ABHUG 2022
IAPWS Australasian Boilers & HRSG Users Group Conference and Workshops
15 - 17 November 2022
Brisbane Convention & Exhibition Centre, QLD

IAPWS

ABHUG2022 Highlights and Press Release

The annual meeting of ABHUG held on the 15th – 17th November 2022 in Brisbane, Australia was chaired by Barry Dooley of Structural Integrity Associates, UK and Bob Anderson, Competitive Power Resources, USA. This ABHUG conference included conventional fossil plant technology and issues closely related to those in HRSGs. ABHUG2022 attracted 82 participants from Australia, Germany, New Zealand, Singapore, UK, and USA. About 45% of the participants were Users.

ABHUG is supported by the International Association for the Properties of Water and Steam (IAPWS) together with the local National Committees of IAPWS in Australia (AUSAPWS) and New Zealand (NZAPWS). It is held in association with the European HRSG Forum (EHF) and the US HRSG Forum (HF). Combined Cycle Journal is the media partner and provides publishing opportunities for the presentations. For the 2022 meeting there were six exhibitors: Duff and Macintosh and Sentry, Flotech, HRL, Mettler Toledo, Swan and Talcyon. The Gold Sponsor for this conference was HRL, with Ecolab and Swan acting as badge and break sponsors.

The meeting provided a highly interactive forum for the presentation of new information and technology related to HRSGs and boilers, case studies of plant issues and solutions, and for open discussion among plant users, equipment suppliers, and industry consultants. ABHUG provided a unique opportunity for plant users to discuss questions relating to all aspects of HRSGs and boiler operation with the industry's international experts.

Key highlights from ABHUG2022 included:

- There were 24 presentations and an ABHUG Workshop on Film Forming Substances (FFS).
- International updates were provided on HRSG and fossil plant cycle chemistry, instrumentation and FAC as well as on the recent IAPWS Technical Guidance Documents (TGD) in these areas including the application of Film Forming Substances (FFS) and monitoring total iron.
- International updates on HRSG thermal transient aspects associated with attemperators, condensate return and superheater/reheater drain management and by-pass operation revealed common HRSG problems.
- Failure Analysis of a high stressed bolted structure (beater wheel) operating in a corrosive and high temperature environment was an informative summary of a catastrophic coal mill failure due to a long standing but previously unidentified design error. In addition to providing definitive information on why the failure occurred, insight was provided into how a complex forensic investigation and root cause assessment are effectively conducted. The description of the forensic investigation, involvement of Victoria's 'Work Cover', and the station's decision to continue to operate the station while the investigation was ongoing were enlightening. The depth of the investigation was impressive and triggered lots of good discussion about how to find the root cause on equipment with lots of secondary damage. A good discussion followed about the

importance of generating reports and good records from investigations into failures and incidents. The consensus was that the quality and rigor of this investigation should be a benchmark for similar investigations in the future.

- An ultrasonic flow meter to monitor for attemperator spray leaking described a new and effective application of a clamp-on ultrasonic flow meter for continuous or intermittent monitoring of leaking spray valves (block and control) in attemperator/desuperheater systems. Leaking spray water is often responsible for cracking in attemperator thermal liners, steam pipework, and superheater/reheater tubes. The accuracy and capability of the ultrasonic flow meter to measure very small flow rates permits early detection of spray valve leak-through.
- One presentation illustrated a number of case studies of careful assessment of aging HRSG HP Superheater and Reheater headers. The failures included tube to header joint cracking, branch weld cracks downstream of attemperators, branch weld cracks at the cold reheat inlet, and improper selection of the location for replication of header metallurgy. Another related to the failure of a header end cap on a high temperature superheater header. The endcap was correctly manufactured according to ASME (and would also be acceptable to AS1228/AS1210) but failed after more than 2,000 cycles. The root cause was a lack of fusion that cannot be avoided in this design that resulted in a stress concentration at the gap root where a fatigue crack was able to initiate and propagate to failure. Some of these liberated and caused significant secondary damage and a high risk to personnel. While this HRSG had seen a significant number of cycles, many HRSGs in Australia will approach these cycling levels soon and those with this design should plan inspection to look for this type of cracking.
- A couple of presentations on reheater failures were informative. The first described a detailed analysis of sub-critical boiler reheater (vestibule) temperature profiles that provided information on how to manage steam-side oxide data, the use of oxide/temperature algorithms and methods to differentiate poor data resulting from oxide spallation. There were unexpected effects of a successful DCS upgrade on reheater temperature distributions which reinforced the need to examine all online data measurements when major changes are implemented. A second presentation on the drivers for a reheater outlet stub failure on a supercritical boiler reminded the audience that application of "gas touched length" analysis early in life can often identify design deficiencies. Also, early recognition of tubes operating above design and oxidation limits will reduce the oxide growth on ferritic tubing.
- This ABHUG meeting's workshop was on Film Forming Substances (FFS). The latest international activities on FFS were reviewed regarding the effectiveness, methods of application, and risks associated with these potentially game changing additions to boiler and HRSG cycle chemistry. While there are some good results beginning to emerge from plant trials, the understanding of the chemistry and physics behind FFS is still low and evolving. Some of the major take-a-way messages included:

