



SUOMEN SOODAKATTILAYHDISTYS  
FINNISH RECOVERY BOILER COMMITTEE



**American  
Forest & Paper  
Association**

# Developments in North America

Wayne Grilliot

American Forest & Paper Association



# Topics

- Recovery Boiler Safety Trends
  - BLRBAC North American Information
- American Forest & Paper Association
  - AF&PA Recovery Boiler Program
  - AF&PA Recovery Boiler Operational Safety Seminars and Conferences
- Summary



## ➤ Black Liquor Recovery Boiler Advisory Committee (BLRBAC)

- Started in 1961
- Membership: Operating mills, boiler manufacturers, & insurers
- Provides Recovery Boiler incident history, data, & analysis
- Share knowledge and generate & maintain guidelines to help facilitate the safe, reliable operation of Black Liquor Recovery Boilers.

## ➤ AF&PA Recovery Boiler Program

- Started in 1974
- Works closely with BLRBAC
- Open to all companies & mills operating Recovery Boilers
- Membership: Operating mills in North & South America
- Sponsors research projects focused on Recovery Boiler safety
- Offers Recovery Boiler Operational Safety Training Seminars



# BLRBAC Subcommittees (10)

- ESP (Emergency Shutdown Procedure) - Frank Navojosky, Chairman
  - Safe Firing of Black Liquor - Vernon Blackard, Chairman
  - Safe Firing of Auxiliary Fuel - Bruce Knowlen, Chairman
  - Personnel Safety - John Fredrickson, Chairman
  - Instrumentation - John Browning, Chairman
  - Waste Streams - Paul Seefeld, Chairman
  - Fire Protection in Direct Contact Evaporator - Stephen Cox, Chairman
  - Materials & Welding - Mike Blair, Chairman
  - Water Treatment - Tom Przybylski, Chairman
  - Publicity & News - Matt Paine, Chairman
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- The BLRBAC Subcommittee Meeting Minutes are posted on the BLRBAC website: [www.blrbac.net](http://www.blrbac.net)



## **BLRBAC Website Site: Current Posted Guidelines (2023 last revs.)**

- **Recommended Good Practice For Design, Operation, and Testing of the Emergency Shutdown System for Black Liquor Recovery Boilers (Dated: April 2023)**
- **Safe Firing of Black Liquor in Black Liquor Recovery Boilers (Dated: Fall 2023)**
- **Materials & Welding Guidelines (Dated: April 2013)**
- **Safe Firing of Auxiliary Fuel in Black Liquor Recovery Boilers (Dated: February 2012)**
- **Fire Protection in Direct Contact Evaporators and Associated Equipment (Dated: February 2016)**
- **Personnel Safety & Training (Dated: April 2018)**
- **Application of Rotork Actuators on Black Liquor Recovery Boilers (Dated: October 2005)**
- **Boiler Water Management Guidelines for Black Liquor Recovery Boiler (Dated: 2023)**
- **Instrumentation Checklist and Classification Guide for Instruments and Control Systems Used in the Operation of Black Liquor Recovery Boilers (Dated: April 2014)**
- **Thermal Oxidation of Waste Streams in Black Liquor Recovery Boilers (Dated: April 2017)**



## **BLRBAC ESP Subcommittee Publishes Incident Learnings**

- **BLRBAC Website Link:** [www.blrbac.net](http://www.blrbac.net)
- **Several Examples Below**
- **Numbers Indicate Incident Number**
  - Refractory exposed to smelt must be inspected and repaired on major outages. Eventually total refractory replacement may be required to maintain integrity. S23-01
  - If smelt flows over pressure parts such as tubes and headers during a smelt leak, thickness checks of pressure part components is prudent. S23-01
  - During smelt spout or dissolving tank issues, the senior most available operational person must be involved to look in and monitor the furnace to ensure the bed is observed for pooling. S23-02



