



Application Note for Boiler Tube Failure Reduction

Subject: Boiler tube failure tracking, repairs, analysis

Date: July 12, 2001

Updated: November 9, 2006

Markets: Boiler Equipment Owners
Boiler manufacturers and OEMs
Power Plants

Need

Faced with deregulation and increased retail competition, many power generation utilities have adopted business strategies centered on increasing availability and extending the life of their plants. Various programs have been implemented to increase availability, but boiler tube failures continue to be the number one cause of forced outages in the fossil plants today, responsible for 6% loss of availability. Each forced outage can cost the owners hundreds of thousands of dollars in replacement power.

In many cases failures are caused repeatedly because tools are not available to analyze the data collected. An integrated program is required that would not only provide an easy way to track and document tube failures, but would also provide tools for data and root cause analysis.

In addition, it is necessary to quickly generate the documentation and reports necessary to analyze and repair the failures. Context specific reference information, like weld procedure, needs to be readily available to the technicians and engineers.

The problem becomes even more acute when a central team of engineers is responsible for a fleet of boilers. Tools are required that not only provides insight into the root cause of tube failures, but provide a broader perspective in terms of identifying trends across a boiler fleet.

Sample Case

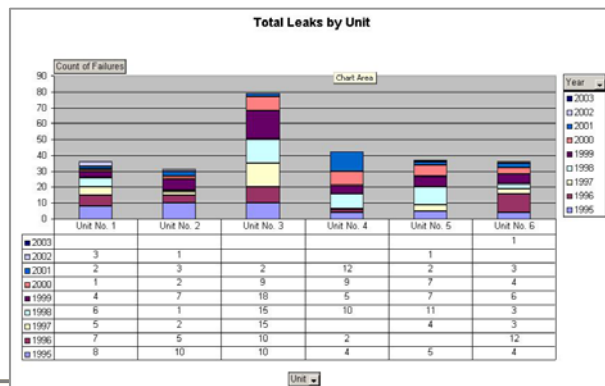
Consider a power utility company with multiple plants sites, including sister units at various locations. Over a 20-year period, the number of forced outages due to tube failures ranges from 0 to 20 per unit per year, but it is noticed that somehow one of the units is experiencing a substantially higher forced outage frequency than the other.

The records for the two plants are kept at their respective locations with some information in hard copy and other information in electronic files. Each plant uses their preferred consultants and metallurgists to analyze failures and perform condition assessments, but the information available is not uniform across the plants. This makes it difficult for the plant engineers and central engineering to analyze the root cause of these failures or to determine the effect of fuel and operating conditions. NDE is done on a regular basis, but correlating the information with the failures is too cumbersome to be accomplished manually.

Because no standard documenting process has been used, there is no easy way to visualize/ analyze trends, review recommended actions and repair history, or generate integrated reports of failures across multiple boilers.

The central boiler engineering team that is responsible for all the fossil power plants needs to have a software package that helps them track and analyze tube failures easily. A graphical interface is required, with the main objectives of using a software package to:

- Improve availability
- Reduce forced outage costs
- Reduce cost to repair
- Extend component life
- Perform root cause analysis
- Determine commonalities across the boiler fleet
- Plan for future outages

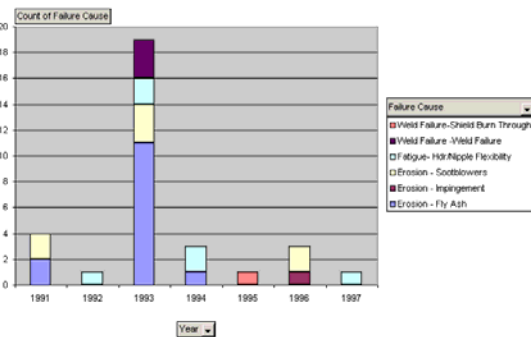


Solution

Installing the Aware™ Boiler module enables plant engineers and a central engineering group to achieve the objectives described above. ATI and Alstom Power, utilizing their complimentary expertise in software development & boiler maintenance expertise, co-developed the Aware Boiler Module. It uses a common database across all plants and is easily accessible from any web browser within the company’s intranet, without having to install software on each users machine. Standard tube failure and inspection forms are provided for all boiler pressure parts, ensuring that a consistent set of data/ knowledge is collected for each tube failure and/ or inspection.

