



# IN BRIEF

ISSUE 5 MARCH 2014

GAS PROCESSORS ASSOCIATION EUROPE

## STANDARDISATION OF NATURAL GAS QUALITIES IN EUROPE

Klaus Altfeld, Peter Schley, E.ON New Build & Technology GmbH

### Gas quality, natural gases, LNG, hydrogen, contaminants, Wobbe index, methane number

Natural gas qualities in Europe will become increasingly diverse and combustion characteristics (Wobbe index, methane number) will vary over wider ranges. Gas quality parameters have been laid down in the draft standard elaborated by CEN TC 234, working group 11.

#### Introduction

The gases injected into the European gas transportation and distribution systems will become increasingly diverse: while conventional pipeline gases from the North Sea, Russia, Algeria and other producer regions are not expected to change significantly, liquefied natural gas (LNG) will be gaining importance as well as, in the medium term, hydrogen or methane from surplus renewable electricity, in addition to biomethane. The diversification trend is welcome as it enhances supply security. Moreover, gases from renewable sources help reduce climate-harming carbon dioxide emissions (so-called greening of gas).

But, as a result, the market will see a greater variety of gas qualities, and gas qualities will vary over a wider range. The European Commission gave a mandate to CEN (M/400) to standardise natural gas quality specifications, the target being that this specification shall be as wide as possible within reasonable costs. CEN

TC 234, working group 11, elaborated a draft standard on quality of gas group H.

#### Gas quality parameters to be standardised

##### Sulphur

Gas usually contains a small amount of sulphur as a result of the decay of organic substances. This can come as hydrogen sulphide, carbonyl sulphide or mercaptan, depending on the origin of the gas and its treatment. Further, in nearly all distribution grids, but also some transmission grids, artificial odorant is added to make the gas smell for the purpose of leak detection; the majority of odorants are based on sulphur organic compounds.

It is generally agreed that, preferably, high pressure networks should contain non-odorized gas. For such gas, a maximum content of 20 mg/m<sup>3</sup> total sulphur will apply. The limit value for hydrogen sulphide and carbonyl sulphide (H<sub>2</sub>S+COS as sulphur) is 5 mg/m<sup>3</sup>. Mercaptan sulphur without odorant is limited to 6 mg/m<sup>3</sup>.

In all European countries, distributed gas is odorized for safety reasons. As most odorants used are sulphur based molecules, odorisation increases the amount of sulphur in the gas, which should be avoided as sulphur is harmful both to the environment and to many modern

gas technologies. Clearly, sulphur-free odorants are a promising option if we prefer not to increase the sulphur content.

#### Oxygen and carbon dioxide

At network entry points and cross border points between CEN member states, the maximum mole fraction of oxygen/carbon dioxide shall be no more than 0,001 %/2,5 %mol/mol. However, at entry points where the gas entering will not flow to another member state's network through a cross border point, a higher National limit of up to 1%/4% mol/mol may be applied, provided that the network is dry and not connected to installations sensitive to higher levels of oxygen/carbon dioxide, e.g. underground storage systems.

#### Hydrocarbon dew point

The hydrocarbon dew point temperature is limited to a maximum of -2°C (absolute pressure range: 1 – 70 bar). Above this temperature no condensation of hydrocarbons may occur.

#### Water dew point

The water dew point temperature is limited to a maximum of -8°C at 70 bar absolute pressure. This corresponds to a water content of some 40 mg/m<sup>3</sup>. If the absolute maximum operating pressure (MOP) of the pipeline is below 70 bar the maximum water dew point temperature is -8°C related to the MOP. Example: For MOP of 16 bar, water dew point temperature of -8°C corresponds to a water content of 160 mg/m<sup>3</sup>.

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## Contaminants

The gas shall not contain constituents other than listed in the standard to the extent that it cannot be transported, stored and/or utilized without quality adjustment or treatment.

## Methane number

The methane number is a rating indicating the knock characteristics of a fuel gas, comparable to the octane number of petrol. The methane number can be calculated from the gas composition by several methods, each of which can give slightly different results. The procedure for calculating the methane number is described in the normative annex of the standard. The minimum methane number shall not be below 65.

## Hydrogen

There are proposals to inject hydrogen (H<sub>2</sub>) from renewable sources into the natural gas network. This measure would allow the very large transport and storage capacities of the existing infrastructure, particularly underground storage facilities and high-pressure pipelines, to be used for indirect electricity transport and storage.

The results of the GERG study "Admissible Hydrogen Concentrations in Natural Gas Systems"<sup>1</sup> show that an admixture of up to 10 % by volume of hydrogen to natural gas is possible in some parts of the natural gas system. However there are still some important areas where issues remain (GERG is the European Gas Research Group, Brussels):

- Underground porous rock storage. Hydrogen is a good substrate for sulphate-reducing and sulphur-reducing bacteria. As a result, there are risks associated with: bacterial growth in underground gas storage facilities leading to the formation of H<sub>2</sub>S; the consumption of H<sub>2</sub>, and the plugging of reservoir rock. A limit value for the maximum acceptable hydrogen concentration in natural gas cannot be defined at the moment. (H<sub>2</sub>-related aspects concerning wells were not part of this project).
- Steel tanks in natural gas vehicles. Specification UN ECE R 110 stipulates a limit value for hydrogen of 2 vol%.
- Gas turbines.

Most of the currently installed gas turbines were specified for a H<sub>2</sub> fraction in natural

gas of 1 vol% or even lower. 5 % may be attainable with minor modification or tuning measures. Some new or upgraded types will be able to cope with concentrations up to 15 vol%.

- Gas engines. It is recommended to restrict the hydrogen concentration to 2 vol%. Higher concentrations up to 10 vol% may be possible for dedicated gas engines with sophisticated control systems if the methane number of the natural gas/hydrogen mixture is well above the specified minimum value;
- Many process gas chromatographs will not be capable of analysing hydrogen.

Investigations have been conducted to evaluate the impact of hydrogen as related to the above topics. At present it is not possible to specify a limiting hydrogen value which would generally be valid for all parts of the European gas infrastructure and, as a consequence, a case by case analysis is strongly recommended.

## Wobbe index

The Wobbe index is the most important quality parameter in regard to the combustion of natural gas, for example in boilers, gas stoves and industrial furnaces. The burner heat load (power output) is approximately the same for varying fuel gas compositions (different calorific values) as long as the Wobbe index and pressure do not change. In the draft standard an indicative Wobbe index range of 13,6 kWh/m<sup>3</sup> – 15,8 kWh/m<sup>3</sup> is mentioned. (Reference temperatures: 0°C (volume)/25°C (combustion)). However it is noted in the draft standard that "this Wobbe index range will not always allow gas flow throughout Europe due to local differences". Furthermore it is explained: "For Wobbe index, gas not compliant with the limit range may not be considered acceptable for conveyance. However, gas that is compliant with the limit range could not be acceptable for conveyance in some gas networks in some countries. Thus the implementation of this European standard shall be subject to national assessment of the ability to accept all or part of the gases compliant with this European standard, taking into account its end-use."

## What is the reason for such complex wording?

Gas appliance technology has gone through

decades of development reflecting the properties of the natural gases normally used in the respective countries. As a result, EU member states have developed and specified different Wobbe index ranges to ensure safe, low-emission and efficient operations.

Admissible Wobbe index ranges have been, and still are, different; harmonization is difficult given established structures. An initial effort was made by EASEE Gas some 10 years ago. But the proposed range of 13,6 to 15,8 kWh/m<sup>3</sup> was only the largest common denominator. The range could, in particular, not be applied in member states with very high levels of gas consumption (e.g. U.K., DE, F, IT) as national regulations did not allow the high value of 15,8 kWh/m<sup>3</sup> for safety reasons. This is still the case today.

Under a project initiated and financed by the EU approximately 100 largely new residential gas appliances were tested to see how they responded to varying Wobbe indices ("GASQUAL" project). As expected, it was found that problems occurred for Wobbe indices above 15,5 kWh/m<sup>3</sup> (high CO emissions, malfunctions). Extrapolation of the results to all gas appliances existing in Europe (some 180 millions) using optimistic assumptions (e.g. no pressure variations in the natural gas network; correct setting on all appliances) shows that millions of appliances in Europe would have to be retrofitted or replaced resulting in high costs.

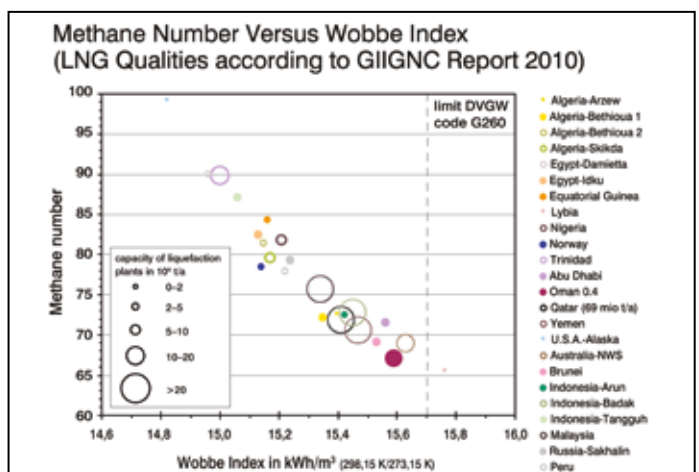
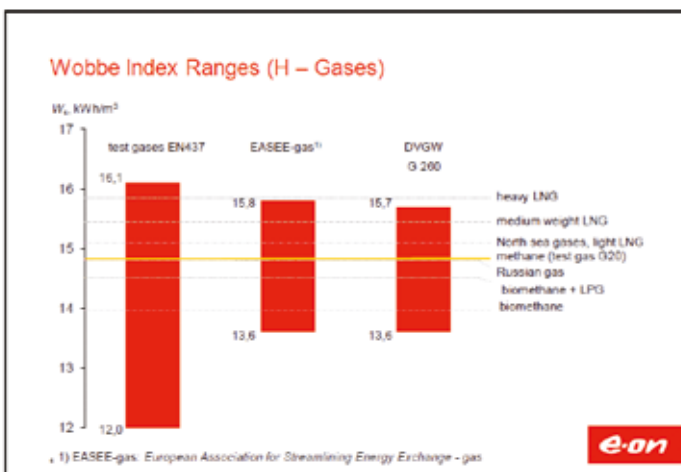
## Conclusions and outlook

The standardization work of CEN TC 234, WG11 made good progress. For many gas quality parameters, acceptable compromises have been found. The harmonisation of the Wobbe index band is more complex as a result of the historical developments in the member states. Some 180 million gas appliances are affected concerning safety, emissions and efficiency. However, a solution is easily feasible if the upper limit of the Wobbe index range is specified in a careful and prudent manner to avoid any risk for existing appliances.