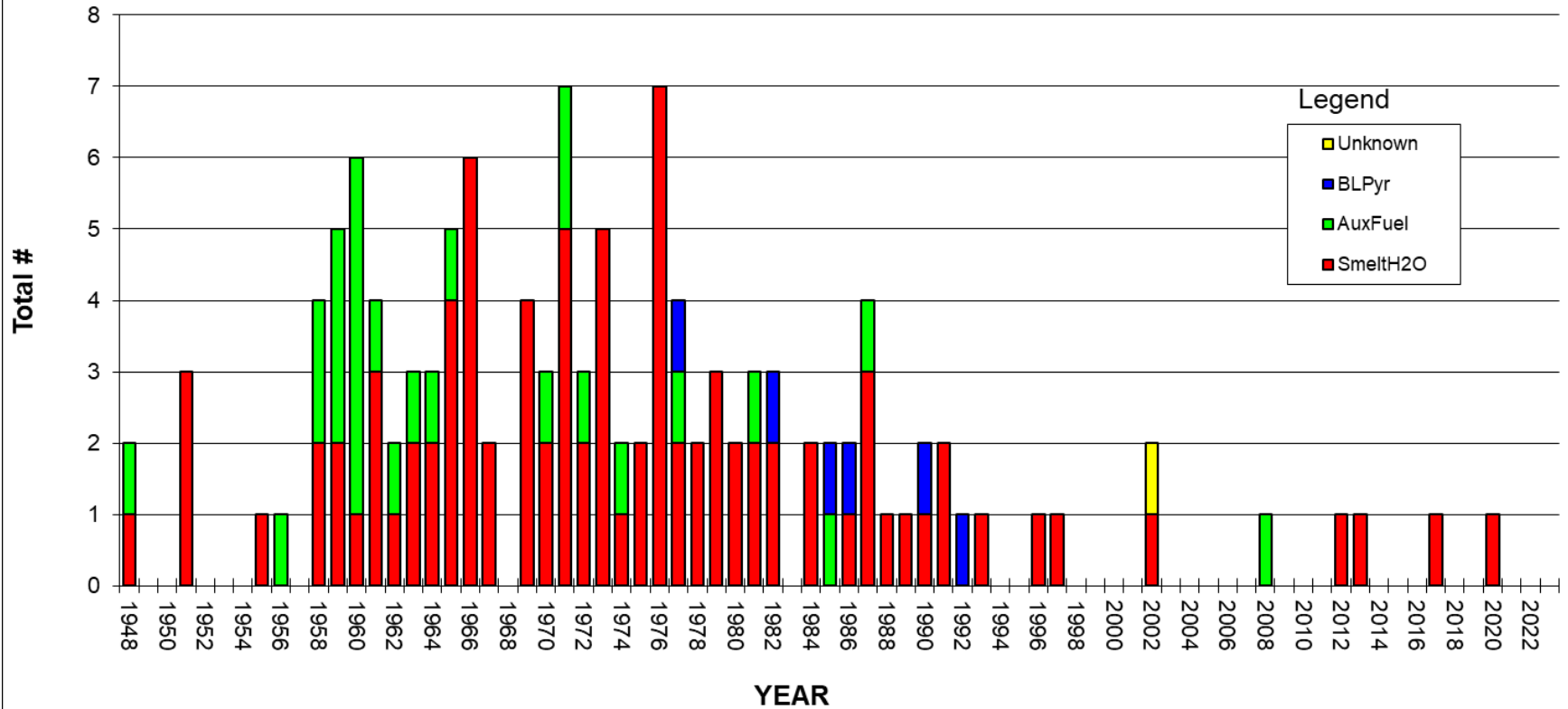
# Registration

- MetroConnections is now handling BLRBAC meeting registrations.
- A link is provided on the BLRBAC website: [www.blrbac.net](http://www.blrbac.net)
- Credit cards are accepted.
- Meeting Registration is now \$500, in advance
  - At door \$525
- Free hotel shuttle to and from airport
- Spring 2023 - 191 registered
- Fall 2023 - 200 registered
- Spring 2024 - 196 registered



