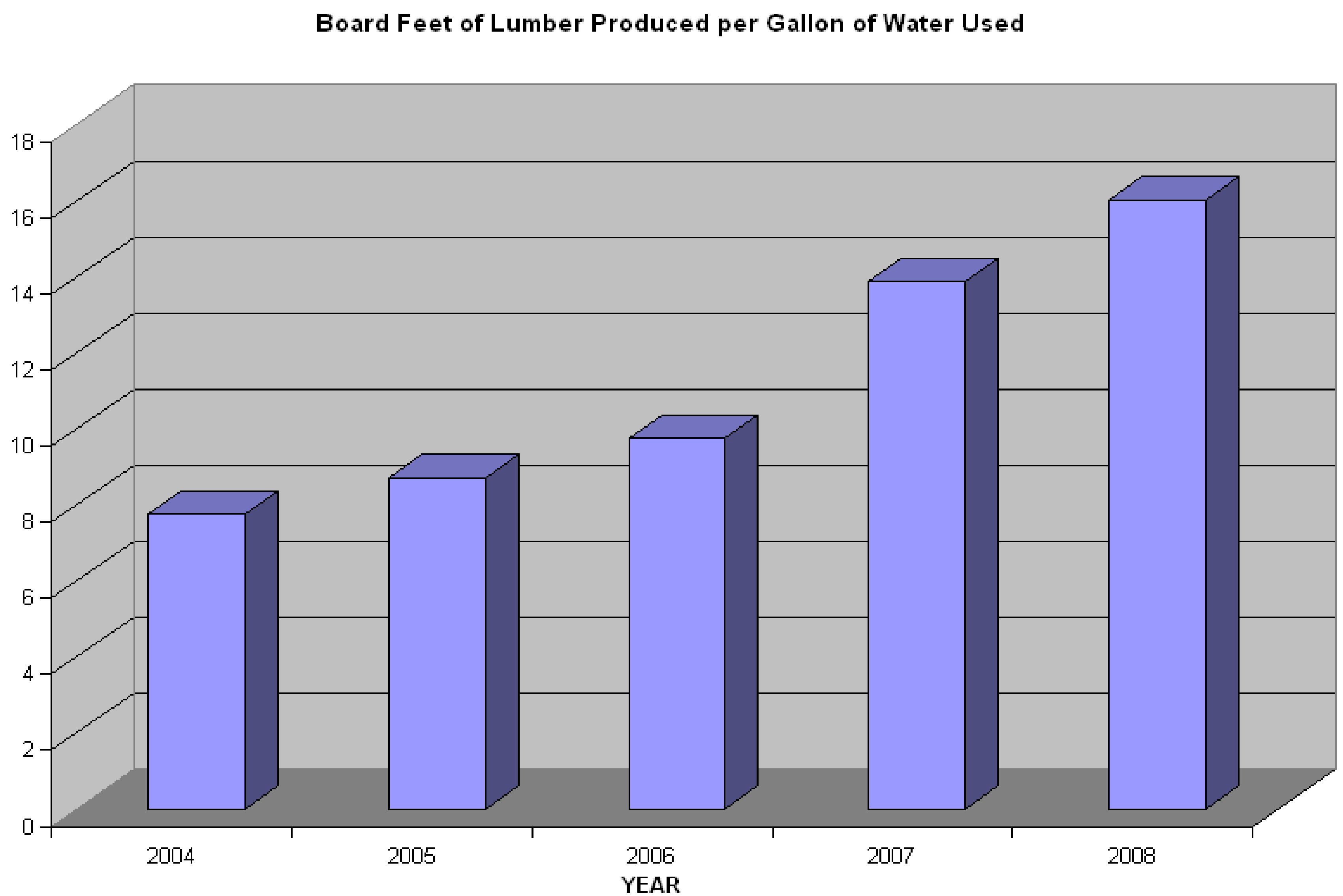
Measurement	
NexGaurd (ppm)	
Start Date	10/1/2008
End Date	2/14/2009
Mean	284.72
Standard Deviation	61.34
Low Value	116.00
High Value	437.00
Period Total	28,756.87
Total Points	101
LSL	225.00
USL	350.00
Points in Spec	70
% of Points In Spec	69.31%

As expected, wet chemistry control has gotten tighter as well.

Standard deviation has decreased by 49.2%

Measurement	
NexGaurd (ppm)	
Start Date	2/14/2009
End Date	3/6/2009
Mean	247.95
Standard Deviation	29.13
Low Value	203.00
High Value	309.00
Period Total	4,711.00
Total Points	19
LSL	225.00
USL	350.00
Points in Spec	15
% of Points In Spec	78.95%

Another achievement was the reduction in water per volume of production



Some of the improvement highlights included

Summary

- Improvement in pre-boiler corrosion stress control
  - Before - 44% in desired range
  - After – 87.1%
- Scale control overfeed reduced from 73% to 15%
  - More improvement anticipated as next control protocol steps are taken
- Summary of improvements and ROI
  - From the initial work since implementing the overall program – cycles have increased from 10 to 30
    - Blowdown reduced by 69%
    - Water saved – 2.4 Million gallons
  - Reduced wet testing
  - Extended equipment life
  - Improved efficiency
  - Greatly increased knowledge of system behavior
  - Enhanced process visibility
  - Reduced total operating cost

Key Take Aways…

Summary

- Asset Reliability and Efficiency is the Key in Steam Plant Operations
- Controlling Scale and Corrosion is the Key to Asset Reliability
- New Methods of Measurement and Control have "Changed the Game"
    - Indirect Control to Direct Control
    - Reactive to Proactive
    - Greater Visibility with less Operations Time Requirement
    - Equals Greater Asset Reliability with lower Total Costs of Operations