The submission of the standard to public enquiry will be in March 2014.

## References

- (1) Altfeld, K. and Pinchbeck D.: "Admissible hydrogen concentrations in natural gas systems", *gas for energy*, No. 3 (2013), pp. 36-47



# GAS PROCESSING AND DARWINISM

By Keith Thomas, Chairman, GPA Europe

## VIEW FROM THE TOP

In the last *In Brief* I started to review where the gas industry may be going in the next 30 years and extolled the virtues of the everyday Glycol Dehydration Unit, the workhorse of the gas industry. Following on from this my line of thought has developed, helped firstly by some pertinent questions from a commercial colleague, a book my son was reading, and of course the experience of our last GPAE meeting in Edinburgh.

I was recently asked by one of my younger commercial colleagues to comment on the ubiquitous diagram which plots transport capacity against distance to market dividing the areas up into CNG / LNG / Pipeline and Stranded Gas. By simple use of your finger it was, it appeared to him, possible to make a technological decision on which strategy to adopt to bring gas to market. His simple and very sensible question was: Can it really be that easy? I remember seeing an excellent presentation by John Morgan at a GPAE conference several years ago where he plotted actual cases onto the same diagram. Guess what... there were LNG plants where there should have been pipelines, pipelines where it should have been LNG, and even stranded gas that was not stranded. So my answer, plagiarised, was of course that the diagram was a very neat guideline, but there were a whole host of other factors that may influence it; geography and politics to name but two. As I pointed out in my last article, the envelope is being continually pushed which brings me to my next point. I recently read the very bold statement: "Nothing makes sense in Biology except in the light of Evolution". I suppose, again plagiarising, that one could also say "Nothing in Technology makes sense without Innovation". A bold statement indeed, but having sat through the sessions of the last GPAE conference, and considered how these had changed over the last 20 years or so I think that is in fact a very valid point.

At the beginning of the 90s the emphasis of the gas industry was dealing with the gas finds that occurred while looking for oil, or dealing with the gas that was produced during oil production. Few companies explored

directly to find gas. Certainly the development of gas markets in Europe made gas finds in the North Sea worth developing, but outside of this area of well-developed infrastructure, gas was more of a nuisance than a highly profitable hydrocarbon product. At best the LPG, which could be extracted and more easily transported, was exploited as a product and the gas often re-injected (or worse still flared). Here our famous diagram comes into play, for example with gas in Nigeria being exported since the end of the 90s as LNG. Of course Algerian LNG, as an example, does not fit the diagram but bear with me. The point is that there were significant energy sources available with the source gas having low value in its home market. However they needed the technology to achieve this and of course significant advances in LNG technology have been made to make this possible. Russian gas is also an interesting example (according to the diagram an LNG candidate but for obvious reasons it deviates). Long distance pipeline technology was pushed to new limits to make this export possible. This was reflected within the GPAE as the emphasis swung slowly from the 90s where it was on gas treatment and field applications into the new millennium where the actual processing of the gas to add value, by for example compressing it, liquefying it, or as I remember on one occasion capturing it in hydrates for transport became a significantly larger proportion of our presentations and indeed our industry.

So where are we now and where are we going? Well one of the primary questions that has been cropping up in the last decade is where is the gas coming from? The worldwide demand for gas is becoming ever stronger (if we ignore the inherent weakness in the European market). The ability to get the gas to market has never been greater. The "easy gas" has however, unfortunately more or less all been exploited. So the shift is now to gas sources which require the use of new and novel technology. Shale gas seems to be the norm now but less than 10 years ago it was an absolute novelty, and outside of the US it has still yet to really take off. But the US has



Keith Thomas

shown if the resource is there it has the capability to change the market, making low cost gas available which once again seeks a market. Who would have imagined 10 years ago that North America would become an export market? Not me. Deep sea and isolated offshore fields are now being developed. This has spawned an interest in FLNG which has finally moved one major into taking the initiative and to build a full scale plant. So the circle repeats itself. Find new gas; find new ways to exploit it.

To come back to my original point. What seems to be happening is that these two activities are now much more closely interlinked. At the same time new resources are found, the decision as to how they can be exploited is being made in parallel. The speed and inter-linkage of these two elements will only increase over the next 20 years. The commercial necessity drives innovation which in turn facilitates the technology required. This all depends however, on having enough people with the right quality and experience to make it work. And that, as they say, is another story.

# YOUNG PROFESSIONAL TRAINING EDINBURGH, 18 SEPTEMBER 2013

## MORNING SESSION: GAS TERMINAL DESIGN

### Session Moderator: David Weeks, John M Campbell and Company

It has long been an ambition of the GPA Europe Ltd. Board, Management and Program committees for the Association to engage more with young engineers; professionals at the outset of their careers who are the future lifeblood of the Gas Processing industries and, indeed, GPAE itself. Past initiatives had enjoyed limited success but the first Young Professionals day held at the 2012 Berlin conference on the subject of Acid Gas Removal Unit design and operation had shown great promise in finally realising this ambition. Consequently, the second Young Professionals day which opened the GPAE's 30th Anniversary Conference in Edinburgh was a much anticipated event.

The theme for the morning session on Wednesday 18th September, selected by the YP committee of Adam Jones (Costain) and Rushil Patel (Bechtel), was 'Gas Terminal Design' which was intended to set the scene for the afternoon visit to BP's terminal at Kinneil. For those Young Professionals unable to attend the site visit, a parallel learning session on Major Machinery Selection was organised.

Some sixty young, and a few not-so-young, attendees assembled promptly at 10 a.m. for the first of two presentations and were welcomed by session Chair, David Weeks of John M. Campbell & Co., who also presented on some of the process engineering aspects of gas terminal design.

Phase envelopes were introduced to the audience as a visual means of illustrating and understanding gas plant design and phase behaviour. Isobaric, isentropic and isenthalpic cooling pathways were plotted on the phase envelopes to explain the thermodynamics of refrigerant cooling, turbo expansion and Joule-Thompson expansion which are the keystones of all gas plant unit operations. The influence of available feed



David Weeks

gas compositions and required sales product specifications in determining the necessary process blocks in the overall plant flow scheme was explained. The initial session concluded by 'closing the loop' by linking the largely

theoretical aspects of process design to actual gas plant flow diagrams for gas conditioning facilities and NGL extraction plants.

After a much needed coffee break and networking opportunity, the morning session reconvened with our second speaker, Alex Fraser of BP, presenting on the importance of cradle-to-grave involvement of Operations personnel in the design of gas plants. Alex explained that whether a project is in the conceptual phase, front end engineering design preparation or full EPC development, the Owner's Plant Operators must be an integral part of the design team to provide inputs to assure the future operability and maintainability of the planned facilities. From review of all issues of P&I diagrams, to involvement in HAZOP studies to the writing of system operating guidelines and operating manuals, the role of the plant operator in assuring the feasibility of design and the practicality of long term, economically beneficial plant operations must not be underestimated or overlooked.

The session wrapped up just after noon with participants having much to ponder over their well-earned lunches.

**David Weeks**



Lunch is served

# YOUNG PROFESSIONAL TRAINING EDINBURGH, 18 SEPTEMBER 2013

## AFTERNOON SESSION: MAJOR MACHINERY SELECTION

### Session Moderator: John Morgan, John M Campbell and Company

After the GPA's usual high-quality, sociable (and sleep-inducing) lunch, the afternoon's four YP papers awoke us all.



Ed Jackson

Andreas Ruetzel, from Burckhardt Compression AG hit the ground running with a fine overview of Compressor Selection; the emphasis was on reciprocating machines. This was a very thorough, well-illustrated presentation. Andreas' paper (and all the others) is on the GPAE website. Even if you were present, consider revisiting this paper for careful study of the basics.

How many people reading this can immediately differentiate between twin-shaft, twin-spool gas turbines? Edward Jackson of Siemens nailed that and many other fundamentals in his "Gas Turbine Introduction: Principles of Design and Operation" paper. Wobbe number, combustor configurations, exhaust heat recovery, and an unusually broad range of fuel types enriched this comprehensive coverage of the basics.

Ian Mather's paper "An Introduction to Radial Inflow Turboexpanders" (Atlas Copco Gas and

Process Division) addressed another gas processing fundamental of cryogenic processing. Well-illustrated material taught us about guide vanes, seals, and magnetic bearings. He also reminded us of the pedigree of their machines stretching back to Mafi-Trench – among the pioneers of our industry's expander technology. His LNG carrier re-liquefaction compander material was an interesting bonus.