## KRAFT RECOVERY BOILER EXPLOSIONS

North America Pulp and Paper Industry

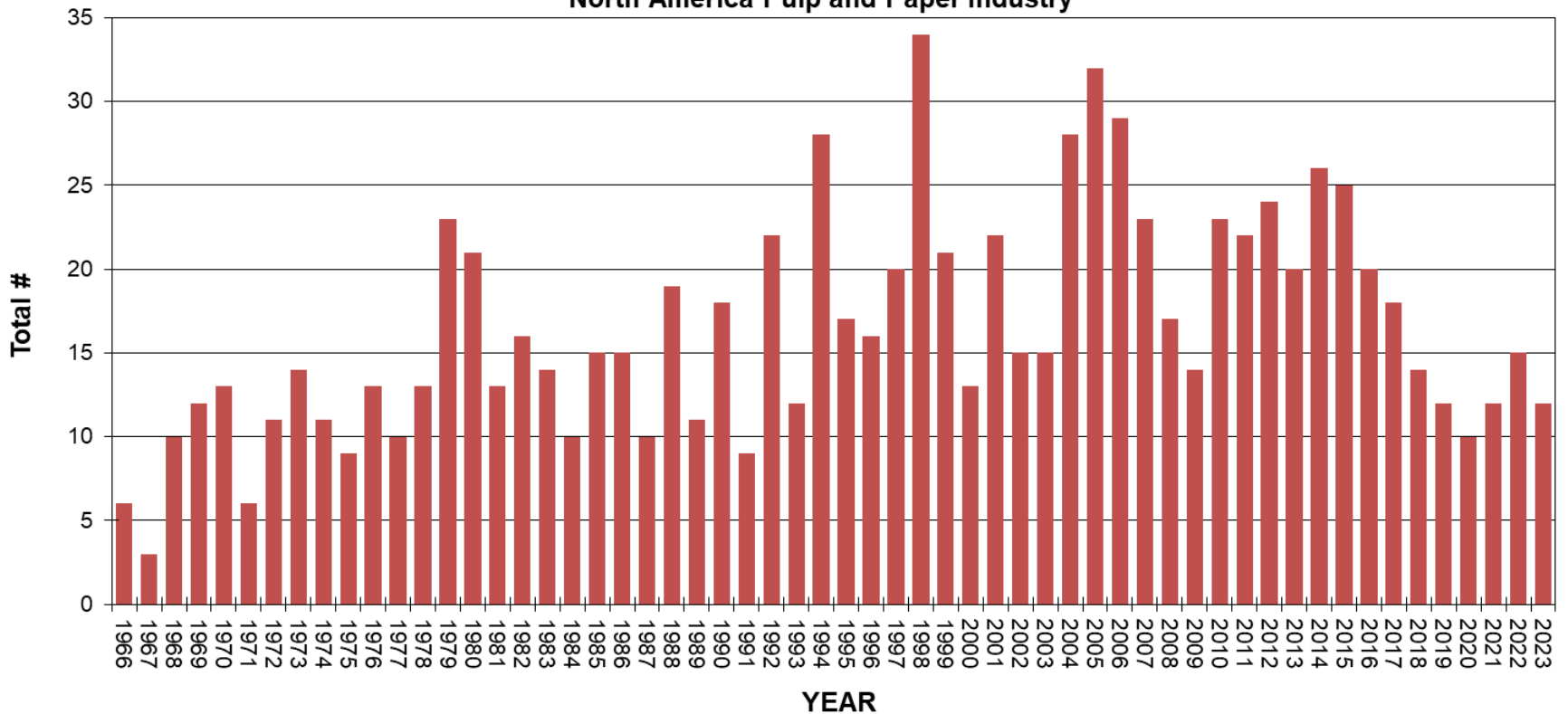






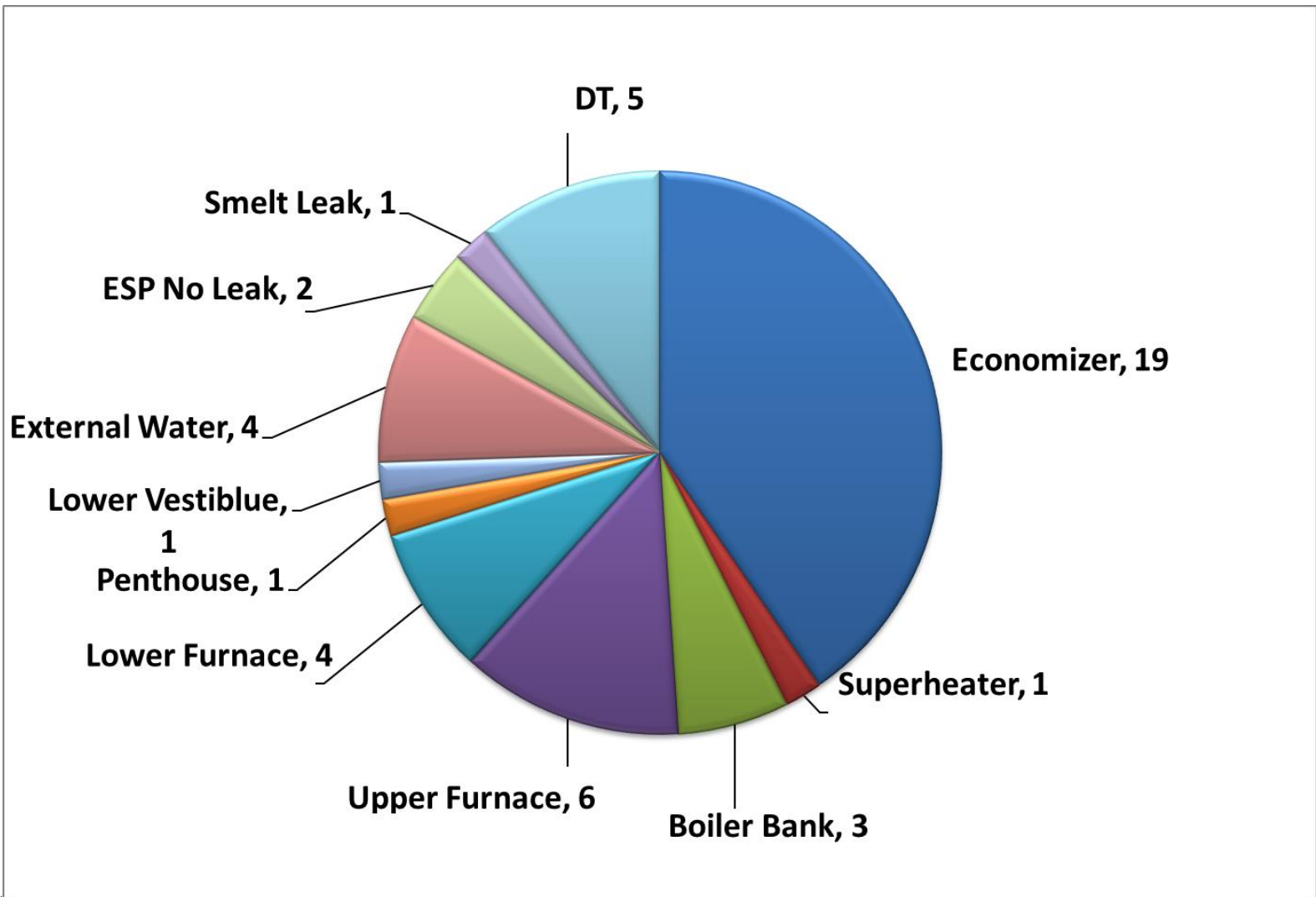
### KRAFT RECOVERY BOILER CRITICAL INCIDENTS