Because it is web-based, access can be granted (if desired) to OEMs, met-labs or other consultants to facilitate collaboration and reporting. Outside reports in any format (e.g. PDF, MS Xcel, MS Word, Tiff, etc.) are easily loaded into the program and available for sharing among multiple engineers & management.

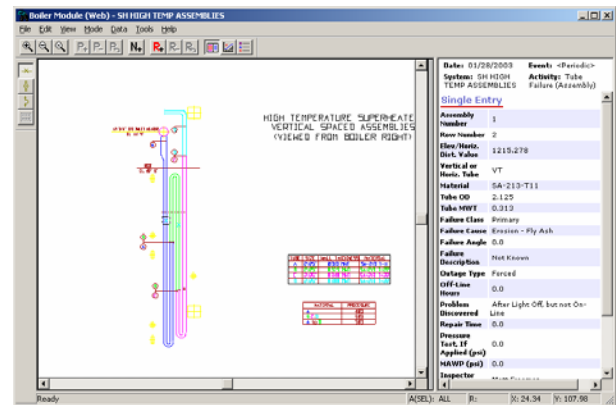
Q1 Boiler Type (All) Plant (All) Unit (All) Component ECONOMIZER ASSEMBLIES



The package enables the team to achieve its objectives by:

- Trending of historical data, combined with the predictability features complements plant availability improvement programs.
- Easily access and correlate data/ knowledge from all plants through a single interface accessible through a web browser from any computer on the intranet.
- Outliers are easily identified with failure causes, repairs, recommendations, etc. easily accessible.
- Outage and R-1 report writing time is reduced .
- Loss of reports and files containing valuable information is eliminated.
- Inquiries about previous outages are easily answered
- Repair non-conformances are reduced – (fix it right the first time).
- Team approach to problem solving, reducing cycle-time and travel-related expenses.
- XML approach to communicate with other plant databases, like CMMS, enables transfer of accurate data and eliminate double entry

A drawing interface is available that provides users a visual tool to use during analysis. Failures and/ or repairs are shown on the drawings, with the user having the ability to color code points by cause, repair, date, etc.



Benefits/ Results

Implementing the Aware Boiler module achieves the following benefits/ ROI:

Benefit	Return on Investment
Reduction in forced outages based on improved data/ knowledge/ analyses availability	50% reduction of forced outages caused by tube failures.
Reduce time manually analyzing and searching for data	½ person year/ plant/ year.
More efficient outage and R-1 report writing	50% reduction in time to write reports
Decrease time distributing information/ manually collaborating	1 person month/ plant/ year.
Decrease time justifying repairs & replacements to management	1 person week/ year
Eliminate cost to collect historical information for condition assessment studies.	\$5K/ plant/ year

Your Implementation Effort

Implementing the Aware Boiler module is accomplished with minimal effort. A form is provided to specify the boiler equipment, which is filled out in less than an hour. ATI’s professional services group then models the boiler within the Aware™ software, so the end user only needs to install the software and attend a ½ day training session. Assuming a few hours of discussion, the total implementation time can be achieved with 1 man-day of your effort. If the drawing interface is desired, additional time may be required to collect the drawings and other information.