David Ball distinguished himself with his first technical paper "Cryogenic Submerged Motor Pumps & Expanders." This was another nicely paced and clearly presented paper. Great photographs illustrated the many applications for LNG pumps. With an understandable emphasis on LNG, David also reminded us of parallel applications in ammonia, ethylene etc that predate the 'LNG-age.' The pump's electric motor is immersed in the LNG which requires special design features including gas seals on the power supply.

Key topics were covered very well throughout with energetic and enjoyable presentations. Congratulations and thanks to all the speakers.

In particular I'd like to acknowledge the current GPAE YP co-chairs, Adam Jones (Costain) and Rushil Patel (Bechtel) for their leadership in the



John Sheffield

GPAE YP program. Please contact them with papers and ideas for future sessions. Soufyane Teffahi (formerly BP and now with Nexen) worked hard over the last few years to launch the GPAE Young Professional program: Soufyane, thank you from all GPA members for your dedication in making the GPAE YP happen. Good luck as your career advances.



Engrossed in thought

# YOUNG PROFESSIONAL TRAINING

## EDINBURGH, 18 SEPTEMBER 2013

### AFTERNOON SESSION: LNG PRODUCTION AND REGASIFICATION

#### Moderated by Murtaza Khakoo, BP

Even with equally good parallel sessions - the site visit to BP Kinneil Gas Plant and the Major Machinery Selection presentation - the afternoon session on LNG Production and Regasification managed to attract approximately 50% of conference participants.

#### New Horizons for Gas Processing: Small Scale LNG and CCS

Six excellent papers with a theme of LNG production and regasification were presented, commencing with Theo Bodewes of Shell Global Solutions presenting on Shell's advances in two areas - small scale LNG and CCS. Asserting that 65% of the energy mix will continue to be of fossil origin by 2050, LNG is seen as a major component fuelled by new small scale users e.g. ships, trucks etc. as transport fuels. Citing their Alberta project, Shell mentioned their Moveable Modular Liquefaction System (MMLS) for LNG production from clean pipeline gas using standardised, container-based, small scale liquefaction units.

Environmental pressure to minimise CO<sub>2</sub>, NO<sub>x</sub>, and SO<sub>x</sub> further will continue. Predictions are that even with carbon capture and storage (CCS), fossil fuel will be more competitive than solar and offshore wind sources and close to biomass. Shell is progressing its initiatives on CCS with their first projects for power generation (co-funded by Saskatchewan Government) and for oil sands development (co-funded by Alberta Government).



Theo Bodewes, Shell Global Solutions

Shell is also currently in the planning phase of its post-combustion CCS project at Peterhead power plant.

#### Where is LNG Going? Global Survey on Commercial and Technical Trends in the LNG Industry

John Sheffield from John M Campbell and Company - a regular at the GPAE podium - next presented the digest of 170 global responses to their survey initiated after LNG 17 on commercial and technical trends in the LNG industry. With statistics that would surpass even the best of American football commentary, consensus feedback pointed towards a bullish trend in LNG demand with market growth of 5-7% to 450mtpa by 2020 and business moving towards short term trading (30% of volume) and

pricing. Small scale LNG is seen to fuel growth as a realistic substitute for diesel - without tax, it is the cheaper fuel.

On the supply side, the survey pointed to additional exports from new developments in USA of 20-40mtpa in 10 years' time together with non-US LNG projects (East Africa, Australia). Onshore LNG projects will target 3-5mtpa in preference to "mega LNG Trains" as in Qatar. Offshore LNG project will require addressing safety, LNG transfer, high costs and risks. For both, disposal of acid gases was identified as a key environmental challenge.

#### Technology Assessment for Two-Phase LNG Expanders Operating for Ten Years in Gas Liquefaction Process

Katarzyna Chołast of PGNiG (co-authors Andrzej Kociemba, PGNiG, and John C Heath and Hans E Kimmel, Ebara International Corporation) discussed the operating experience of two-phase LNG expanders at their 115mmscf nitrogen rejection and helium recovery unit. Carefully taking the audience through the complex process with truly cryogenic temperatures, Katarzyna explained that the drivers for installation were due to differences from design composition (lower H<sub>2</sub> & N<sub>2</sub> content) and condition (lower pressure), which resulted in the plant not achieving nameplate capacity, increased methane emission and instability in plant operation.

To improve thermodynamic efficiency and debottleneck the plant, Ebara - supplied





Katarzyna Cholaś

two-phase LNG expanders were therefore installed in parallel to a J-T valve on subcooled "rich" liquid at -150°C, and expanded from 21bar to 2bar. The units were easy to install, operated quietly and offered good control whilst regaining lost production while the power generated reduced imports. Average statistics on field operational experience show in excess of 70,000hr operating hours: 78-91% onstream factor and 13,000hr (1.5yrs) average interval between bearing replacements.

### A New Process for Improved Liquefaction Efficiency

After the coffee break, Adam Jones of Costain Energy and Process (co-author Grant Johnson, Costain Energy and Process) introduced the dual N<sub>2</sub> expander process. He stated that the process was suitable for FLNG as there is no flammable refrigerant, it offers high availability, and has the ability to handle compositional changes. Costain discussed their proposed enhancement in which the "cold" expander recompressor is used to compress incoming feed natural gas instead of compressing nitrogen refrigerant.

The increased efficiency is demonstrated by an evenly pinched composite cooling curve.

Adam's presentation then discussed a comparison of three configurations - a standard N<sub>2</sub> expander; one with external feed gas compression and Costain's enhancement. This showed an additional 0.86mtpa LNG production which is equivalent to one extra LNG cargo (~\$17m) for Costain's enhanced process.

### LNG Vaporizer Selection

John Mak of Fluor, another regular at the GPAE podium and all the way from the USA, presented his analyses on LNG vaporiser selection for small LNG schemes in two climatic regions - warm (18+°C), and cold. The paper was co-authored by Nick Amott, Curt Graham and Dhiraz Patel, also of Fluor. John explained that the energy utilisation of the two most common LNG

vaporiser options for large scale import terminals - the open rack vaporiser (ORV - 70% of installed units) and the submerged combustion vaporiser (SCV - 25% of installed units) is an issue for smaller scale. He discussed the many options for LNG vaporisers pointing out the pros and cons of each system, before presenting his qualitative comparison for 7 alternative LNG vaporisation options for 3 and 0.3mtpa LNG regasification. This showed glycol-water/air or air alone as the most favourable for warm climates although dense fog, large space, low capacity (40% redundancy) are some issues. For cold climates, conventional ORV / SCV remain favourable.

### LNG Regasification Terminal Basic Design: Challenges and Moving Forward

Fadzliana Ahmad and Asliza Abu Bakar, both of Petronas, presented the last paper of the afternoon session discussing their small LNG import scheme at Eastern Sabah. The scheme is designed to supply 48mmscfd to a power plant, reserving a further 52mmscfd for an, as yet, not fully developed pipeline consumers supply.

A standard design with one 160,000m<sup>3</sup> LNG tank and intermediate fluid vaporiser (IFV) using glycol, water and air is proposed to supply LNG within a tight heating value specification of 35.1-48.1MJ/m<sup>3</sup>. The standard design however did not permit absorption of LNG tank boil off gas in the recondenser during turndown. This was solved by installing a 3rd stage compressor to inject boil off gas directly to send off. A residual issue of achieving heating value specification with a higher proportion of BOG gas was mitigated by imposing the restriction of sourcing rich LNG

until pipeline consumers are developed.

The afternoon of excellent papers closed on time to allow delegates to meet in plenty of time for the Drinks Reception.

**GPA Europe would like to thank ABB Consulting for sponsoring the Reception.**

**Murtaza A Khakoo  
BP Exploration, Sunbury**



Adam Jones, Costain Energy and Process



Fadzliana Ahmad, Petronas

## YOUNG PROFESSIONALS' SITE VISIT TO BP KINNEIL

**Contributed by King-Chung Chong (King) - Design Engineering Manager  
Heatric, division of Meggitt (UK) Limited**

Thank you GPA Europe for arranging a tour of the BP Kinneil Terminal site which was a wonderful and valuable experience. Everybody who attended only had positive things to say about the tour. For most Engineers who were there, their day-to-day job environment is within an office, so pulling on a bright orange overall and a green hard hat really got the heart racing with excitement. It reminds you that in whichever field you are, whether it be equipment suppliers, process design, or structural support, it all fits together and forms a bigger picture in Engineering. You could really appreciate the size of the equipment and complexity of layout and pipework. It was good for understanding where our equipment lies in the grand scheme of things. The tour guides were extremely friendly and helped with our understanding of how the plant operated. It was the perfect platform to learn fuelled by the energy by Young Professional Engineers. To top things off, it was even a beautiful sunny day!

# GPA EUROPE 30TH ANNUAL CONFERENCE EDINBURGH, 19 SEPTEMBER 2013

## MORNING SESSION: COMMERCIAL ISSUES

### Moderated by Keith Thomas, E.ON New Build and Technology

Breaking with the normal convention the meeting this year had an initial session outlining various political and market views of where gas at present stands in national and European energy mixes.

### Keynote Speech: The Role of Gas in the Renewables Age

The Keynote speech was from Fergus Ewing MSP, the Scottish Minister for Energy, Enterprise and Tourism on "The Role of Gas in the Renewables Age".

The Minister outlined the draft Heat Generation Policy Statement which will present the Scottish Government's understanding of how heat is delivered now, both domestically and industrially, and set out scenarios for meeting its heat vision (that by 2050 we will have a largely decarbonised heat sector with significant progress by 2030), highlighting the pros and cons for each.