#### North America Pulp and Paper Industry





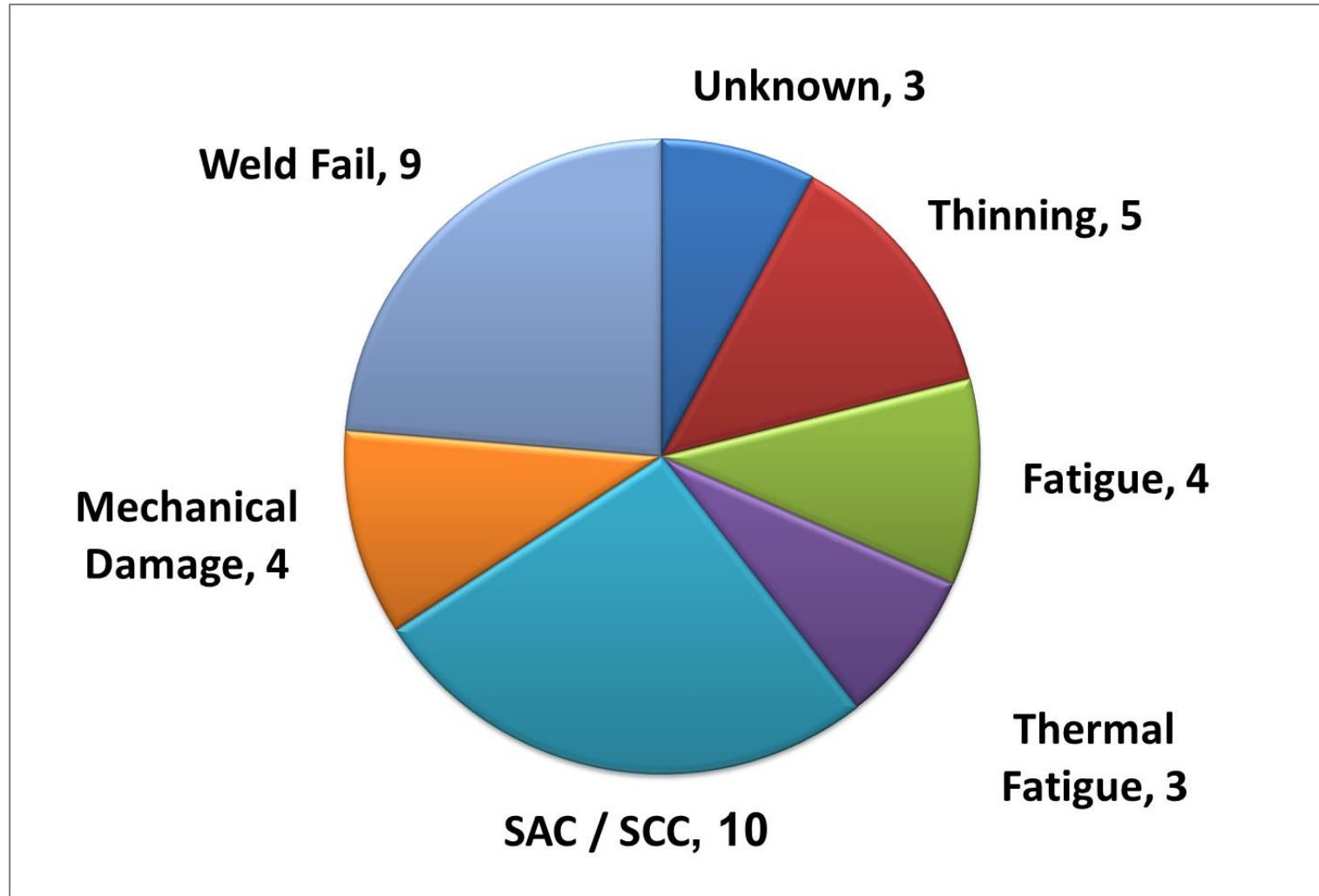
## Incident Locations



BLRBAC Data



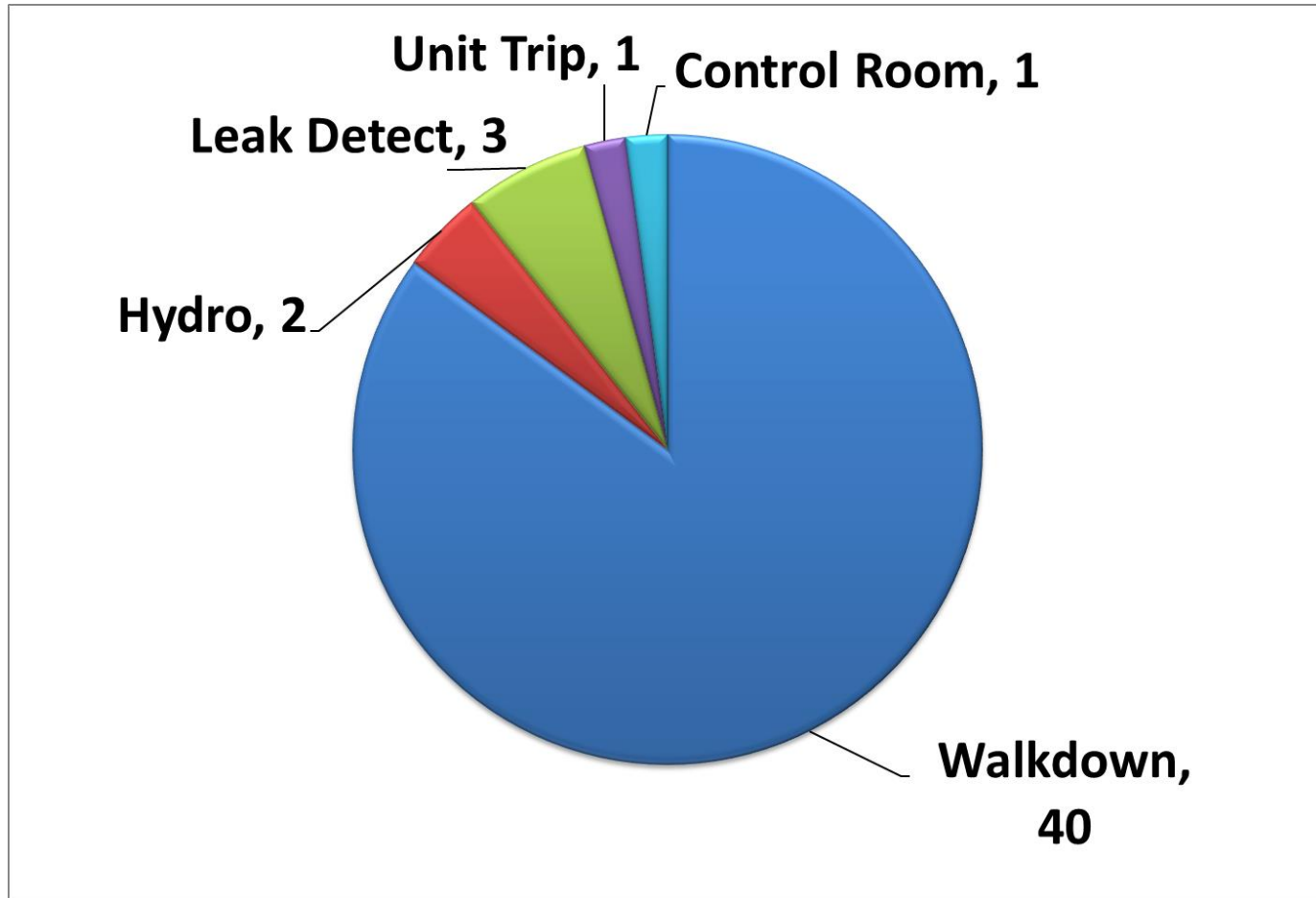
## Leak Cause



BLRBAC Data



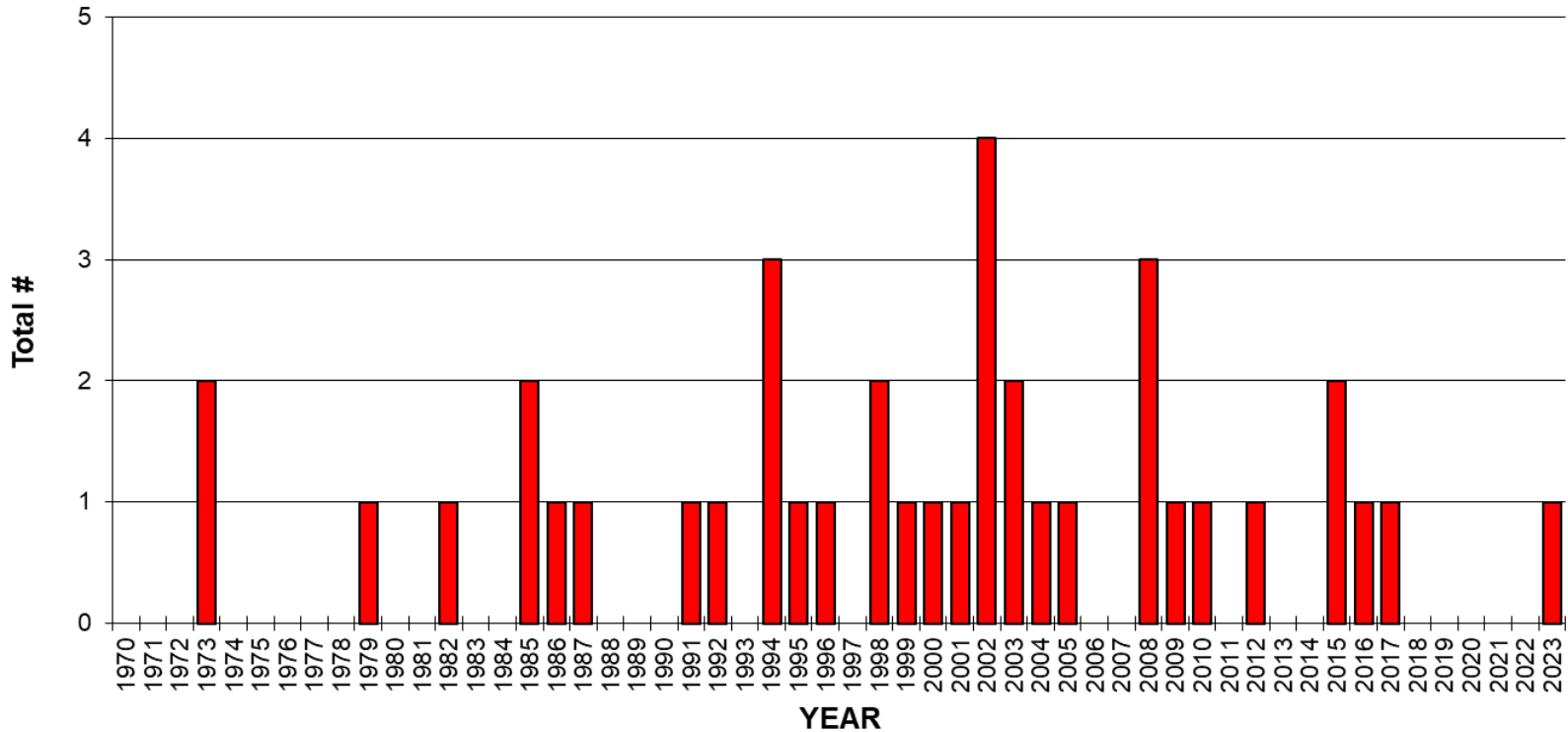
## How Discovered





## KRAFT RECOVERY DISSOLVING TANK EXPLOSIONS

North America Pulp and Paper Industry





# 2023 Incident Review

- 47 North American Incidents
  - 0 Smelt Water Explosion
  - 1 Dissolving Tank Explosion
  - 12 Critical
  - 26 Non-critical
  - 4 Dissolving Tank issues
  - 1 Smelt leak
  - 2 ESP w/ No Leak
  - 1 External Water not in Recovery Boiler interior
- 12 ESP'd (2 w/ no leak, 1 ESP on a DT issue )
  - 12 Critical (2 found on Hydro)
  - 9 Critical in operation with a bed & 7 of these ESP'd
  - 78% of Critical ESP'd that Should ESP



# Leak Detection Systems

- Leak Detection Systems Installed – 25 (53%)
  - Identified leak - 5
  - Confirmed leak - 3



# Boilers in Service

## ➤ North American Total – 169

➤	US	Canada
– Number	131	38
– Avg Age	44	47
– Max Age	71	76

## ➤ Oldest

- Kruger - Three Rivers, Quebec, Canada
- 1947 Alstom





# AF&PA Recovery Boiler Program

## The AF&PA Recovery Boiler Program

- Established in **1974**
- Help improve the **safety, integrity, and reliability** of Recovery Boiler operations
- Membership is open to all companies & mills that operate Recovery Boilers
- Identify the root cause of Recovery Boiler explosions and critical incidents
- Activities are funded by membership dues



# AF&PA Recovery Boiler Program

The **Recovery Boiler Program** is directed by a **Steering Committee**

- **Frank Navojosky** – International Paper
- **Wes Hill** – Georgia-Pacific
- **Jeff Wagoner** – International Paper
- **Greg Burns** – Domtar

Program Projects & Initiatives based on Member & Industry Needs

- Member Company Input
- BLRBAC Incidents



# AF&PA Recovery Boiler Program

## Documents developed by the Program:

- **Reference Manuals**
- **Audit Guidelines**
- **Best Practices**
- **Training Aids**
- **Checklists**
- **Textbooks**
- **Studies**



## AF&PA Recovery Boiler Program

- The Program sponsors R&D projects for:
  - **Safety Improvements**
  - **Process Improvements**
- Program Projects and Initiatives focus on:
  - **Safety**
  - **Operations**
