



ETN is a non-profit association bringing together the entire value chain of the gas turbine technology community in Europe. Through the co-operative efforts of our members, ETN facilitates gas turbine research and technology development, promoting environmentally friendly stationary gas turbine technology with reliable and low cost operation.

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Christer Björkqvist
Managing Director

Multitude of opportunities in 2014

2013 encompassed many successful accomplishments and passed milestones – we are now a well-established association ready to take activities to a new level. In the summer we celebrated our 100th member organisation and we also moved to a new office in Brussels equipped with a good size meeting room. We hope that our new office will become a vibrant one, highly visited and used by our members. Another milestone is that ETN's first R&D recommendation report has been finalised and published. It is our hope that this will be a well-used document that can pave the way for additional R&D opportunities and inspire future project initiatives.

I am also pleased that ETN's cooperation with the International Energy Agency has grown considerably over the past year, which shows that ETN has established a sound reputation across Europe and has proven to be a valuable source of information to EU institutions and to international organisations. 2013 also witnessed the creation of the ETN Industrial Emissions Directive Committee, which provided valuable technical comments to the BREF Review Team.

In December 2013, the new EU funding programme for research and innovation "Horizon 2020" was launched with several topics of interest to ETN members in the 2014-2015 calls. We have been working hard to secure R&D opportunities under this programme so I now hope to see a good response from the industry and the R&D community to enable successful submissions of new R&D project proposals.

However, in Europe we are still experiencing a high amount of policy, economic and market uncertainties which have a negative impact on the willingness to invest in research. Simultaneously, our industry has suffered indirectly from high electricity and gas prices, which have reduced the competitiveness of Europe's energy intensive industries. The importance to quickly address these issues is increasingly being acknowledged by politicians and there is now quite a number of promising initiatives that aim to improve this situation. Hopefully it will not be too late.

In 2014 we can hope for a wide European acceptance to shale gas exploration and a CO₂ price recovery under the EU Emissions Trading Scheme, which would both favour more environmentally friendly gas power generation over coal. We are also eagerly waiting to see if there will be an agreement on 2030 emission targets as an intermediate milestone to the ambitious 2050 targets. The European Commission has also started an interesting consultation on renewable subsidies with the aim to put an end to differentiated support for renewable technologies. Even if these events would improve the situation in Europe, it is clear that we still need to optimise research and technology development by embracing a mind shift towards an open innovation culture which will both reduce costs and risks. An increased openness towards external cooperation and knowledge exchange will enable us to ensure a continued and successful European innovation culture even in uncertain and challenging times.

For a successful innovation culture you need to have a networking culture. Let's explore the multitude of development opportunities in an open way together in 2014!

High pressure combustion tests at ENEL Sesta test rig

By Alessia Bulli, Ansaldo Energia

Following the indications resulting from the ambient and low pressure combustion tests performed on the test rigs of the University of Genoa (UNIGE-DIME) and Cardiff University Gas Turbine Research Center (GTRC), the design of a full scale burner for high pressure testing was completed.

On the ENEL test rig in Sesta, the most promising full scale prototype burner has been tested in September and October 2013 incorporating different design features for fuel injection. The design variants evaluated included different sizes of the syngas premix holes in the diagonal swirler and different dimensions of the outer section of the CBO (Circular Burner Outlet). The central body of the burner was left unchanged during the tests.

In the first part of the tests, a comparison with the data of the scaled burner tested in GTRC has been carried out, during which it was shown that the NO_x emissions achieved with the full scale burner used in the Sesta testing were even lower than previously observed, but that the operational range (determined by the flashback tendency) was further limited with increased operating pressure.

For the tests at high operating pressure (> 10 bar), very useful information was gained on the operational characteristics for undiluted, hydrogen rich syngas combustion in lean premix mode even though it was not possible to perform the test at the intended full pressure level (> 15 bar).

The main findings are that a strong reduction (up to 60%) of the burner outlet is needed to reduce the flashback risk and that, in order to avoid thermoacoustic flame instabilities, the same premix

channel geometry as used for NG combustion must be maintained. From the operational point of view, several tests showed that the high hydrogen concentration helps to operate the burner even without a pilot flame (neither NG nor syngas pilot). Moreover, the use of a pilot flame makes the burner more likely to exhibit combustion instabilities. This particular behavior was observed at all combustion test sites. For all the high pressure test conditions the NO_x emission remained below the limit of 50 mg/Nm³.