Fergus Ewing MSP

With a 70% fossil fuel based economy, the Minister asserted this cannot be changed overnight and a target of growing renewables by 100% to 2020 will need to recognise reality. The future will be a mix of fossil fuel based energy with carbon capture and storage (CCS) and renewables. The Minister made mention of Shell's post combustion capture project at Peterhead and Summit Energy coal fired CCS at Grangemouth, identifying the main challenges as transporting to storage sites and preventing leakage. Many depleted oil fields are available for storage although CO<sub>2</sub> EOR would make it more interesting but has its own issues. For renewables, onshore wind is well developed employing 1.5% of civil engineering workforce. This however compares to 450,000 working in the Oil and Gas industries in the UK, half of which are based in Scotland. A large wave and tidal project has been approved as test facilities but requires deep pockets. Other renewables options being pursued are fuel cell for buses and pump storage power.



Howard Rogers, Oxford Institute for Energy Studies

### UK: The Changing Role of Gas in the UK Energy Mix

Following on from this, Howard Rogers of Oxford Institute for Energy Studies presented a paper on "The Changing Role of Gas in the UK Energy Mix"

This paper discussed the current trend and future projects for energy supply into the UK. The gradual decline in UK production has required Norwegian, and Dutch gas imports (now also declining) and LNG imports to meet UK's annual demand of 90-100bcm. Uncertainties in supply post 2015 predicted are due to uncertainties in Asian LNG market demand; timing of non-US

(Australia, E Africa) LNG production; N America shale development and pricing policy on Russian supply. UK indicative prices are predicted to be between Henry Hub (HH - 6\$/mmbtu) and Asian/Japan (12-16\$/mmbtu). Current trends in UK energy show gas and coal dominating, supported by spiky renewable contributions, primarily wind. On shale gas, Oxford Institute predict that even while drilling 300 wells/yr over 10 years - a big ask, supplies will amount to less than 10% of UK supply. A levelled cost of power generation showed gas CCGT with CCS and coal with FGD are on par with nuclear and onshore wind. Coal with CCS (e.g. Shell Peterhead)



GPAE thanks Fergus Ewing MSP for his attendance in Edinburgh

and offshore wind are 30-60% more costly alternatives and will require subsidies.

### European and German Energy Policy and the Role of Gas

The third speech of the session from Gerald Linke of E.ON New Build & Technology went on to consider "European and German Energy Policy and the role of Gas"

Natural gas takes us into the future with the aid of new, highly efficient systems incorporating renewable energy sources: natural gas used in combined heat and power systems, in heat pumps for heat and cold production or in fuel cells. Natural gas offers a broad range of sophisticated systems - innovations that make it possible to enter a new carbon-free, sustainable energy world. The development of mobility based on natural gas also follows this path.

Natural gas helps to achieve the goals of the energy turnaround by providing affordable, socially



A record attendance

acceptable solutions. It is not just innovative and efficient; it is also renewable in the shape of biomethane. New technologies ensure security of supply and integrate electricity from wind and solar energy by using it to produce hydrogen or methane that is fed into natural gas grids. These grids can store a huge amount of green gas, making it available when needed and thus offsetting the fluctuations in wind and solar energy.

In order to support the energy turnaround, Gerald postulated that it was necessary to ensure that biomethane and other renewables like synthetic biomethane or hydrogen can play an equal part in the heating market. Also there is a need to promote the urgently needed, accelerated modernisation of boilers, not least by granting tax relief and creating investment incentives for micro-cogeneration in homes in view of the huge amount of energy saved. Additionally, it would be necessary to extend significantly the expiring tax benefits for natural gas vehicles for the sake of low-carbon mobility and encourage power-to-gas research and pilot projects as well as incentives for realising the first commercial systems

He went on to present the European and German energy supply perspective discussing the



significant growth in gas infrastructure from 1970 to present. There is significant tension in Europe on renewables versus fossil fuel but this is now leaning towards promoting gas, in preference to coal and CCS, as more compatible with renewables.

Renewable supplies currently favoured in addition to wind are biogas (biomethane); wind in conjunction with power-to-gas (introducing up to 10% of hydrogen into gas grid); and micro-CHP. On the demand side, increase in efficiency e.g. using condensing boilers, substituting diesel for cars, trucks with CNG, LNG (large trucks, train etc); use of heat pumps; fuel cells etc are seen as driving future for emissions reduction in Europe.



Joel Moxley, President of US GPA

**Guest Speaker: Joel Moxley, President of the US GPA**

The final speech of the initial session was by Joel Moxley, President of the US GPA. In his message of congratulations to GPA Europe for reaching the 30th Year milestone, the President of US GPA took the opportunity to present the US gas mix. The current energy mix of gas, coal, nuclear and 9% renewables is being transformed by the N America shale gas bubble that is filling up declining conventional gas, lowering prices from 8 to 3,50\$/mmbtu. By 2015, it will also convert the US from an LNG importer to a net exporter with 4 LNG export schemes now approved.

Statistics on shale gas developments are awesome e.g. Marcellus - 15mill acres of field area with potential for 175,000 wells @1650 wells/yr has a field life of 100yrs! This is backed up with relative low cost wells taking 20-30 days to drill with 1 rig drilling 12-15wells/y at \$7-10mill/well and producing ~20mmscfd/well.

The rich shale gas required to meet lean US pipeline gas specification, has also spawned some fast paced, low cost NGL recovery plants and a boom in chemicals plant de-mothballing / construction fuelled by distressed LPG and ethane. Surplus ethane / LPG are also being earmarked for export e.g. the Mariner East project proposing to export 70,000bpd of ethane to Europe.



Our American colleagues



Phillip Staplehurst, BP

**BP's Shah Deniz 2: Opening the Southern Corridor**

The full technical session of the day was opened by Phillip Staplehurst of BP with his paper "BP's Shah Deniz 2: Opening the Southern Corridor".

Phil gave an overview of the SD2 concept presenting the enormity and complexity of the development and the technological challenges which have to be overcome and which are key to enabling gas production.



Efstathios Skouras, Statoil ASA

Focus was on the subsea facilities describing the architecture including standardisation of well clusters, the use of directional drilling to get over the no-drill zone, 7" hangers for increased gas production, direct electric heating (DEH) on flowlines and qualification and implementation of HIPPS valves suitable for 14,000psi.

Phillip also went on to discuss how BP was able to call upon the experiences and learnings from the existing Caspian developments.

**PhaseOpt - Online Tool for Hydrocarbon Dewpoint Monitoring**

In the following paper, Efstathios Skouras with his co-authors Torbjom Vegard Løkken and Christian Aaserud, Statoil ASA, Research, Development and Innovation (RDI), Norway and Gassco AS presented "PhaseOpt - Online tool for hydrocarbon dew point monitoring".

Statoil presented results of their field testing of the PhaseOpt tool on the Asgard Transport Pipeline in the North Sea handling rich gas. The tool consists of a sampling system, online GC analyser for extended compositional analysis up to C12, a new thermodynamic model for HC dewpoint calculations and direct control of pipelines & process plant.

The new thermo model called UMR-PRU is a predicative EOS that combines Peng Robinson with a UNIFAC type model for excess Gibbs energy through the universal mixing rule. Statoil plans to make this model available in Hysys through CAPE

OPEN. The PhaseOpt HC dewpoint predictions show a good match with measured field data whereas SRK can under-predict dewpoint in high pressure regions.

PhaseOpt claimed to be accurate to +/-2bar hence the intent is to reduce margins and design and operate closer to the HC dewpoint. Extended compositional analysis takes a little longer (~10mins).

**Motivating UK Gas Producers into GS(M)R Compliance**

To close the morning, Paul Stockwell of IMA together with co-authors Diane Broomhall and Brian Strugnell of GL Noble Denton presented a paper titled "Motivating UK Gas Producers into GS(M)R compliance"

Existing instrumentation is designed to analyse dry gas. IMA gave an update on the testing of a prototype liquid detection system being developed in conjunction with National Grid and GL Noble Denton. Lab testing has been performed at GL's

Loughborough facilities and high pressure test loop at Spadeadam.

Aerosol tests have shown that a liquid film will form at the pipe wall making detection difficult. The new instrument is an optical device which can detect down to liquid depths of 0.33mm. Using a new form of Raman spectrometer, the instrument can also identify the liquid type

present e.g. methanol, glycol, condensate or compressor oil.

The developers are now looking for beta sites for further trials, suitable for 600# systems.



Paul Stockwell, IMA



Sandy proudly displays his Scottish roots

# GPA EUROPE 30TH ANNUAL CONFERENCE EDINBURGH, 19 SEPTEMBER 2013

## AFTERNOON SESSION: OFFSHORE APPLICATIONS

### Moderated by Simon Crawley-Boevey, Cameron Ltd

After lunch the theme of the conference moved on to Offshore Applications. One paper was withdrawn at the last moment which meant that the session was reduced to five papers. This allowed time for discussion and more questions from the audience.

### North Sea Platform Production Enhancement - Integrated Design Approach to Flash Gas Compressor Iterating

The first paper of the session was presented by Roland Pike and Arun Karuppasamy of g3Baxi Partnership. The paper was co-authored by Mark Roberts and Kath Mansfield, Hess South Arne, and John Gill, g3Baxi Partnership. The presenters described how a compression train on the South Arne



Arun Karuppasamy, g3Baxi Partnership

platform, comprising back-to-back flash gas compressors, required re-rating to meet a planned production profile.

The presentation covered both the technical challenges involved in re-rating the centrifugal compressors as well as the final solutions adopted. The challenges included designing for low volume flows whilst accommodating a large variation in gas composition (due to the intermittent operation of a future flare gas recovery system).