  - **Maintenance**
  - **Recovery Boiler Integrity**



# AF&PA Recovery Boiler Program

## Two Standing Subcommittees

### ➤ **Operation & Maintenance Subcommittee**

- **Frank Navojosky** – International Paper (Co-Chair)
- **Wes Hill** – Georgia-Pacific (Co-Chair)

### ➤ **Research & Development Subcommittee**

- **Greg Burns** – Domtar (Co-Chair)
- **Jeff Wagoner** – International Paper (Co-Chair)

### ➤ **Subcommittee Membership**

- Representatives from the Member Companies



# Operational Safety Seminars

- The **O&M Subcommittee** sponsors the **Recovery Boiler Operational Safety Seminars**
  - Objective: **Safe Operation of Recovery Boilers**
- Operators, Supervisors, Superintendents, Maintenance Professionals, Engineers, Steam Chiefs, and Managers attend
- **Training continues to increase in importance**, as more senior operators and supervisors retire
- Companies are finding these Safety Seminars to be an important part of their **Safety & Training Programs**



# Operational Safety Seminars

- The dialogue among the attendees and monitors of the Safety Seminars provide attendees with valuable information and insight
- **Team Exercises** help operators and supervisors make the important decision: **When to ESP a Recovery Boiler**
  - The Case Studies are based on **actual BLRBAC Recovery Boiler Incidents**
  - **Eight (8) New BLRBAC Case Studies** each year for the **Team Exercises**!
- Over **4,700** have attended the Seminars since they were started in 1985
- Safety Seminar Monitors
  - **Dean Clay**, BLRBAC ESP Subcommittee Secretary
  - **John Andrews**, Former BLRBAC ESP Subcommittee Chair



# Operational Safety Seminars

## **2024: Four (4) Recovery Boiler Operational Safety Seminars Two (2) Online Virtual & Two (2) In-Person**

- **March 20, 2024 (Virtual)**, Wednesday (7:45 am - 4:30 pm **Eastern Time**)
- **April 10-11, 2024 (In-Person)**, Wednesday afternoon/Thursday morning (**Eastern Time**) After BLRBAC, at the Atlanta Airport Sonesta Hotel in the Gable 1&2 Room. 2 Half-Day Sessions
- **May 16, 2024 (Virtual)**, Thursday (7:15 am - 4:00 pm **Pacific Time**)
- **October 9-10, 2024 (In-Person)**, Wednesday afternoon/Thursday morning (**Eastern Time**) After BLRBAC, at the Hilton Atlanta Airport Hotel. 2 Half-Day Sessions





