EXHIBITONS, CONFERENCES

The Future of Gas Turbine Technology (Brussels, 15-16 October 2008)

Jim Roberts – Gas Turbo Technology

Around 140 people attended this bi-ennial conference organised by the European Turbine Network, of whom the majority were from manufacturers of gas turbines or auxiliary equipment, but with around 30 from universities or other technical institutes, a similar number from energy companies (electricity or oil and gas), and about ten being civil servants or representatives of trade associations.

Most of those attending were European, but some participants were from as far afield as the USA, Iran, Japan, and even Indonesia.

The programme fell into two distinct parts –

- reviews of market and technology trends, policies and regulation
- reviews of miscellaneous technical activities, many of which were papers by various companies promoting their latest developments to the conference

The latter papers were too numerous and detailed to review in this article.

The discussions of market and technology trends mainly focussed on the strategic international requirements of the energy industries, namely efficiency, low emissions, and the search for lower carbon dioxide generation to mitigate global warming in line with international agreements (the Kyoto agreement, European carbon trading scheme, etc.).

The headline contributions were from senior level keynote speakers, from Oxford University school of turbomachinery, from the UK electricity company RWE npower, and from Siemens. Each reviewed the developments in gas turbine technologies over the last few years from their different perspectives, and more importantly, they considered the key issues driving the future development of combined cycle gas turbines – market demands, fuel availability, performance and technology development.

Professor Legrani, from Oxford University, focused on how the direct relationship between efficiency and turbine entry temperature has brought forward the material improvements, thermal barrier coating developments, and above all the cooling technologies in today's products. He added that in theory there is still plenty of headroom to address before reaching the stoichiometric limit (2560 °C), although advanced aeroengines are now reaching 1950 °C.

Addressing the fuels issue, Legrani commented on the potential of Integrated Gasification Combined Cycle to deliver high efficiency operation on coal together with the ability to capture carbon dioxide from the fuel gas stream. With the growing demand for carbon dioxide reductions, IGCC is expected in due course to offer a superior solution to even the most advanced supercritical steam plant.

The general trend of gas turbine production volumes remains upwards, but this will be impacted by climate change issues, so this growth remains dependent on reaching the various objectives in numerous development programmes, including the European programme for «Zero Emissions Plant».

In Legrani's view of the medium term, guaranteed CCGT efficiencies will be 60%, and 65% will be available in the longer term, still with acceptable emissions.

Key research areas remain overall cycle efficiency, fuel flexibility, materials development, heat transfer and cooling technologies, and the increased integration of systems.

David Wallis, manager of turbine generators at RWE npower in the UK, gave his view of future CCGT developments, considering what might happen between now and 2020. His company employs 10,800 MW of all technologies, and continues to base its strategies on the assumption that within the 2020 horizon, gas will remain the primary fuel for the company's new plant, rather than coal.

Wallis' view of the future was similar to Legrani's, but his main discussion point was the historical failure of new products to deliver the promised performance with the reliability required for commercial service.

Although CCGT evolution raised brochure efficiencies from below 52% in 1993, to 60% in 2002, the technical risks were underestimated, and advanced equipment frequently failed to meet realistic operational requirements. RWE npower had been a champion of the CCGT revolution and bought each new generation of OEM products, but were greatly disappointed by their lack of readiness for service. He added that all the manufacturers are now being far more cautious about their promises, recognising that full service validation of technical advances can take typically up to seven years.

Based on their experience, RWE npower have developed a model for technology risk assessment, and now prefer not to be the first user of new products. In fact they see some of the more acceptable, lower risk, advances being in the use of improved bottoming cycles. They hope to see «I class» machines as the standard around 2020, offering 62% CCGT efficiency.

Wallis summarised the company's «wish list» as –

- Minimum 60% efficiency with little service degradation
- Low emissions without SCR (selective catalytic reduction) over a wide load range
- Reliability and availability
- Flexibility of operation (good turndown)
- Ability to burn gas from different sources automatically
- Low initial and maintenance costs

Wolfgang Menapace of Siemens discussed his company's perception of the market requirements. In terms of volumes, he considers the current annual 200GW market for gas and steam turbines as a peak, with the resurgent nuclear industry taking an increasing share of new generation capacity, along with a growing proportion of renewables.

Siemens technical developments are focused on performance and RAM (reliability, availability, maintainability), and with the increasing emphasis on climate change as well as economics, these developments recognise that efficiency improvements impact not only fuel bills, but also offer increased CO_2 savings.

The company practices an evolutionary path for gas turbine developments, and in recognition of the need to correct the operational inadequacies of premature entry to service highlighted earlier, invested in a full–size test bed to resolve these issues.

Siemens are offering 60% CCGT efficiency now on its latest and largest product, like its competitors, but unlike some of them, is not using steam cooling but more advanced air cooled technology. This machine offers 340 MW in simple cycle, and 530 MW in combined cycle, from a pressure ratio of 19.2, and with an exhaust temperature of 625 °C. With this high exhaust temperature, further efficiency improvements are coming from bottoming cycle developments, such as using triple pressure steam cycles reaching 130 bar and 565 °C. More developments still are possible in the steam cycle parameters.

For coal–fuelled plant, Siemens currently see comparable efficiencies of 47% for both advanced supercritical steam plant and IGCC, but the latter costs more unless CO_2 capture is required, which is simpler with the IGCC cycle.

In the discussion involving government personnel, the representatives of both the European Commission and the US Department of Energy summarised their activities on clean coal development and carbon capture and storage, and emphasised the importance of international involvement if climate change is to be arrested.

Victor Der, from the Office for Fossil Energy in the US Department for Environment, emphasised the triangular relationship between policy, technology, and market.

The USA has a «near–zero emissions» on coal programme, similar to the European Zero Emissions programme, and which is emphasising the efficiency of capture of carbon dioxide in both combustion and gasification based cycles. The programme has specific targets for 2010, 2012, 2015. A low NO_x, hydrogen fired, gas turbine is a key component of the DoE clean coal programme

Targets for 2010 include 2ppm NO_x in the simple cycle gas turbine exhaust, steady improvements in CCGT efficiency, and the development of hydrogen burning to match natural gas capability.

In an expert panel session summarising the key points raised in the discussion, the continuing need for international cooperation to face the challenges of emissions and climate change were re–emphasised, while recognising that different nations have very differing economic needs. Carbon capture and storage is seen as a very important development, which must be validated in the developed world and then implemented internationally.

Overall, this conference did confirm a general consensus of views on the future requirements of world power generation markets, and the policy and technology developments which will deliver answers to those requirements. Fortunately for the gas turbine community, its technology still remains central to these developments.