Roland Pike, g3Baxi Partnership

Compressor design for low molecular weight gas limits operation at high molecular weight, with the converse also being true. Therefore the objective was to design a compressor that could satisfactorily operate over a range of gas compositions. In addition, the re-design needed to accommodate the low volume flows, which presented challenges in terms of design (low efficiencies) and selection (limited impeller inventory due to manufacturing difficulties).



Nick Chen, ABB Consulting

### Flare and Blowdown Systems Review

The next paper was delivered by Nicholas Chen and Ken Bell of ABB Consulting. Their presentation started with historical case studies which demonstrated the importance of reviewing flare systems, and the possible severe consequences of inadequate systems. They described how historically, flare systems tended to be designed and installed when the site was constructed with particular project hazard assumptions, flaring scenarios and process conditions in mind. During the intervening years, equipment and control modifications may have been made to the process plant connected to the flare system to improve production. This could have introduced new tie-ins, new relieving scenarios, loads and conditions into the flare system which may have exceeded the original design basis. It is therefore essential that the flare system is regularly reviewed to ensure that the system integrity, the relieving basis and potential loads placed upon it still fit within the original design envelope.

The paper described a variety of findings from recent live flare system studies.



Ken Bell, ABB Consulting

## The Pros and Cons of Subsea Gas Processing - A Flow Assurance Perspective

Before the coffee interval Sandy Dunlop introduced the new GPA Europe website to the audience. The session broke for coffee returning for the first presentation of the final session of the day which was presented by Terry Wood of INTECSEA, Worley Parsons Group.

The presentation began with a summary of the current status of subsea processing technologies which have developed considerably with some fields in production now using subsea separation. Gas field developments entail numerous multifaceted issues related to the transported fluid such as: pressure drop; hydrates; corrosion; scale; sand and wax. For the gas to be produced and transported efficiently and safely, these issues are required to be controlled and addressed; generally by injecting chemicals, insulating or heating the pipelines, and removing the water or sand.



Terry Wood, INTECSEA

The presentation reviewed the advantages and disadvantages of current subsea processing technologies on gas developments in relation to the flow assurance issues expected. Subsea processing can deliver benefits such as enhanced production and increased recoverable reserves of remote fields, and saves the costs associated with an in-field fixed or floating structure.



Martin Watson, FEESA



A Johnson, FEESA

## Managing Flow Assurance Uncertainty Through Stochastic Methods and Life of Field Multiphase Simulation

Martin Watson of FEESA gave the penultimate paper of the day. Co-authors of the paper were A Johnson, M Montini, T Lim and T Bellion of FEESA. Martin's presentation explained how life of field stochastic methods could be extended to the design and operation of surface facilities and showed how they could lead to more appropriate and economic designs. As case studies, the flow assurance strategies of three marginal projects were developed using stochastic approaches. The first case study was MEG optimisation of a large wet gas network, and techniques were also demonstrated via two further examples: (i) handling reservoir uncertainties for a daisy chained multiple oil well tieback and (ii) assessment of risk based hydrate management of a single oil well tieback to an existing subsea facility. Although the latter two examples were primarily for oil systems, they demonstrated techniques that could be employed in gas developments. The benefits

of the approaches became clear as the flow assurance risk of choosing a cheaper alternative (such as smaller MEG system, less insulation, etc.) could be quantified.

## Design Considerations for Preventing the Formation of Solids in Natural Gas Processes

The final presentation was presented by Michael J. Harlan of Bryan Research & Engineering Inc (BRE). The paper described methods for predicting hydrate and solids formation in gas pipelines using BRE's ProMax software, and modelling hydrate suppression techniques such as methanol and glycol injection. In natural gas streams, solids can form as dry ice, water ice, and hydrates. Preventing solids from forming in natural gas streams is an essential component of gas processing. Hydrate formation is favourable at low temperatures, high pressures or when the gas is near or below its water dew point. Solids can also form as pure compounds in the case of dry ice and water ice. In most cases there is a single temperature where hydrates will begin to form at constant composition and pressure, but there are common circumstances where it is possible to have multiple hydrate formation temperatures. Thus, to avoid operating problems and shutdowns due to solids formation, full knowledge of hydrate points, the possibility of multiple hydrate points, as well as freeze out points is important. Often,



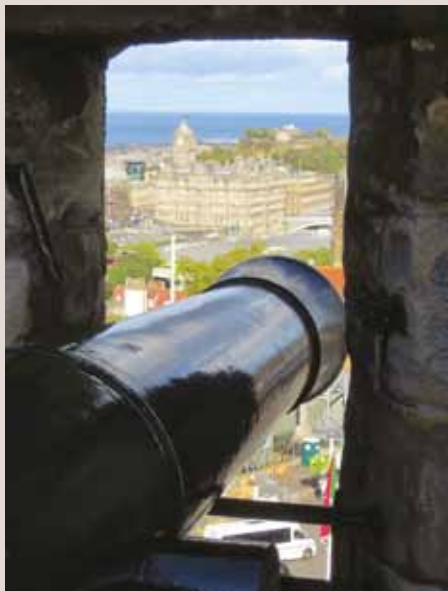
Michael J Harlan, Bryan Research & Engineering

hydrate suppression techniques are utilized when solids formation cannot be avoided by means of operating in a temperature-pressure regime that does not favour the formation of solids.

The day was wrapped up with Sandy Dunlop inviting the delegates to the Conference Dinner at Prestonfield House and enticing the audience to look forward to the extraordinary entertainment that was to come.

# EDINBURGH COMPANIONS TOUR

21 Companions woke up to a terrible rainy and dreich Scottish Day, but the smiley face of our tour guide, Charlie Hunter, soon cheered us all up when he arrived dressed in his kilt - a true Scottish guide!



Defending the castle



View of the Castle

Our day started with a short coach tour of the centre of Edinburgh so that people who were staying for the weekend could get their bearings. We travelled around Charlotte Square to see the location of the Georgian House, along George Street and then down to Jenners (the Harrods of the North), past the Scott Monument (a tribute to the famous Scottish author Sir Walter Scott) and the National Galleries of Scotland at the foot of the Mound. Then it was on over the Bridges and along the Royal Mile towards the Castle, whilst being shown Greyfriar's Bobby and the Elephant House, the birthplace of the Harry Potter series of books.

At the Castle, Charlie pointed out St Margaret's Chapel, Mons Meg and the Queen Anne Building to name but a few of the sights, telling us a brief



The tour party

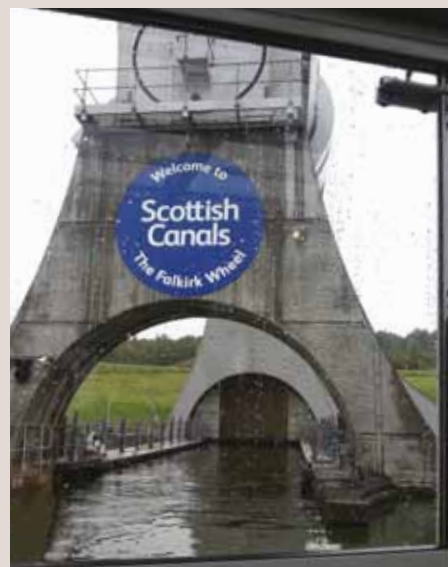
history, before we passed onto see the "Honours of Scotland" - the Scottish Crown Jewels, along with the Stone of Scone upon which Scottish kings used to be crowned before the stone was stolen by the English king Edward I. We also visited the Great Hall resplendent with swords and claymores and lots of other weaponry of the past. Although time was limited Carolyn managed to get off to a Scottish store near the Castle to buy a poncho to keep off the rain and a pair of Scottish wellington boots and a kilt for her granddaughter.

Charlie then took us down the Royal Mile to Holyrood House, showing us various places along the way, and then past the Scottish Parliament building and on to the Palace of Holyrood House. It has been a Royal residence for 500 years and today the Queen spends a week every year there during the summer. The origins of the building lie in the foundations of an Augustinian abbey built in 1128. Our tour of the palace took us to the Great Stair, the Royal Dining Room, the Throne Room, and Mary Queen of Scots' Chamber to name but a few.

The party returned to the bus to take a trip towards Falkirk and the Inchyra Grange hotel for lunch. The GPA Europe had used this hotel as a conference venue in 1999 and our little party did look a bit lost in the huge dining room. But lunch was very good and gave time to chat and catch up with acquaintances only seen once a year.

After lunch we drove to the tourist attraction of the Falkirk Wheel - a wonder of modern technology. The wheel is a rotating boat lift connecting the Forth and Clyde Canal with the

Union Canal and was opened in 2002. We boarded a boat on the Forth & Clyde Canal which then passed onto one of two counter-balanced compartments on the wheel. The wheel then revolved, raising us twenty four metres and depositing the boat on to an aqueduct which feeds into the Union Canal. This Canal was then reached by passing up a further eleven meters through two locks. The power consumed during the process was 25 kW! Some of the party were



The Falkirk Wheel

a bit concerned about the heights but it was generally thought to be an excellent experience. We travelled back down to the Forth & Clyde Canal before boarding the coach.

Time was passing quickly and Charlie knew what had been planned for the evening so the coach made its way straight back to the hotel. Despite the weather, I think everyone enjoyed themselves and Charlie got us all into a great mood for the evening by getting us all singing on the coach which made the journey back seem even shorter!! We arrived back in plenty of time to prepare for the Conference Dinner and the Taste of Scotland Show.