# **Recovery Boiler Safety Seminars – Topics Covered**

- **BLRBAC Incident Summary Review**
- **Safety Interlocks**
- **ESP Subcommittee Learnings from Reported Incidents**
- **Recovery Boiler BLRBAC Incident Team Exercises - 1<sup>st</sup> Session**
- **Recovery Boiler Explosion History & Prevention**
- **BLRBAC and AF&PA Resources**
- **Dissolving Tank Explosions & Prevention**
- **Recovery Boiler BLRBAC Incident Team Exercises - 2<sup>nd</sup> Session**
- **Leak Detection Systems**
- **Opportunities to Improve Recovery Operations**
- **Review of Submitted “Operating Problems”**
- **Q & A**



## 2023 Case 1

### **Description of Events**

The 15-minute steam vs feedwater differential alarm alarmed, operators followed the checks and walked the boiler down and did not find any obvious causes on walkdown, reached out for more assistance. Additional walkdown was completed with day tech where suspicious noises were heard around 8th floor at superheater.

Believed to have a superheater leak, liquor was pulled, bed burned out for 2 hrs and fire pulled. About the time of fire being pulled the FW operator reported the chemical test had dropped some on the feedwater. Inspection showed that there was no bed in the boiler and no longer smelting so decision was made to cool down the unit as planned on normal shut down, another test was run and came back relatively unchanged.



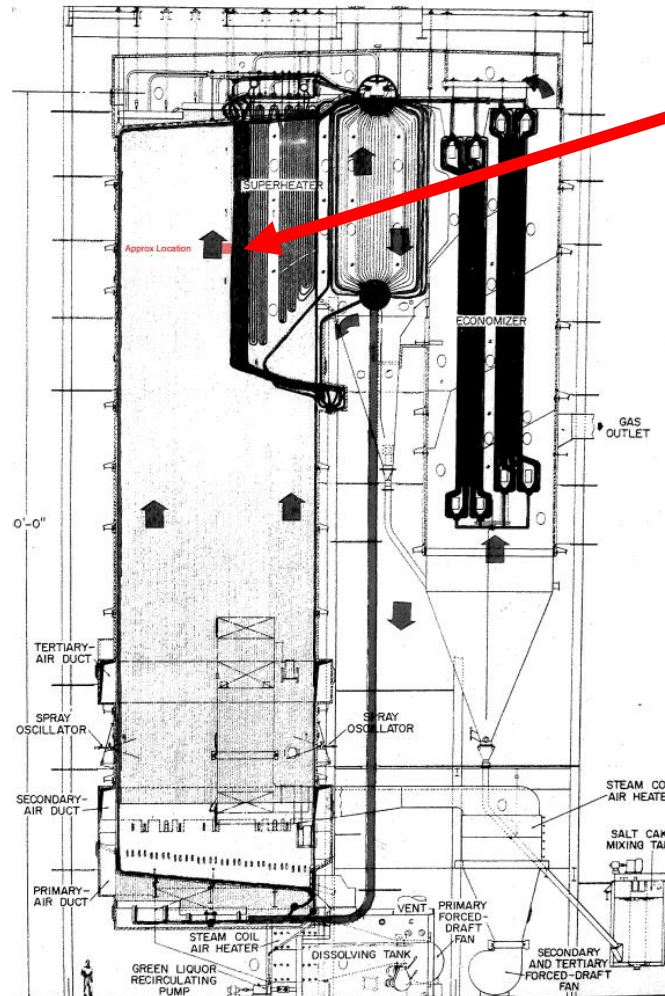
## 2023 Case 1

### **Tube Leak and Root Cause**

Platen 6, row 1 loop 1, of the high temp superheater was the original leak, near a T&G attachment to the rear furnace screen tube. The superheater leak washed out the screen tube adjacent to it, resulting in three water leaks.

On hydro found a weeper on weld attachment (D-link) on Platen 9 row 5 loop 1 of low temp superheater

Initiating failure is believed to be a superheater tube leak adjacent to the attachment. The metallurgical report indicated the SH failure was due to erosion/erosion-corrosion initiated from the OD of the tube. However, the exact erosion mechanism is not readily apparent or present on adjacent tubes. (Sootblowers are on the opposite side of the thinning). Another possible root cause is the failure initiated at an old arc-strike or nick when attachments were installed.





SH Tube Leak  
Tube Leaks



Screen



## **BLRBAC Incident Case Reviews**

- Participants are assigned to Breakout Teams during the Team Exercises to review the BLRBAC Incident Cases.
- **4 cases are reviewed during the 1<sup>st</sup> Breakout Session**
- **4 more cases are reviewed during the 2<sup>nd</sup> Breakout Session**
- Each group chooses a primary speaker; others add comments
- Discuss the incidents, share insights, and remedies for each situation
- Below is a list of “Considerations” for the reviews, but other thoughts & comments are welcome.
  - **What actions were done well?**
  - **What could have been done sooner or better?**
  - **Do you agree with the root cause?**
  - **What could be done to prevent future occurrences?**
  - **Does your mill have anything in place that would have helped the situation?**



# Annual Conference & Meetings

## 2024 AF&PA Recovery Boiler Conference & Committee Meetings

- February 6-7, 2024, at the Atlanta Airport Marriott
- **Great attendance. 93 people attended!!!**
- Some of You Here Attended - **Thank You Very Much!!!**

## 2025 AF&PA Recovery Boiler Conference & Committee Meetings

- **February 4-5, 2025**, at the Atlanta Airport Marriott
- 1st Tuesday & Wednesday each February
- The Conference is open to everyone interested in Recovery Boilers
- **We hope to see you there!**



# Annual Conference & Meetings

- **Objective:** Keep the members and the Recovery Boiler community informed about:
  - **New developments**
  - **Industry Best Practices**
  
- **The presentations included:**
  - **New equipment & process technology**
  - **New research developments**
  - **Industry best practices**
  - **AF&PA Program activities & project updates**
  - **Industry ESP & Incident History**
  - **BLRBAC activity updates**
  - **TAPPI Energy, Recovery & Recast Committee Report**
  - **Updates from International Recovery Boiler Committees**