The major challenge encountered during the high pressure tests was the difficulty in regulating and keeping constant the hydrogen percentage in the fuel gas mixture. This issue played an important role in the burner performance and is considered to have produced a great impact on all flashback events. From video recording of the flame zone, a detailed analysis of the flashback events can be drawn; an example is shown in the picture series below (from left to right; normal operation – onset of flashback – emergency shutdown (after 5sec.) – afterglow of overheated burner parts).

If a flashback occurs (especially at high operating pressure), the flame position cannot be restored to a safe position and permanent damage is done to the hardware (even if the fuel flow is shut down within a few seconds). Specifically, the external part of the diagonal swirler was damaged giving useful in-

formation on the flame position after flashback has occurred. As even small inaccuracies in the system regulation can trigger such flashback events, special attention has to be paid on the control system in order to guarantee stable operating conditions.

Even though further design modifications must be considered in order to reach a final burner configuration capable of operating at the design pressure of the gas turbine engine, all the knowledge and tools necessary to do so have now been put in place. Future design efforts can now be supported by dedicated CFD calculations which will be performed once the improved syngas combustion model is fully validated and available for productive numerical design work (the model uses a specific reaction mechanism which has also been developed in this project). The validation will be based on all the test results achieved so far, and will provide a realistic estimate of the maximum percentage of hydrogen acceptable in the fuel mixture, that would still allow to achieve the full operating pressure with a given burner configuration.

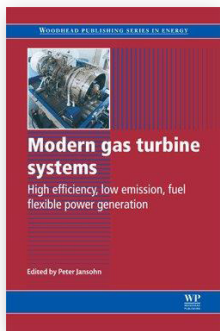
For more information on the high and full pressure tests at ENEL Sesta test rig, please consult the previous article published in the [July/September 2013](#) edition of this Newsletter. For more information on the H₂-IGCC project, please visit the website at www.h2-igcc.eu. ■



Modern gas turbine systems

High efficiency, low emission, fuel flexible power generation

In September 2013, Woodhead Publishing published a book edited by Peter Jansohn, Chairman of ETN Project Board/Paul Scherrer Institute, titled "Modern gas turbine systems: High efficiency, low emission, fuel flexible power generation".



Seven ETN member organisations also contributed to this book (Paul Scherrer Institute, University of Leeds, Cranfield University, Alstom, Siemens and En-desa Generacion).

A. Mom, in his role as ETN's President Emeritus is also the author of the introduction chapter.

About the book

Modern gas turbine power plants represent one of the most efficient and economic conventional power generation technologies suitable for large-scale and smaller scale applications. Along-

side this, gas turbine systems operate with low emissions and are more flexible in their operational characteristics than other large-scale generation units such as steam cycle plants. Gas turbines are unrivalled in their superior power density (power-to-weight) and are thus the prime choice for industrial applications where size and weight matter the most. Developments in the field look to improve on this performance, aiming at higher efficiency generation, lower emission systems and more fuel-flexible operation to utilise lower-grade gases, liquid fuels, and gasified solid fuels/biomass.

The first part of the book provides an overview of gas turbine types, applications and cycles. The second part moves on to explore major components

of modern gas turbine systems including compressors, combustors and turbogenerators. Finally, the operation and maintenance of modern gas turbine systems is discussed in part three. The section includes chapters on performance issues and modelling, the maintenance and repair of components and fuel flexibility.

Modern gas turbine systems is a technical resource for power plant operators, industrial engineers working with gas turbine power plants and researchers, scientists and students interested in the field. ETN is currently negotiating a special price for its members. The discounted price will be communicated in February 2014. ■

Air Filtration Workshop

As a follow up to ETN's Filtration Technology Project, ETN is hosting an Air Filtration Workshop with Camfil, AAF and Donaldson, which will take place on Thursday 20 February 2014.