Pocket_PC

Internet Explorer

http://208.36.17.98/PDAUpdateAc

System: ECONOMIZER LEFT SIDE WALL
 Activity: Tube Failure (Wall)
 Date: 01/22/2003

Row #

Material

Failure Class

Failure Cause

Future Actions

View Tools

Primary Tube Failure Analysis

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DATE: 04/21/1997 22:45:01
 SYSTEM: ECONOMIZER ASSEMBLIES
 ACTIVITY: Tube Failure (Assembly)

On-Line Date: 04/22/1997 18:53:00
 Problem Discussed: AFTER UNIT ON-LINE
 Failure Orientation: CIRCUMFERENTIAL
 Failure Angle: 180.0
 Analysis Disposition: NO ANALYSIS REQUIRED

Analysis Results:
 1-1/2" LONG CRACK, CENTERED AT ABOUT 7:00 (NORTH IS 9:00) IN HIPPLE TO TUBE WELD, ABOUT 2" OFF HEADER. INITIAL TO BE FIN HOLE, BUT WAS ACTUALLY CRACK

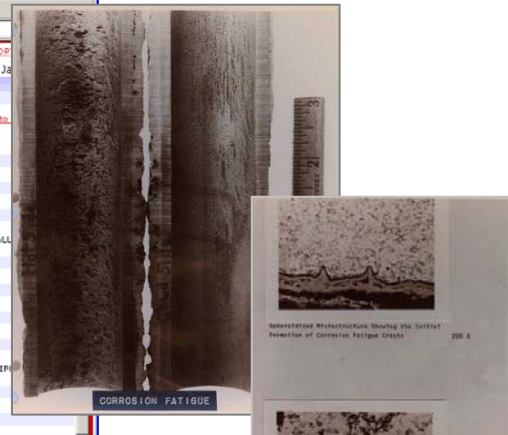
Flow/Leak: Dist. Value: 56.944
 Assembly Number: 80
 Tube Number: 17
 Material: SA192
 Tube OD: 2.0
 Tube MWT: 0.2
 Vertical or Horiz. Tube: HR

Failure Comments:
 APPEARED THAT ASH ON BEAM PREVENTED DOWNWARD EXPANSION OF ASSYS. THIS CAUSED BENDING STRESS AT HDR NIPPLE. ECON. HAS LESS CLEARANCE BETWEEN ASSYS & BEAM THAN MOST OTHER UNITS.

Tube Failure ID: ECD497
 Replacement Material - MWT: 2
 Replacement Material - OD: 2
 Replacement Material Type: SA192

Repair Comments:
 MPAC W/O: 97-06559; GROUND OUT CRACK AND REWELDED. WELD APPROX. 3/4" WIDE (LOOKING EAST). ON TUBE SIDE OF HEADER HIPPLE WELD. 1-2" FROM HEADER SURFACE

Repair Time: 20.133
 Failure Class: PRIMARY
 Repair PWD#: PRP-97025-1
 Off Line Date: 04/21/1997



APPENDIX 5 - NATIONAL BOARD FORMS

FORM R-1 REPORT OF WELDED REPAIR

in accordance with provisions of the National Board Inspection Code

1. Work Performed By _____ (Name of repair organization) (Print name)

2. Owner _____ (Name)

3. Location of Installation: Charcot - Unit 3 (Name)

NSIC _____
 Correct and that all material, construction, and _____
 Signed _____ (Name of repair organization)
 I, _____, Inspector and certificate of _____
 described in this report on, and state that to _____
 the National Board Inspection Code, _____
 hereby, expressed or implied, concerning the _____
 shall be liable in any manner for any _____
 as inspection.

Comments: _____
 (Initials and dates) (Date)

Tube Failure Analysis

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WELCOME ADMINISTRATOR

Click on the button to see the respective results:

BoilerType: Plant: Unit: Component: List of Primary Failures - By Component

List Leaks for dates between Refresh

Failure Date	Plant	Unit	Component	BoilerType	Failures
2001	Bradley	Unit 1	FURNACE REAR WALL TUBES	A-10	1
1999	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	3
1998	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	3
1997	Bradley	Unit 1	ECONOMIZER ASSEMBLIES	A-10	1
1997	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	1
1996	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	5
1996	Bradley	Unit 1	FRONT STEAM COOLED TUBES	A-10	1
1995	Bradley	Unit 1	ECONOMIZER ASSEMBLIES	A-10	1
1995	Bradley	Unit 1	ECONOMIZER LEFT SIDE WALL TUBES	A-10	1
1995	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	2
1994	Bradley	Unit 1	ECONOMIZER ASSEMBLIES	A-10	1
1994	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	2
1993	Bradley	Unit 1	ECONOMIZER ASSEMBLIES	A-10	5
1993	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	6
1992	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	4
1991	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	4
1991	Bradley	Unit 1	FRONT SCREEN TUBES	A-10	1
1991	Bradley	Unit 1	FURNACE FRONT WALL TUBES	A-10	1
1991	Bradley	Unit 1	FURNACE REAR WALL TUBES	A-10	2
1989	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	2
1988	Bradley	Unit 1	FURNACE REAR WALL TUBES	A-10	1
1987	Bradley	Unit 1	ECONOMIZER ASSEMBLIES	A-10	1
1987	Bradley	Unit 1	FINISHING SUPERHEATER	A-10	1

Tube Leaks

Tube Leaks

Features Suited For BTF Reduction

Pre-configured to track and analyze tube failures

The Aware Boiler module is pre-configured to document and analyze tube failures. This makes it possible to start using the software from day one. You have the flexibility to tailor the application to meet your corporate needs and to expand on the application, if required. A list of key features is provided below:

- Keeps an easy to access record of all tube failures, repairs and UT readings including locations, failure cause, outage duration, photos, weld procedure, etc.
- Automatically creates R-1 report
- Attach Met Lab reports to tube failure records, so all relevant information for a failure is in one place.

Graphical Interface

This module supports displaying tube failures and NDE data superimposed on component-specific AutoCAD drawings. Even though you can get enormous benefits from the system without a graphical interface, current users have contended that a picture is worth a thousand words. Using the graphical interface allows you to describe the failure accurately and also gives a much better perspective of analysis results. It is important to point out that the AutoCAD drawings can be generated and integrated into the system by you.

Supports hand help devices

Using a PDA, Tablet PC, Pocket PC or a web pad, users can access and update failure information connected to the central database. This provides a convenient way for boiler technicians and engineers to enter failure information even when they remote from their desk.

Pre-built analysis tools

Many analyses are built-in with the module that is made available through portal pages. You can do your root-cause analysis or predict where failures are likely to happen. The results can be used to plan for the work scope for an upcoming outage.

The list below shows some of the pre-configured reports:

- Failure break down based on
 - Manufacturer and boiler types
 - Component types
 - Failure causes
 - Date range
- Lost hours based on
 - Manufacturer and boiler types
 - Component types
 - Failure causes

The users can select the date range for each of these reports. Using the powerful search capability within Aware™, users can create and integrate analysis of their choice.

Features Suited For Enterprise Level Deployment

Enterprise ready

Aware™ is web-based and ready to be deployed enterprise-wide with minimum effort. There is no need to install the software on client machines. All your units and components can be configured in ONE CENTRAL database. This makes it easy for your IT personnel to maintain and possible for engineers to analyze boiler data across all plants and units.

Special portal pages are integrated and available to the users. With instant and continuous access to the data, managers can now access the same information in an easy to understand format to make run, repair and replace decisions.

Easily Scalable and Expandable

To reap the benefits from the Boiler module immediately, you can start out with a single boiler unit and expand over time. No data migration or extra efforts are required as you add more units to the system. Being web-based, no additional IT costs are incurred to add users.

Pre-built forms and reports

The Boiler module comes with pre-configured forms and reports that provide boiler engineers the capability to accurately describe the scope of work to contractors for repairs. Users can create the weld traveler and R-forms immediately.

Security

Aware supports a sophisticated security feature where users can be assigned read/write access to individual pieces of information. The security can also be applied such that users from one plant or unit will not be able to modify data that they do not own.

For Additional Information, Please Contact:

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