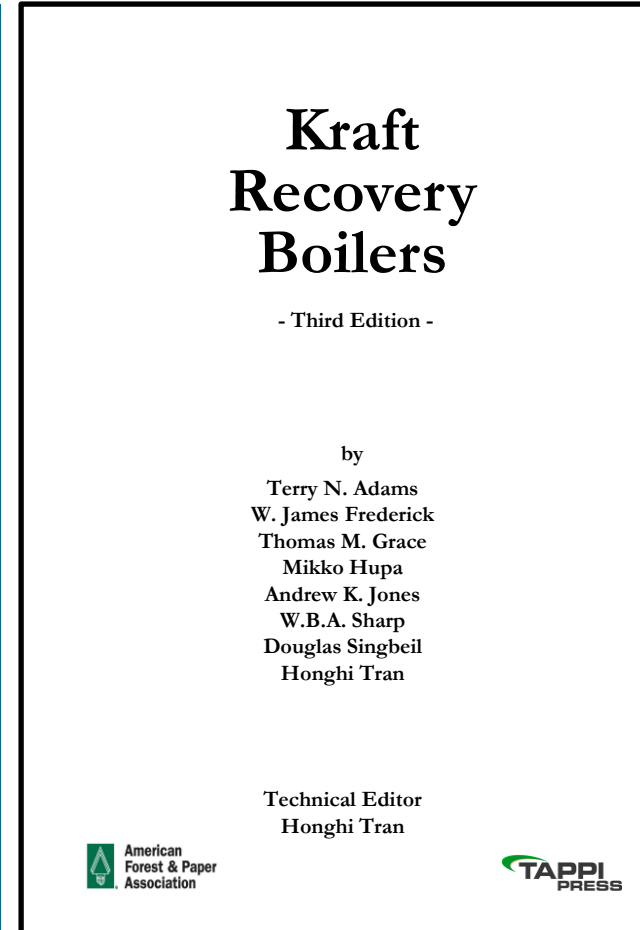
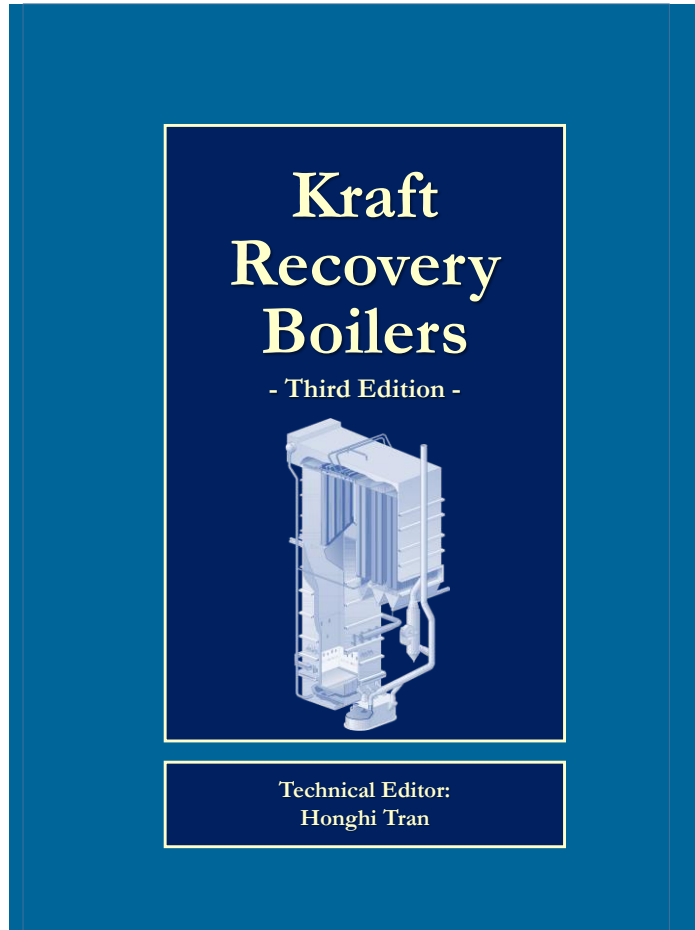
# Smelt Dissolving Tank Studies

- The **O&M and R&D Subcommittees** are both working to develop best practices around Dissolving Tank related issues
- The **R&D Subcommittee** sponsored 4 research projects at the University of Toronto for improved safety and reduced operating risk of Dissolving Tanks
  - The 4 projects focused on:
    - **Dissolving Tank key operating conditions**
    - **Advanced monitoring techniques**
- The program built on prior AF&PA studies and related research at the University of Toronto.
- The 4 projects have recently been completed. The reports are available to AF&PA Recovery Boiler Program members.



# Best Practices

- **The O&M Subcommittee** has created the following documents over the last several years:
  - **Recovery Boiler Functional Checks AF&PA Example Document**
  - **Recommendations for Dissolving Tank Safety**
  - **Impact Considerations for Recovery Boiler Extended Run Time**
    - These documents are posted on our website and are available to everyone to download
- **Next O&M Subcommittee Project**
  - **Stress-Assisted Corrosion (SAC)**





# Kraft Recovery Boilers “Blue Book”

- **The AF&PA R&D Subcommittee** sponsored the publication of the new **Kraft Recovery Boilers, Third Edition** textbook
- **Dr. Honghi Tran** of the University of Toronto led the effort to author the new book
- Dr. Tran and 7 other world-renowned Recovery Boiler experts completed the 16 chapters of the new book
- Book sales have been very strong, with over **1,000 copies sold!!!**
- **In its 5<sup>th</sup> Printing already!!!**
- Available through **TAPPI Press**.
- The book is also part of the **TAPPI Kraft Recovery Operations Course**



## Technical Editor & Chapter Author



**HONGHI TRAN** obtained his B.Sc. and M.Eng. from Shizuoka University in Japan, and his PhD from the University of Toronto in 1982. Honghi is Frank Dottori Professor of Pulp and Paper Engineering and Director of the Pulp & Paper Centre in the Department of Chemical Engineering and Applied Chemistry. He helped establish and direct consecutively 12 large industrial research consortia, focusing on issues related to energy and chemical recovery in kraft pulp mills. Honghi has authored or co-authored over 300 refereed papers and has 8 patents. Honghi has chaired the TAPPI Kraft Recovery Course since 2006. He was named a TAPPI fellow in 2000, PAPTAC fellow in 2015, and Canadian Academy of Engineering

Fellow in 2016. Honghi received numerous prestigious awards including the 2013 PAPTAC's John S. Bates Gold Medal and the 2017 TAPPI Gunnar Nicholson Gold Medal. He was inducted to the Paper Industry International Hall of Fame in 2017.