The objective of this Air Filtration Workshop is to:

- Highlight experiences and requirements from users;
- Inform you about the current available standards EN779:2012 and EN1822:2009, its value and shortcomings;
- Bring to your attention that real life situations will be completely different than the results from above lab tests;
- Discuss what kind of test you feel necessary to make sure that the products would fulfill your current and future needs;
- Discuss the possibility to set up a standard test on a filter system, to be better addressed for the GT industry;
- Inform you of the value of an air filtration system on your Capex and Opex.

Course details:

- Date and time: 20 February 2014, from 09:00 – 16:00 lunch and coffee included
- Location: Brussels, Belgium (Manos Hotel)
- Price: ETN members: free
- Target audience: operational staff (maximum 2 representatives per organisation)



Please contact the [ETN office](#) should you wish to participate in the Workshop. Please note that priority is given to ETN members and that place is limited.





EU news summary

Potential of shale gas production in Europe

The success of shale gas development and production in the United States has led to significant benefits in terms of lower energy prices, improved security of supply, additional employment, a more competitive manufacturing base and foreign investment. While the scale of the shale gas success story in the United States may not be repeated to the same extent in other regions of the world including Europe, there are still significant potential benefits in developing shale gas resources.

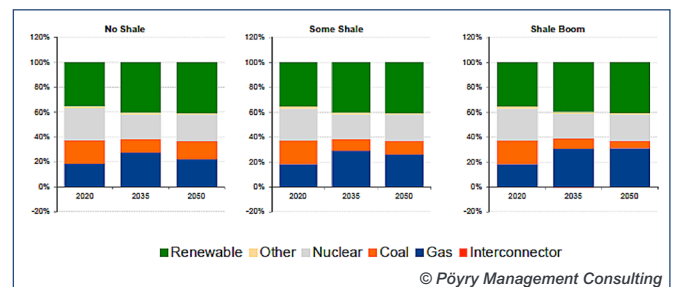
Whilst figures in several reports on shale gas published over the past years differ considerably one from another, all agree on one thing: the production of shale gas represents a unique opportunity for Europe. One of the major impacts is lower gas prices, resulting in gas-fired power generation becoming a relatively more attractive option than competing fuels such as coal. The dependency of Europe gas import should as well reduce significantly while GDP and jobs are expected to increase. It is also projected that in the long term more gas-fired power plants will be built, displacing other power generation technologies.

The German Federal Institute for Geosciences and Natural Resources (BGR) published its [Report on Energy Resources in Europe and Germany](#) in December 2013. According to the report, natural gas from unconventional deposits has large potential to secure the energy supply for Europe in the coming years.



Schematic representation of geological basins with potential shale gas in Europe

Pöyry Management Consulting also published a report in November 2013 titled “[Macroeconomic effects of European shale gas production](#)”, which examined the impact that shale gas production could have on the energy markets and economies of the European Union’s 28 countries. According to this report, the production of shale gas in Europe would not affect the growth of renewables. However, it does reduce coal burn in electricity generation as shown in the following picture.



EU electrical generation mix

The debate about Europe’s energy policy is continuing to develop and the role of shale gas in that future is being increasingly discussed by politicians. As the Pöyry report states, “Strong political will is expected to be necessary in order to secure the level of support that will be required to achieve large scale production of shale gas in Europe”.



2014-2015 Calls under Horizon 2020

With the EU budget (Multiannual Financial Framework) finally approved, the European Commission has published the 2014 and 2015 calls for projects under Horizon 2020, the new funding programme for Research and Innovation for 2014-2020.

The calls for projects below were taken from the Secure, clean and efficient energy work programme and represent potential topics that might be of interest for the gas turbine community.

- LCE1-2014: New knowledge and technologies
- LCE2-2014/2015: Developing the next generation technologies of renewable electricity and heating/cooling
- LCE3-2014/2015: Demonstration of renewable electricity and heating/cooling technologies



EU news summary

continued

- LCE4-2014/2015: Market uptake of existing and emerging renewable electricity, heating and cooling technologies
- LCE15-2014/2015: Enabling decarbonisation of the fossil fuel-based power sector and energy intensive industry through CCS
- LCE16-2014: Understanding, preventing and mitigating the potential environmental impacts and risk of shale gas exploration and exploitation
- LCE17-2015: Highly flexible and efficient fossil fuel power plants

If you have any concrete ideas for projects under these topics, please contact the ETN office. After the ETN Project Board's review, the ETN office will then circulate short abstracts to all ETN members for submission of interest and possible contributions. For more information on the calls under Horizon 2020, please [click here](#).

