**Advanced Boiler Technology Workshop Program**

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| Day 1  |  |
| **Time**  | **Activities**  | **Delivered by**  | **Presenter** |
| 09:00 – 09:30 | Registration |  |  |
| 09:30 - 12:00 | SESSION I – Boiler Design Overview | Doosan Babcock | David Anderson/ Mark Upton |
| 0930 – 10:45 | 1. **History of Boiler Development** (30 minutes)

A brief history of power boiler development and how this development led to the need for Codes and Standards. Early developments were shown to be unreliable and dangerous with many explosions and injuries. In the USA it was ASME that led the drive for better quality and safety through the publication of the Boiler & Pressure Vessel Code. This presentation will look at the development of power boilers from the early days through to modern times.1. **Current Designs** (45 minutes)

A review of some current boiler designs offering improved efficiency and flexibility to the operators. Focus will be on the current Doosan 1000MWe class of coal fired plant and how current technology is applied to meet the needs of the power market. |  | 1. Mark Upton
2. Mark Upton
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| 10:45 – 11:00 | Tea Break  |  |  |

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| Time  | **Activities**  | Delivered by  | Presenter |
| 11:00 – 12:00 | 1. **The Future (**60 minutes**)**

With the continued drive for tighter emission controls for coal fired power plant there is a need to improve efficiency.HSC is a technology with higher net efficiency against the current USC; that enables power plants to operate at higher main steam temperature and pressure level and utilize nickel-based alloys for high temperature parts and high pressure parts of turbines and boilers.This presentation will look at options to utilize this technology whilst minimizing the risk and cost to the power plant operators. |  | 1. David Anderson
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| 12:00-13:30 | Lunch Break |  |  |
| 13:30 – 15:00 | SESSION II – Internationally Recognized Design Code Comparisons | ASME /Harbin Boilers Co. Ltd. | Stuart Cameron/ Dong Mei Finch |
| 13:30 – 15:00 | 1. **ASME/EN** (45 minutes)

Boiler plant designed and manufactured to the ASME and EN Standards have equivalent levels of safety but have a different approach in terms of the role of the Inspecting Body and the technical requirements.ASME tends to focus on the critical safety requirements which is supported by the technical specifications of the Manufacturer whereas the EN Standard is more prescriptive.An overview comparison of the two Codes will be presented together with an outline of the proposals for incorporation of a new Part in the ASME Code which will be applicable to ultra- supercritical boiler plant.1. **GB/ASME**(45 minutes)

In the last 15 years, China has added over 3000 coal fired steam/power generation units to its domestic fleet of utility stations. They range from 300MW to 1000MW in unit capacity with steam parameters reaching 32.9MPa and 600°C for the main steam, and 620°C for the reheat steam. Many of these station boilers were designed and constructed based on the relevant Chinese design and safety codes. The design calculations of pressure parts were based on the Chinese code “GB/T 16507 – Water Tube Boilers (Parts 1-8) - 2013” or its predecessor “GB/T 9222 Water-Tube Boiler Pressure Part Strength Calculations”. This presentation will compare and discuss the similarities and differences between ASME and Chinese codes for the purpose of pressure part strength calculations, including the determination of design conditions, material allowable strengths, and calculation methods. The use of non-Chinese materials is permitted by GB/T 16507 and this presentation will also discuss the many ASME and EN code specified materials which have been used in the design and construction of boilers supplied by Chinese boiler makers.  |  | 1. Stuart Cameron
2. Dr. Dongmei Finch
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| 15:00 – 15:15 | Tea Break  |  |  |

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| Time  | **Activities**  | Delivered by  | Presenter |
|  | SESSION III – Revisions to ASME Section I | Doosan Babcock/EPRI | David Anderson/Jonathan Parker |
| 15:15 – 16:45 | 1. Overview of the TG-Modernization work (30 minutes)

In general Section I of the ASME Boiler Code was originally developed for industrial boilers through to sub-critical boilers operating at relatively low temperatures and pressures under steady state conditions. Current and future boilers do and will operate at higher temperatures and pressures under cyclic loading leading to a need for a modernized Code. This presentation will look at the process undertaken by ASME and the developments of the Code to meet the needs of the users. It will look at the changes included in the 2017 Edition and also future plans.1. Advantages of applying Design by Analysis Methods for High Temperature Components operating in Advanced Power Generating Plant (60 minutes)

Historically design approaches were based on Design by Rule. As operating scenarios for many boilers have become more complicated it is apparent that in some cases Design by Analysis Methods offer important advantages. These benefits are derived because it is increasingly apparent that local geometry and variations in properties have a significant influence on the in-service behavior of high energy components. This paper describes the challenges faced by Designers and the advantages available from application of Modern Engineering Methods. These effects are illustrated by consideration of the predicted creep performance of fabricated lateral branch connections, typical of those in hot reheat piping systems. These fabricated branches have experienced creep damage in service, but details of the location, extent and operating scenarios vary . Detailed analysis has thus considered how specific design, fabrication and operating factors influence the expected life and mode of failure for these components. Then, the modeling approach established was used to illustrate the effect of changing the weld metal type and geometry on in-service performance. These results illustrate that apparently similar components can exhibit very different behavior depending the specific approaches used for purchase, design, quality assurance and in-service maintenance. Thus, best practice should involve application of an integrated methodology for asset management. |  | 1. David Anderson
2. Jonathan Parker
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| 16:45 | Day 1 Ended |  |  |