## Chapter Authors



**TERRY ADAMS** was an independent technical consultant to the pulp and paper industry in the area of chemical recovery until he retired in 2017. He obtained a B.Sc. from the University of California at Santa Barbara, a M.Sc. from the University of Michigan, and a Ph.D. from Drexel University with a specialty in combustion. Terry has worked as a Professor at the University of British Columbia, a Combustion Scientist at Weyerhaeuser Co., and since 1986 an independent consultant with a client base of over a hundred mills. He co-authored Kraft Recovery Boiler Physical and Chemical Processes, TAPPI Press, published in 1988 with Dr. Jim Frederick, and is the editor and co-author of Kraft Recovery Boilers,

TAPPI Press, published in 1997.



## Chapter Authors



**THOMAS M. GRACE** obtained a B.S. in chemical engineering at the University of Wisconsin and a Ph.D. from the University of Minnesota. He was a faculty at the Institute of Paper Chemistry (now IPST at Georgia Tech) for 22 years, and an adjunct professor at the University of Toronto for 15 years. He formed T. M. Grace Company in 1988, consulting on recovery boilers and chemical recovery. Tom has a long involvement with BLRBAC and the AF&PA Recovery Boiler Committee, investigating recovery boiler explosions for 25 years. He authored many papers and book chapters on chemical recovery. Tom was awarded the TAPPI Gunnar Nicholson Gold Medal in 2001 and inducted to the Paper Industry International Hall of Fame in 2003.



**ANDREW K. JONES** is a Senior Engineering Fellow at International Paper (IP) where he fosters the implementation on new process innovations. Previously he was the recovery boiler SME. He has been with IP since 1997. Previously he worked for ABB/Combustion Engineering leading an R&D group. He received his PhD from the Institute of Paper Chemistry in 1989. Andy is active in TAPPI, having led the Engineering Division, and was conference chair for the TAPPI PEERS conference. He won the TAPPI Engineering Leadership and Service Award in 2004. He was the conference chair for the ICRC (International Chemical Recovery Conference). Andy was named a TAPPI Fellow in 2016 and he received the Engineering Division Technical Award and Beloit Prize in 2018.



## Chapter Authors



**MIKKO HUPA** is a Chemical Engineering Professor at the Åbo Akademi University (ÅAU) in Turku, Finland. Mikko has supervised more than 40 PhD Theses and authored or co-authored more than 350 journal papers in the areas of high temperature chemistry, biomass and black liquor combustion and gasification, and fluidized bed combustion. Mikko has wide experience as an industrial consultant on issues of chemical aspects of combustion and energy processes. He has served as President of the International Flame Research Foundation, an international organization on industrial combustion with 250 member organizations in nearly twenty countries around the world. Mikko was named a TAPPI Fellow in 2005. Since 2015 he has worked as the President of his university ÅAU.



**WILLIAM J. (JIM) FREDERICK, Jr.** received his BS, MS, and PhD degrees in Chemical Engineering from the University of Maine. Jim has been active in kraft chemical recovery since 1975, both in industry, research, and consulting. Jim has been active with both TAPPI and the AIChE Forest Products Division throughout his career. He received the AIChE Forest Products Division's award in 1998, and he was named a TAPPI Fellow in 2007. He co-authored the book *Kraft Recovery Boiler Physical and Chemical Processes* (American Paper Institute, 1988), was a contributing author to *Kraft Recovery Boilers* (TAPPI Press, Atlanta, 1997). He is the lead author on a new book, *Black Liquor Evaporation*, to be published by TAPPI in 2019.



## Chapter Authors



**W.B.A. (SANDY) SHARP** is a consultant specializing in solving corrosion and materials problems in pulp and paper mills and chemical plants. He has master's degrees in Metallurgy and in Corrosion from Cambridge and London Universities in the U.K. and a Ph.D. in Chemistry from the University of Ottawa. Sandy's materials engineering experience includes 28 years leading corrosion control efforts within Westvaco (now WestRock). He has published 62 technical papers in refereed journals. He developed TAPPI's short course on solving corrosion problems and has won TAPPI's Joachim Leadership and Service Award and Engineering Division Award. Sandy is a TAPPI Fellow, a Materials Technology Institute Fellow, and the first NACE (Corrosion Engineers' Association) Fellow from the pulp and paper industry.



**DOUGLAS SINGBEIL** holds a BSc in Chemistry and an MSc in Metallurgy from the University of British Columbia. He began his career with FPInnovations (formerly Paprican) in 1982 as a research scientist. He has since served in numerous roles, including Corrosion Group Leader, Research Leader for Bioenergy & Corrosion, Research Manager for Process Engineering, and is currently Industrial Sector Leader for BioProducts. Over his career, Doug has addressed corrosion in recovery and biomass boilers, digesters and other process equipment. He has authored/co-authored more than 60 papers. He received awards for several of these, including the 1998 and 2004 ISCPPI Walter Mueller Awards and 2005 PAPTAC Weldon Medal. He was appointed a Fellow of NACE International in 2009.





# Recovery Boiler Program Information

- AF&PA Recovery Boiler Program Website:  
<https://www.afandpa.org/get-involved/industry-programs#RecoveryBoiler>
- Recovery Boiler Program General Information
- Information on Available Documents
  - Publications
  - Studies
  - Training Aids
  - Standards



# Contact Information

➤ AF&PA Website:

<http://www.afandpa.org>

➤ AF&PA Recovery Boiler Program Website:

<https://www.afandpa.org/get-involved/industry-programs#RecoveryBoiler>

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# Summary

- Multiple organizations are working together to help further improve Recovery Boiler safety:
  - AF&PA, BLRBAC, Canadian BLRBAC, TAPPI, the University of Toronto, Manufacturer, & Suppliers
- Accurate, timely information in the hands of well-trained operators is the most important
- For continuous improvement, every incident must be thoroughly analyzed and the results broadly shared
- Retirements and personnel turnover necessitates continuous training
- Use incident history to properly focus training, standards updates, and research priorities



# Questions?

# Thank You!