Call Competitive Low Carbon Energy: Deadlines

Topics	2014	
LCE1, LCE2, LCE11, LCE15, LCE16	1 April 2014 (Stage 1)	23 September 2014 (Stage 2)
LCE22	1 April 2014	
LCE4, LCE7, LCE8, LCE10, LCE14, LCE18	7 May 2014	
LCE3, LCE12, LCE19, LCE20	10 September 2014	

Topics	2015	
LCE1, LCE2, LCE11, LCE15, LCE17	3 September 2014 (Stage 1)	3 March 2015 (Stage 2)
LCE3, LCE12, LCE19, LCE21, LCE4, LCE5, LCE6, LCE9, LCE14	3 March 2015	
LCE18	28 April 2015	
LCE13	5 May 2015	

Source: European Commission

Call Competitive Low Carbon Energy: Budget (M€)

Topics	2014	2015
LCE1	20	
LCE2, LCE11	60	59
LCE3, LCE12	73	80
LCE4, LCE14	20	20
LCE5, LCE6, LCE7	60	71,48
LCE8, LCE9, LCE10	44,15	26
LCE13		10
LCE15, LCE16, LCE17	33	35
LCE18	34,25	57,85
LCE19	3	3
LCE20	10,5	
LCE21		10
LCE22	1,5	

Source: European Commission

Reviewing Process of the Large Combustion Plant BREF - Correspondence with the European IPPC Bureau

After the deadline of 30 September to submit comments on the Large Combustion Plants (LCP) Best available Techniques Reference Documents (BREFs), ETN received a number of emails from the European IPPC Bureau (EIPPCB) with valuable information on the next milestones and the reviewing process of all the comments received from the industry, the organisations and the member states.

Completeness of Draft 1 (D1)

The Bureau gave clarification on how the provided information was used in order to elaborate D1 and in particular how they proposed the BAT conclusions and Associated Environment Performance Levels (AEPLs). Additional information on how the EIPPCB used the provided information/data for drafting D1 is provided on the Members Area of the ETN website (available exclusively to ETN members).

They also confirmed that there will be no second draft of the LCP BREF. However, the completeness and accuracy of the information contained in D1 and its draft conclusions will be improved through the detailed assessment of the comments. In addition, if necessary, they might activate tools such as intermediate working documents, dedicated subgroups/meetings, and limited 'request for additional information' to help to improve this issue, depending on the outcome of the comment assessments.

Next Steps

An initial general assessment of the comments received has been performed, focusing on the comments qualified as 'major', and referring both to the 'whole document' and to the 'BAT conclusions'. These major comments will be carefully considered in order to prepare a Background Paper (BP) summarising the major issues to be dealt with at the Final Technical Working Group (TWG) Meeting. The EIPPCB is planning to hold the Final TWG Meeting to conclude on BAT in the second half of 2014, due to the very high number of comments received (about 8500). Before the Final TWG meeting, they will provide ETN with the latest versions of the sections 'Current emission and consumption levels', 'Techniques to consider in the determination of BAT' and of Chapter 10 'Best available techniques conclusions'.

ETN will keep you informed of any future updates on this matter. ■

Overview on the Chinese Market

Christer Björkqvist, ETN Managing Director completed in November 2013 two trips to China, first as an invited keynote speaker to the GT World China Summit and then as part of an EU delegation to explore potential cooperation opportunities with China in the field of Concentrated Solar Power gas turbine systems.

"It has been two very interesting trips which have provided ETN with interesting market information as well as valuable connections within the Ministry of Science and Technology (MOST)", says Mr. Björkqvist.

China's Minister of Environmental Protection, Zhou Shengxian, has stated that tackling air, water and soil pollution is a top priority for the government in the next five years. China is one of the world's leading primary energy consumer, but has recently announced an unexpected "low carbon-roadmap".