**Advanced Boiler Technology Workshop**

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| Day 2 |  |
| **Time**  | **Activities**  | **Delivered by**  | **Presenter** |
| 08:45 – 09:30 | Registration |  |  |
|  | SESSION IV – Worked Examples for Boiler Components | Doosan Babcock | David Anderson/ Others |
| 09:30 – 10:45 | 1. **ASME Section I DBR Examples** (30 minutes)

In advanced boiler plant not all components will benefit from, or require, the application of complex Design by Analysis processes. The first part of this session will look at the application of ASME Section I (Design by Rule) to example boiler components. 1. **DBA Examples** (45 minutes)

It is the intent of the modernized ASME Code to provide the user with different levels of complexity with the Design by Analysis processes available within the Code. This session will look at the application of elastic and simplified inelastic analysis methods as applied to example boiler components. |  |  |
| 10:45 - 11:00 | Tea Break  |  |  |
| 11:00 - 12:15 | 1. **DBA Examples** (45 minutes)

This session will build on the previous session looking at more complex in-elastic analysis methods as applied to example boiler components. It will identify the more complex data requirements necessary to undertake this type of analysis.1. **Comparisons of DBR and DBA Calculations** (30 minutes)

The final part of this session will make a comparison of the calculations made by the various methods to show the effects on the design. It will identify where the benefits of more complex analysis will be obtained and also where the more simplified methods are best suited. |  |  |
| 12:15-13:30 | Lunch Break |  |  |
|  | SESSION V –Inspection and Maintenance Best Practice |  |  |
| 13:30 – 15:00 | **Session 5.2: Best international practices in power boiler inspection and maintenance**The practical application of big data and advanced analytical approaches to deliver real value for aged power plant assetsThe development of big data approaches raises the question for plant owners and operators of what level of adoption should be implemented for their plants and what value would this bring. Doosan Babcock has years of expertise in the integrity management of power plant using advanced tools and analysis to deliver increased availability and reliability whilst minimising unplanned outages and outage durations.Through the continual improvement of tools and techniques Doosan Babcock has incorporated increasing levels of advanced data analysis and simulation approaches based on big data approaches which has delivered significant benefits to their clients. Particular benefits have been seen in the areas of risk quantification and root cause analysis work where the approaches applied have allowed Doosan Babcock to provide their clients with a greater understanding of the risks facing their plants and how best to address. The presentation will explain a number of these new approaches, the benefits that they can deliver and what level of adoption was required by the plant operator to allow them to achieve these benefits. Finally the presentation will also look at how these tools are expected to evolve in the near to medium future and what additional benefits these evolutions will bring.  | Doosan Babcock  | Simon Cadwallader  |
| 15:00 – 15:15 | Tea Break  |  |  |
| 15:15 – 15:45 | **Session 5.2 Part 1: Best local practices in power boiler inspection and maintenance – CLP Prpspective**Experience sharing on life management strategy and maintenance practice of subcritical coal firing boilers in local power plantsCastle Peak Power Station (CPPS) of CLP Power Hong Kong Limited consists of 4 x 350MW and 4 x 677MW coal firing units. The eight units were commissioned in phases from 1982 to 1989. The Castle Peak boiler plant is a subcritical natural circulation boiler, six of the boilers use pulverized coal as primary and ULSD as backup fuel while another two boilers have retrofit with tri-fuel burners which also able to burn natural gas for steam generation.Power plant boilers operate at high temperature and high pressure. Critical components of boiler include large bore pipes, pressured part components (manifold, interconnecting pipe, headers and final/ platen superheater tubes) and feed system. Most of these components have time and condition dependent serviceable life. In order to ensure the integrity and safe operation of the boilers, prudent life management strategy and maintenance practice of boiler components are essential to CLP.The experience sharing outlines the following topics* Formulation of effective life assessment strategy in addressing contributing factors affecting boiler life (creep, fatigue, erosion, flow accelerated corrosion, under deposit corrosion)
* Development of guidelines for effective inspection and maintenance
* Root cause analysis of boiler parts failure and benchmarking with internal/external failure records
* Mechanism of reflecting the inspection results to overall asset management
* Various new technology adopted in boiler inspection to achieve better cost and time effectiveness
 | CLP  | Lau Chak Lam |
| 15:45 – 16:15 | **Session 5.2 Part 2: Best local practices in power boiler inspection and maintenance – HKE Prospective**The way to achieve a high availability and reliability BoilerHK Electric have been providing a world-class supply reliability of over 99.999% since 1997 through their generating station and electric grid. A reliable steam boiler is one of the key success factors. The presentation will firstly cover the inspection and maintenance strategy on the boilers. After that, it will show how they confront and prepare for the challenge. | HKE | S.L. Lam |
| 16:15 – 17:00 | Open Forum | All speakers |  |