**Anne Dunlop**



Verifying an urban myth

# THE EDINBURGH CONFERENCE DINNER

**To celebrate the 30th Anniversary of GPA Europe I felt that we needed a completely new event in the Annual Conference calendar to make the conference memorable. Whilst planning the event, I visited Prestonfield House, a Jacobite era mansion on the outskirts of the City of Edinburgh to see if they could handle our needs as a venue for the Conference Dinner.**

As a native of Edinburgh I had visited the house before for my brother's wedding, so I knew it was worthy of attention. Built on the site of a monastery originally constructed in 1150, the building was burned down during demonstrations in the seventeenth century, and on the site a Jacobean mansion was built in 1687. The family, the Dicks, were staunch Catholics in an era of religious tension and there is little doubt that they supported the Jacobite rebellions in 1715 and 1745 and Bonnie Prince Charlie was probably a visitor in 1745. The grounds today host exotic animals including peacocks and Highland Cattle whose presence meant that Brian Marshall could not offer his usual celebratory fireworks display

– so what could we do to make the evening memorable?

The house is now a bijou hotel but offers a stable block where large dinners can be accommodated. Also, during the tourist season, the venue puts on the Taste of Scotland Show which I had seen with some other business visitors to the UK. When it became clear that the Show was available for exclusive booking, the decision was made – the 30th Anniversary Surprise would be the complete “Taste of Scotland” show.

The surprise was kept until the actual night, when the delegates and partners arrived and were greeted by a piper and Cameron, our host for the evening. A welcome drink was followed by a succulent meal of Scottish delicacies and still no-one knew the final event of the evening. Suddenly the lights dimmed and the music began and we were treated to two hours of traditional Scottish songs, poetry and dances with guests being



The Chairman's welcome

invited on to the floor to take part. The highlight of the evening was a traditional Address to the Haggis followed by a sample of the heavenly dish taken with a small glass of whisky, by those who wished. Many of the guests who had never tasted haggis before commented favourably.

The evening ended with buses returning to the hotel, but there was a continual buzz of comment on a fantastic evening which I believe was enjoyed by everyone.

**GPA Europe would like to thank BASF for sponsoring the Conference Dinner.**



Guests in their national dress



Dining in the stable block



Guests join in the fun

# GPA EUROPE 30TH ANNUAL CONFERENCE EDINBURGH, 20 SEPTEMBER 2013

## MORNING SESSION: GAS TREATING

### Morning Session: Moderated by John A Sheffield; John M Campbell/ Petroskills

An early morning start was called for to allow those (including the Moderator) participating in the GPA Europe Golf Tournament to get off to the course on time. By 0830 the room was already nearly full as members responded to the request, despite the previous evening's dinner celebrations.

### Thiopaq O & G Bio-desulphurisation; An Alternate Sulphur Recovery Technology

The final session was opened in grand style by Gijs van Heeringen of Paqell B.V. (co-authors C Lee and Gary Bowerbank, Shell Projects and Technology) who described the recent developments with Thiopaq O&G - a Bio-desulphurisation technology which can be used in high and low pressure gas treating applications. The process is highly selective to H<sub>2</sub>S with very low levels of CO<sub>2</sub> co-absorption and is suitable for projects up to 100tpd sulphur. The process produces 'bio-sulphur' which has a smaller particle size and is particularly suitable for fertilizer and fungicide applications. Thiopaq compares favourably with the traditional Claus process as it does not need a smelter to produce a saleable product. Gijs presented the results of a detailed study where the Thiopaq process was compared to conventional processes and demonstrated that, particularly for lean gases, the process compared favourably on CAPEX, OPEX, Safety and Space requirements.



Ralph Weiland, Optimized Gas Treating

### Fate of Methanol and HCN in Amine and Sour Water Systems

The second paper was presented by Ralph Wieland, a regular contributor to our conferences. The paper, co-authored by Nate Hatcher, described the distribution of Methanol and hydrogen cyanide in amine systems related to sour water strippers in refinery process streams. Several aspects of HCN ingress, prevention and accumulation in refinery amine systems were quantified, which previously were only poorly understood.

In addition, the formation of a previously undiscovered HCN bulge in Amine Regenerators

and Sour Water Strippers was reported, revealed with the use of the PROTREAT® Mass Transfer rate-based simulator.

### Hydrocarbon Management in the Natural Gas Value Chain - Profit or Peril?

David Thom of UOP presented the third paper which focused on hydrocarbon recovery and separation technologies. The presentation described the wide range of available technologies, but concentrated on the packaged modular cryogenic plants which are being deployed to process shale gas in the USA. A case study was described for several schemes processing gas for power generation fuel at 300mmscf/d at three different levels of NGL extraction, showing the impact on process plant configuration and compressor power. Details of 5 other schemes for different gas compositions were also presented.



David Thom, UOP



Peter Hawes, Zeochem

### Short Cycle Adsorbers - The Solution for High CO<sub>2</sub> Concentrations in Natural Gas. A Practical Solution Developed with ZEOCHEM Molecular Sieve

After the break, we welcomed Peter Hawes, a GPAE stalwart, to the podium to present a paper on Short Cycle Adsorbers for the removal of CO<sub>2</sub> in situations where a conventional amine system would be more expensive to build and operate. Peter described the development of the technology for an application with small scale LNG processes and illustrated the presentation with examples from a plant in Norway which had been operating for 10 years. The process gas is first dried with conventional molecular sieves before entering the Short Cycle Adsorber unit. The cycle time is typically three hours and the process is suitable for

## GOLF TOURNAMENT - BRUNTSFIELD LINKS GOLF CLUB

Unfortunately, only five people were able to play in the Golf Tournament on 20 September at The Bruntsfield Links, but they had an excellent afternoon's golf in very good weather. Joe Vara of Rotor-Tech won the competition by a significant margin and his team with John Sheffield and Brian Marshall won the team event. Paul Openshaw and myself struggled round with Paul taking the Longest Drive trophy with a massive 315 yard drive and I won the Nearest to the Pin (green actually), although John Sheffield's ball was closer but in the bunker. Softbits Consultants will be sponsoring the Golf again next year in Madrid. We are planning a "GPA Ryder Cup" so we can win the trophy back from our American friends!



The individual winner - Joe Vara

The winning team

The competitors



Maan Iksander, Saudi Aramco

CO<sub>2</sub> levels of up to 4% and, compared to an amine system, the regeneration requires significantly less heat.

### Energy Optimisation At Saudi Aramco Shaybah NGL Recovery Facility

We then welcomed Maan Iksander of Saudi Aramco to present a paper on Energy Optimisation at the Shaybah NGL Recovery Facility. Maan described studies that were performed on four aspects of the NGL recovery facility including:

- Acid Gas Dehydration
- Deleting the Feed/Residue Heat Exchanger
- Demethanizer Side Draw Pumps Elimination
- Hot Oil System Optimization



Jim Ferrero, GlobalLogix

Options were evaluated in the context of the harsh environmental conditions in which the plant had to operate and recognising the scarcity of water and remoteness of the location. Overall the studies resulted in CAPEX reduction and a saving of 20MW of power.

### How Secure is Your SCADA System?

The final paper was presented by James Ferrero of GlobalLogix on the subject of Security of SCADA systems. His paper was co-authored by Siv Hilde Houmb, SecureNOK AS. James' description of how easy it might be to hack into a SCADA system through the many vulnerable points was a timely reminder of the risks some of our networks might be exposed to. His paper described the most vulnerable access points and suggested a number of approaches that should be adopted to improve security without breaking the budget.

The Moderator closed the conference presentations by thanking all of the speakers and calling on the delegates to show their appreciation for all the excellent contributions and also to Sandy Dunlop for selecting Edinburgh as the location for the conference and for his superb organisation of the Conference and the entertainment.

# GPA EUROPE TECHNICAL CONFERENCE LONDON, 21 NOVEMBER 2013

## KNOWLEDGE SESSION: FLARE & RELIEF SYSTEMS – DESIGN AND RATING

### Session Chairman: Adrian Finn, Costain

Brian Marshall, MD of Softbits Consultants and familiar to many at GPAE was supported by Softbits Technical Manager Alexis Haro in providing a comprehensive and stimulating overview of the concepts and alternatives of flare system design.

Flare systems must ensure safe disposal to atmosphere of flare gas from all sources in accordance with applicable design codes, standards and laws using recommended practices (API RP 520, 521 and 2000) whilst minimising cost and considering environmental impact from smoke, radiation, noise and luminosity/visibility. Flare system design considers and includes a number of components; flare tips, purge gas and seal systems to prevent air/hydrocarbon mixtures, flare stacks or booms, flare liquid knockout drums, piping systems, relief and vent sources and relief scenarios. Flare system design also presents major challenges in the management of process data as changes in calculated relief flows, header sizes or piping configuration can have a significant knock-on effect and lead to re-design and/or cost increase. Advances in computerised network system analysis programmes have helped process design in recent years.

The first part of the overview discussed flare stacks and tips. The various types of vertical flare types were presented and compared in terms of cost and land requirement. Inclined flares are appropriate offshore due to limited space and the



Brian Marshall explains the complexities of flare relief

need to avoid any burning liquid falling on topsides. Flare tip types were explored and compared including non-assisted, assisted and endothermic. Low cost, non-assisted "pipe tips" are of simple design. They rely on natural diffusion of air into the burner flame which can result in low combustion efficiency and consequent high radiation from glowing soot particles whereas more expensive sonic tips are smokeless. These create high velocity gas (from having a relatively high pressure at the flare base – up to maybe 6 bar) to create turbulence, increase air entrainment and more efficient combustion, akin to opening the port on a laboratory Bunsen burner. This gives smokeless operation and relatively low radiation. High pressure flares may use "staging" by opening in steps against rising pressure. Endothermic flares burn low calorific value gas and often use an external heat source. Alternatives including horizontal booms, offshore liquid burners, burn pits, open ground flares, "finger flares" (which can be very appropriate



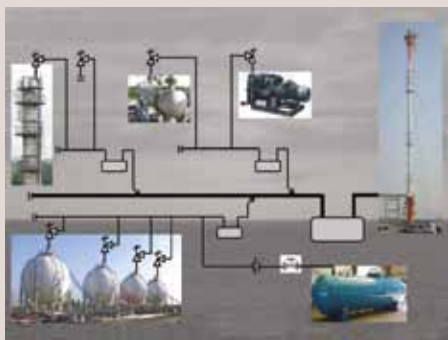
Brian's audience engrossed

where sufficient land is available) and remote flares were also discussed.