  - FSS use can be effective in protecting water/steam touched surfaces from FAC and other forms of corrosion, hence limiting corrosion product transfer
  - FSS should only be used AFTER any existing cycle chemistry program shortfalls are eliminated and a thorough review of the prior chemistry. Without this it was illustrated that failures/damage have occurred in both amine- and non-amine based FFS
  - Hydrophobicity is NOT a valid indication that FSS is providing protection to pressure part surfaces
  - Owners take a substantial risk when feeding any product (including FSS) into the plant for which the products' constituents (hence any unintended interactions) are not known

  One of the key outcomes of this workshop and discussions was a repeat of the IAPWS guidance that before embarking on an FFS program, the water chemistry for the station MUST be known and optimized.
- Addressing caustic gouging in an HRSG HP evaporator drain system shared details of repeated failures in a horizontal drainpipe located inside the HRSG casing and asked for input from the attendees regarding a permanent solution. A HRSG engineer/inspector present identified this as a common design error and informed the group why these failures occurred and how to prevent them. Horizontal evaporator drainpipes inside the casing are exposed to gas temperatures above saturation, so the water boils away leaving deposits that result in corrosion and failure along the top of the drainpipe. One solution is to route the drains downward through the bottom of the casing, so the pipe remains flooded. Another is to upgrade the carbon steel material to T11 or T22. Monitoring the temperature on the top surface of the horizontal piping will confirm the mechanism.
- Integrity of HP Bypass Lines to cold reheat pipe connections reviewed several failures in pipework between the HP bypass and cold reheat pipe connection and described the best NDE methods for inspecting such failures. The mechanisms of the failures discussed included creep, fatigue, creep and/or stress relaxation cracking, fatigue cracks, water hammer events, and resonance effects.
- Work was described concerning the creep lives of aged Grade 91 steels where it was shown how ageing Grade 91 materials decreased the creep-rupture properties, an effect that is often not considered in remaining life assessments. A Larson-miller parametric equation was proposed to manage time/temperature creep data, postulating a time-dependent C-"constant". Further work is ongoing and will be presented at ABHUG2023.
- A case study was described on optimizing an HRSG's performance by adjusting the plant's control logic. The HRSG had been unable to achieve design output and was experiencing unusual temperature fluctuations. Once an understanding of the present temperatures, pressures and flows was determined, it was then possible to interrogate the control logic to determine why the plant was behaving as it was. An error in control logic was found and some controls tightened resulting in a marked improvement in operation.

- For the first time at ABHUG a presentation on HRSG fin tube cleaning utilizing the Kinetic Shockwave principle was provided using a "Detonation-Cord Curtain" and automated high pressure, high volume air jet system with in-house debris removal service.
- The question/answer periods included impromptu discussions of inspection techniques, overall approaches to overheating tube failures, and the oxidation limits for steels used in the superheater/reheater of fossil and HRSG plants.
- The excellent number of steam generators owner/operators at the conference was extremely pleasing as this enabled the information that was shared to be transferred to a wide range of plants, which must ultimately benefit the industry and ultimately the consumer.
- The next meeting of ABHUG will be in Brisbane in early to mid-November 2023.
- Please contact Barry Dooley (bdooley@structint.com or bdooley@IAPWS.org) or Bob Anderson (anderson@competitivepower.us) for further information and with suggestions for ABHUG2023.