With more than 70% coal fired generation, China is suffering from high levels of air pollution, especially in its major cities (approximately 160 cities over 1 million habitants) and also has high international pressure to reduce its CO₂ emissions. As a result, China has now implemented an ambitious national strategy for energy conservation and CO₂ mitigation. This includes a plan to reduce emissions with 25% from today's level within the next 5 years. This also includes a plan to reduce fossil energy demand, especially by recycling construction materials and replacing

the most inefficient coal plants with gas turbines as well as building more IGCC (capture ready) plants that could be used with CCS in the future.

Electricity Networks

China has the world's third-largest coal reserves and massive hydroelectric resources. However, there is a geographical disparity between the location of the coal fields in the north-east and north, hydro-power in the south-west, and the fast-growing industrial load centers in the east (Shanghai-Zhejiang) and south (Guangdong, Fujian). China's power transmission system remains under-developed, with six regional grids instead of a national grid. As a result, northern areas experience shortages in winter due to increased heating demand and problems with coal deliveries and eastern and southern areas are likely to experience shortages in late spring/early summer as temperatures and air conditioning demand rise.

Energy mix

32 nuclear plants are currently under construction which will increase nuclear energy production from 2% to 6% in the energy mix (compared to 20% in the

United States and 74% in France). With regards to renewable energy, China had an installed capacity of 300 gigawatts (GW) in the beginning of 2012, which is already twice the United States capacity at this time. The majority of the renewable production comes from hydropower stations and wind turbines. However photovoltaic production from solar farms has now started to increase as manufacturers are taking advantage of a new package of government subsidies that plans to quadruple solar generating capacity to 35 GW by 2015. In the overall energy mix, renewable power and nuclear still play a smaller role. Therefore, in order to achieve their targets to cut emissions in the next 5 years, China would need a drastic shift from coal to natural gas feed generation, which makes the Chinese market very interesting from a gas turbine perspective.

Emission trading System

China started carbon emissions trading in Beijing, Shanghai and Guangdong province at the end of 2013. Based on the performance of these local markets, a national-level emissions trading platform may be set-up by 2015. ■

Past and upcoming ETN meetings and events

ETN Meeting/Event	Date	Location
H ₂ -IGCC Consortium Meeting*	2-3 December 2013	Cranfield, UK
ETN Board Meeting*	9-10 December 2013	Brussels, Belgium
OMSOP Consortium Meeting*	16-17 December 2013	Brussels, Belgium
IGTC-2014 Conference Advisory Board Meeting*	22 January 2014	Brussels, Belgium
ETN Project Board Meeting*	29 January 2014	Brussels, Belgium
Air Filtration Workshop*	20 February 2014	Brussels, Belgium
ETN Board Meeting*	1 April 2014	Paris, France
Annual General Meeting and Workshop*	2-3 April 2014	Paris, France
H ₂ -IGCC Final Meeting*	13 May 2014	Brussels, Belgium
Power-Gen Europe 2014 (ETN is a participating organisation)	3-5 June 2014	Cologne, Germany
ASME Turbo Expo 2014 (ETN is a participating organisation)	16-20 June 2014	Düsseldorf, Germany
International Gas Turbine Conference 2014	14-15 October 2014	Brussels, Belgium

* Event open exclusively to ETN members

The first edition of the R&D Recommendation report 2014 has been published!

The R&D Recommendation Report is currently available exclusively to ETN members. The report will be published to the wider gas turbine community in March 2014. It includes recommendations on key research topics of gas turbine development based on the current market outlook and the users' demand. From now on, this report will be produced and published biennially.



News on the International Gas Turbine Conference

14-15 October 2014 | Brussels, Belgium

IGTC-14

The deadline to submit abstracts for the 7th International Gas turbine Conference 2014 is now closed. ETN received 53 abstracts from both the industry and universities. All abstracts are now being reviewed and the authors should be contacted at the beginning of February 2014, following the Conference Advisory Board meeting, set to take place on 22 January 2014.

Proceedings of 2008-2010 IGTCs are now available!

The proceedings of the 2008 and 2010 International Gas Turbine Conferences have now been published globally and are available on the ETN website! The proceedings include keynote and technical paper presentations that were given to the participants. The 2012 proceedings are now available exclusively to ETN members and IGTC-12 participants and will be published globally after the IGTC-14, that will take place on 14-15 October 2014, in Brussels, Belgium.

For more information on the IGTC-14, [click here](#).

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