The importance of flare header purging in avoiding potentially explosive mixtures in flare piping was discussed with explanation of both the molecular or labyrinth seal which uses gas density difference (between flare gas and air) to avoid mixing and the fluidic seal which uses purge gas velocity to avoid mixing, and hence needs more purge gas.

Brian discussed the design parameters for good flare design and achieving of a clean efficient burn. A range of radiation prediction methods were introduced including relatively simplistic methods for design purposes based on the "F factor"; the total combustion energy emitted by radiation. Stack sizing relies on minimising radiation to meet API RP 521 allowable radiation levels and if the stack

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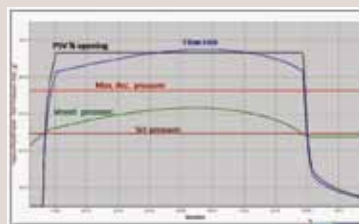
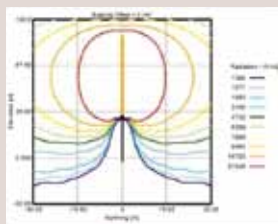
Typical flare system



Offshore liquid burners  
• Multipoint -burners pointing in different directions



Modelling Solid shielding with FLARESIM



PSV sizing -Dynamics  
• PSV selected orifice

length becomes excessive then alternative measures such as radiation shielding or water sprays should be considered, as well as employing high velocity flare tips assisted by pressure, steam or air. If it is not possible for the calculated flare rate to flow through a feasible length flare stack then revision to the plant design will be needed. This can be a particular issue in plant revamps and offshore facilities where the feasible maximum flare rate can dictate processing capacity (and therefore even plant economic viability).

The main process design parameters of a flare system were identified – back-pressure, fluid velocity, noise, temperature, slug flow and hydrate/ice formation. Gas sources dictate design alternatives and flare layout; whether a low pressure or high pressure (sonic) flare (relies on back-pressure) and whether warm or cold. In low pressure systems most of the potential pressure is lost across relief valves with little pressure drop available for the flare tip whereas a high pressure

system maximises the value of the high pressure gas sources. As the gas is at higher density it requires smaller headers, smaller KO drum and a shorter flare stack and so has a lower capital cost. Many gas processing facilities have a number of flares e.g. an LNG plant will have a warm low pressure flare from the acid gas removal system and dehydration, a cold high pressure flare from NGL extraction and refrigerant systems and a stainless steel cryogenic flare from LNG storage.

The second part of the Knowledge Session considered relief sources and overpressure protection of equipment and piping by pressure safety valves (PSV), bursting discs, pressure control valves (PCV) and depressuring valves. Bursting discs are only applicable if a PSV is impractical. The importance of clear definition of PSV terminology for back-pressure (built-up, static and superimposed) in the context of prevailing unsteady state conditions was stressed and the principles of operation for conventional, balanced

bellows and pilot relief valves were reviewed and clearly explained, along with their applicability and sizing methodology. The importance of inlet piping size, maintaining a pressure drop of less than 3% of set pressure and locating relief valves as close as possible to the relieving source were all explained along with avoidance of PSV “chatter”. Lateral pipework must be sized based on PSV rated flow, not the calculated design flow so where rated flow is well in excess of the required flow it may be better and cheaper to use two PSVs in parallel rather than one larger one.

Emergency depressurisation system “blowdown” arrangements (to avoid equipment overstressing and potential rupture) and their design criteria were covered with a clear explanation of the need for engineering judgement in the use of the API guidelines to achieve pragmatic and safe designs. This could be by techniques such as staggered depressuring and definition of realistic relief scenarios based on process calculations, flare system hydraulic design software and design experience.

Dynamic process simulation software can clearly provide a more accurate process model for relief and flare systems than reliance on steady-state modelling. It can take account of flare header “packing” by gas pressure accumulation and other time-related events to show that actual relief rates can be much smaller than using approximations from steady-state calculations as well as that relief flows are inevitably delayed from onset of an overpressure event so operators may have time to adjust plant operation to reduce the significance of a relief event and may even be able to prevent an event leading to a relief or flaring scenario.

This summary can only highlight a small part of the wealth of information provided by Brian and Alex on this important subject and imparted in such entertaining style. The number of questions during the morning and number of audience members wanting to ask further questions over lunch demonstrated just how valuable the presentation had been!

**Adrian Finn**

## GPA EUROPE TECHICAL CONFERENCE LONDON, 21 NOVEMBER 2013

### AFTERNOON MEETING – MODERATOR’S REPORT

#### Afternoon Technical Meeting: Moderated by SigbjørnSvenes, Statoil

After a non-controversial AGM and a tasty lunch in The Brasserie, the delegates reconvened in the Great Western Suite for the afternoon Technical Meeting. The conference session topic “Safety and Asset Integrity” was very well linked with the morning Knowledge Session topic on “Design and Rating of Flare and Relief Systems”. Session chair was Sigbjørn Svenes of Statoil who introduced the afternoon theme by focusing on the increased attention given to safety and asset integrity, especially in a mature area like the North Sea where installations and infrastructure have come of age. Many installations originally designed for 15 to 25 years’ lifetime have seen their operational lives prolonged for years and even doubled, platforms and FPSOs alike, as field

recoveries are increased or new production tie-backs are added. The North Sea Statfjord A platform is one such example, commissioned in 1979 and recently announced by Statoil to continue operation at least to 2020. Such decisions come about after thorough studies on how installations and equipment perform towards current safety and environmental standards, and the



David Bleackley, Petrotechnics

conference papers cover some techniques employed in the industry to achieve these objectives.

#### The Big Step Forward - Using Technology to Systemize How We Improve the Management of Operational Risk by Linking Asset Integrity Risk With Work Risk

The first paper of the afternoon was “The Big Step Forward – Using Technology to Systemize how we Improve the Management of Operational Risk by Linking Asset Integrity Risk with Work Risk”. In spite of the long title of the presentation, the



speaker – David Bleackley of Petrotechnics, finished well inside his time limit and his presentation created a lot of interest and discussion amongst the audience. David's main message was that it is possible to improve Production Efficiency (PE) and reduce operational risk simultaneously through implementing, maintaining and ensuring continued operability of the right protective barriers to achieve those goals. It was pointed out that one of the main risks to control is that the status of barriers or safeguards to prevent incidents often is managed separately from the cumulative work load risk typically performed as part of the look ahead work schedules of the installation in question. A planning and overview decision support tool was suggested to handle the interactions and dynamics of asset integrity and operational risks. By visualizing the safety barrier impairments in correlation with cumulative risk from operations for an asset or within a plant area, the basis for rescheduling work to improve the risk profile is made. In summary, using the capabilities of state of the art operational performance and predictive risk software enables systemization and support for a standardized approach to safe work practices across an organization. David pointed out not to forget such tools can be used powerfully in the frontline decision making to manage risk in the field.



**A problem shared...**

findings not previously identified. Furthermore, the increased awareness of risks from human errors has played a larger part in recent years.

Based on ABB's experience, around 30% of findings from re-HAZOPs resulted in some sort of modification, ranging from set point changes to more substantial hardware modifications. Still, around 50% of re-HAZOP originally recommended actions do not require further work, but process safety awareness is raised from the action. To reduce risks identified in any HAZOP it is, however, of utmost importance to close-out any action items which arise, Mr Baisden concluded.

### **Process Modelling Requirements for the Safe Design of Blowdown Systems - Changes to Industry Guidelines and How this Impacts Current Practice**

Apostolos Giovanoglou, Principal Consultant from PSE Oil & Gas, took the stage after the final coffee break of the day. Mr. Giovanoglou linked his presentation "Process modelling requirements for the safe design of blowdown systems - Changes to industry guidelines and how this impacts current practice" well to the morning Knowledge Session. The definition and intent of a relief and blowdown system was given in the first part. Also, the inherent hazards from the pressure relieving operations itself, like phase changes and low-temperature issues, were addressed. Continuing, Mr. Giovanoglou described the typical conventional flare system calculation approach based on steady state flare



**Apostolos Giovanoglou, PSE Oil & Gas**

system analysis, spreadsheets for relief valve sizing, and phase equilibrium based depressurization calculations. Then he went on to show how a current available dynamic simulation tool using rate-based models rather than pure phase equilibrium approaches could be used for better process modelling to avoid over-conservatism in flare and relief system design. Interestingly, it was also shown that the dynamic tool could reveal non-conservative estimates from conventional phase equilibrium depressurization calculations. This was exemplified by comparing calculated and measured vessel wall temperatures in contact with

liquid phase during blowdown. The presentation concluded that the advanced process modelling techniques used in the dynamic analysis tool were a requirement to assess whether a process is safe under transient relieving conditions and determine the safety margin inherent in the design.

### **Condition Monitoring to Support Production in the Power Industry**

The final presentation of the day, "Condition Monitoring to Support Production in the Power Industry" was given by David Futter of E.ON New Build & Technology. He gave the audience an insight into how E.ON used condition based monitoring for their entire turbine fleet to gain production

efficiency (PE) and manage risk to an optimum position, challenging the Original Equipment Manufacturers (OEM) risk-adverse approach while increasing overall equipment availability. E.ON's condition monitoring strategy is based on the ISO standards, and



**David Futter E.ON**

online monitoring is performed by one centralized team improving availability and customer costs for individual sites as well as optimizing turbine fleet companywide. Mr. Futter described a Data Driven Monitoring system based on data downloaded from individual plants and key parameters defined for various package systems like lubrication, fuel and cooling systems. The system generates alarms/alerts based on reference sets of "good data" from the plant. High focus is given to vibration and combustion monitoring and the audience was given success stories where this continuous detailed monitoring and analysis effort had detected evolving faults to develop into severe damages for heavy duty main frame power generators.

As in previous times, the excellent discipline shown by the speakers including closing remarks from the GPA Europe Chairman, Keith Thomas, allowed this afternoon session to finish within the scheduled time, allowing the participants to rush off for networking, further discussions and refreshments sponsored by GPA Europe in the Steam Bar!

### **Sigbjørn Svenes**



**London Technical Meeting Speakers and Moderators**



**Keith Baisden, ABB Consulting**

### **Managing Recommendations from RE-HAZOPs**

Receiving the laser pointer and microphone for the next presentation was Keith Baisden of ABB Consulting. In his paper "Managing Recommendations from Re-HAZOPs", Keith elaborated on how retrospective Hazard studies can be an effective means of assuring process safety. The HAZOP study methodology originally introduced by the former ICI group was intended to cover greenfield developments, but serious incidents within the oil, gas and petrochemical industries has led to more widespread use (Re-HAZOPs) for existing facilities. Experience has shown that Re-HAZOPs may lead to as many, or even more, actions points than the original exercise. Reasons for this were discussed in the presentation, and amongst others the difference in team composition was stressed as an important factor. During the project development, a large dedicated team with detailed knowledge of the design intent and ready access to equipment vendor personnel is involved, while in a Re-HAZOP, a smaller team with other simultaneous tasks and responsibilities is performing the task. In a Re-HAZOP the team involved would usually have extensive operating and maintenance experience as well as the benefit of hindsight for the plant based on earlier incidents and experiences for the plant. Also, changes in operating conditions and modifications not subjected to HAZOPs previously, may lead to

# CHAIRMAN'S ANNUAL REPORT 2013

**Ladies and Gentlemen, Friends and Colleagues, welcome to the 2013 Annual General Meeting of the GPA Europe Ltd.**



Keith Thomas delivers the Chairman's Report

2013 has been another exciting year with new challenges, some of which we have mastered well, others less so. Having sorted out the legal complexities of founding the GPA Europe Ltd in 2012 this has been the first year where we have been able to operate fully within our new format without distraction.

As in previous years GPA Europe Ltd has once again sought to offer an annual programme based on high quality conferences and Knowledge Sessions spread across Europe. In keeping with our ambitions to re-align our activities to cater for a wider audience, it was decided to move away from the traditional 3 conferences plus AGM / Technical Meeting and this year combine one of our conferences with a professional exhibition to try and build on the success of the format we adopted twice at the GASTECH exhibition in recent years.

Our initial Conference for 2013 was in Paris and was themed around "Technologies for Marginal Fields". Additional to this was a knowledge session on Sub-Sea gas Processing presented by Jagadeesh Unnam of

Cameron. Despite the cold weather and problems accessing Paris by plane and train, both sessions were very well attended. This was encouraging, as previously, early year conferences which we normally held in February had been experiencing declining numbers, and it was generally hoped that a later date and attractive venue would help reverse this trend. The conference was attended by 90 delegates; almost double that of the past few years. In particular there were a large number of delegates from France which has encouraged us to use the venue again, and despite the weather problems, to again hold the conference in March 2014.

As I previously mentioned, it was decided to try and capitalise on the success of our Centre of Excellence at the last two GASTECH exhibitions by joining forces with DMG, the

organisers of GASTECH, to hold a joint exhibition and Conference in Düsseldorf during June of this year. Unfortunately, although several of us spent almost two years planning and trying to make the event a success, it was cancelled shortly beforehand, effectively due to lack of interest. The number of delegates registered was insufficient and DMG had not been able to sell exhibition space or properly organise the first day of the conference as had been agreed. Although we at one point considered taking on the whole conference ourselves it was considered that there was inadequate time to do so while maintaining our normal standard, and that the risk involved financially was too large. Clearly after the success of the Paris conference this was a significant disappointment and setback in terms of re-aligning the association's activities. However, we were

able to strike a deal with DMG with regards to cost which left us with only a very small financial loss and there are a number of lessons learned with regard to our plans for the future. The most significant is that we should plan the conference first and then allow somebody to organise an exhibition to go with it. Secondly, we should not overestimate the capabilities of others however well organised they may seem to be.

September however saw GPA Europe celebrate its 30th Anniversary with the Annual conference being held in Edinburgh. It was, to put it mildly, a very Scottish occasion, and to begin with we broke with the traditional of open technical papers to have a keynote speech from Fergus Ewing, the Scottish minister for Energy and two further speakers discussing the place of Gas in the European Energy market. This was followed by a further 3 sessions of high quality technical papers interrupted only by an evening of entertainment based around the theme "A taste of Scotland", for which I have no adjective. Perhaps it is enough to say it will be very difficult to follow. Additionally we were also able to offer a Young Persons Programme of a session on Gas Terminal Design and Key Machinery Selection together with a visit to the BP Kinneil facility, as well as a Pre-conference session on LNG. Following the disappointment of summer it was good to see that when we concentrate on our own strengths the GPAE is indeed capable of putting on attractive conferences for fellow professionals that reflect the strong technical basis of our organisation.



Votes cast at the AGM



Stine Faugstad - Winner of the 2012 Aungier Award

2013 has also seen the publishing of two issues of the new look In Brief. In particular, due to the mid year conference in Düsseldorf being cancelled it has been a real challenge for our new editor Claire Haycock to publish on time. My thanks therefore go to her for sticking with it and producing something in keeping with our new aspirations. At this point I would like to point out that In Brief is the Association's magazine and hence it is open for anyone to offer anything they think others in the Association may be interested in knowing. The quality of the magazine is very much dependent on the input we as members make.

As David Weeks mentioned last year, contact has been made with the Gulf Chapter and it was originally thought that it may be

beneficial to hold a joint meeting during 2014. This was discussed a number of times in the Management Committee and it was concluded that for the time being it was best not to pursue this further, although we should maintain contact and inform and invite our colleagues in the Gulf Chapter to participate at our conferences in future.

It was particularly pleasing that it was possible this year to present the Aungier Award for the best paper by a young professional. This was won by Stine Faugstad for her paper on Natural gas Liquefaction using the Nitrogen Expander Cycle which was held at this event last year. It has been some time since we have had a paper that has merited this award, and particularly generated such a lively discussion in the committee. Hopefully this is a sign that the association's commitment to encouraging young talent is bearing some fruit.

Looking ahead to 2014 it has been decided to return to our traditional cycle of holding three conferences plus the AGM with technical meeting. The first meeting will be in Paris in March on the theme of Offshore Gas Facilities and their Operation. This will be followed by a meeting in May in the Netherlands on the subject of Gas Exploitation to Markets and our Annual Conference in September which will be in Madrid. Linked to these we will continue to offer Knowledge Sessions and encourage our young professionals group to organise associated events. The subject of rejuvenating the GPAE has been a key issue

for several years now and we seem to have made real headway in the past few years. We therefore need to make sure that we build and develop this in 2014 and to do this we are very much reliant on you and your companies support.

Finally but also perhaps most importantly my thanks to you all for your continued support of the GPAE throughout this year. Also my specific thanks to the Directors, Management Committee and the Programme Committee led by Lorraine Fitzwater who have all worked very hard in the background giving of their own time and energy to make things happen. And last but quite definitely not least my thanks to Sandy and Anne Dunlop who, in the



The Paris Conference

nicest possible way, provide the wind underneath the association's wings and hence give me something to report about.

I look forward to your continued involvement and support in 2014 and hopefully meeting you at the various events we have organised.

Thank you

## FORTHCOMING EVENTS

### 2014

#### 12 - 14 March

Marriott Rive-Gauche Hotel, Paris

#### SPRING MEETING, PARIS, FRANCE

"Offshore Gas Facilities and their Operation"

- One Day Conference
- Knowledge Session on Future of Gas in Europe
- Conference Dinner

#### 14 - 16 May 2014

Holiday Inn, Leiden, Netherlands

#### MAY MEETING

"Gas Exploitation to Markets"

- New technologies in LNG, GTL etc
- Knowledge Session
- Conference Dinner

#### 17 - 19 September

Hesperia Hotel, Madrid, Spain

#### 31ST ANNUAL CONFERENCE - MADRID

- Young Professional Training session
- Gala Dinner
- Companion's Tour
- Golf Tournament

#### 27 November

#### KNOWLEDGE SESSION, AGM & TECHNICAL MEETING

Hilton Paddington, London UK

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## CORPORATE MEMBERS

This listing of current Corporate Members represents the status as at the end of 2012. In addition there were 280 active individual members

### Corporate Level 1 - Premier

Aker Process Systems  
Amines & Plasticizers Ltd  
Atlas CopcoEnergas GmbH  
BASF SE  
Bechtel Ltd.  
BG Group  
BP Exploration Operating Co.  
Compressor Controls Corporation  
Costain Energy & Process  
Dow Oil and Gas Europe  
EON New Build and Technology GmbH  
Fluor Ltd.  
Foster Wheeler Energy Ltd.  
Gassco AS  
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GL Noble Denton  
Invensys Systems France  
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TechintS.p.A.  
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Xodus Group  
Zettachem International

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Criterion Catalysts & Technologies LP

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