In Brief...

GAS PROCESSORS ASSOCIATION EUROPE

Vol 25 Issue 1 **February 2009**

GPAE - LOOKING OVER THE HORIZON

StatoilHydro's Melkøya LNG Plant.
Photo courtesy of Manfred Jarisch / StatoilHydro

In order to celebrate the first 25 years of the GPA Europe, we invited four of our industry leaders to present keynote speeches at the Annual Conference. This was a new and highly stimulating move for our meetings, especially since the speakers explored the state of the gas industry on a broader basis, considering the economic and political aspects as well as the technical. The session was opened by visiting GPA President, Bob Dunn. The Q&A session allowed a further development of the themes. Photos from the session can be found on page 4.

Of course, we are in a changing business environment and what the speakers said in September 2008 would be different from what they would say now after the recent financial turmoil. Some of the references to energy prices seem to be from a dim and distant era, but no one will deny that the future of energy pricing is upwards. Nevertheless, they seemed to develop a theme of Challenge, which was the word most used by all the keynote speakers.

- Challenge presented by an unstable gas price
- Challenge of handling the public perception of the industry as providing dirty fuel; gas is considered the cleanest of the "dirty" fuels
- Challenge of adapting to the environmental requirements
- Challenge of handling public reaction to the rising oil price and at the same time demands for greater environmental sensitivity
- Challenge to increase supplies of LNG; currently a shortfall in supply
- Challenge technologically to achieve better handling of H_2S
- Challenge technologically to refine carbon capture techniques
- Challenge of providing sufficient supply to meet demand, for gas demand is expected to double by 2050
- Challenge for oil companies to diversify into provision of nuclear energy
- Challenge of continuing to recover stranded reserves economically

Nonetheless, the mood expressed was positive and optimistic and the message was that we, as an industry, have met the challenges of the last 25 years and expect to be equally successful in the next 25 years. Following are a few of the key points made:

There are major uncertainties in the market hence decision making is difficult.

High energy prices will help the development of technology and will encourage the exploitation of remote Arctic and challenging sour gas fields.

LNG Projects and gas supplies are available, but Final Investment Decisions (FID) are being delayed. The number of LNG projects receiving FID will not support the projected growth in LNG demand.

Subsea technology will be further developed with longer tie backs and sub sea processing.

Energy efficiency is a key to CO_2 reduction.

Recently completed US LNG import terminals are underutilised.

Floating LNG is a key potential solution for stranded gas.

LNG markets will embrace "spot" trading/arbitrage, making projects more viable.

Gas supply will move to deeper waters, remote areas, stranded gas fields and there will be new opportunities in Coal Bed methane projects.

Growth will continue to be sustained by power generation developments.

There is a need for more flexible business models working effectively with local resources.

Project delivery will continue to require innovative solutions to minimise costs.

Oil & Gas Majors will need to be the technical/commercial partner of choice with NOCs, providing environmental and ethical standards in order to gain access to the reserves.

Oil & Gas Companies should remain focused on what they do best, i.e. Hydrocarbons, but Nuclear energy is important and needs to grow.

We should look at investors from Asia as partners, not competitors.

View from the Top

A Happy New Year?

Looking through some articles in the energy press during the last few days of 2008, there doesn't seem to be too much to celebrate. Here are some of the "lowlights", just in case you missed them:

- In July 2008, crude oil in New York was trading at a record $147/bbl. It recently fell 73% to a four-year low of $39 /bbl. Global oil demand this year will have fallen for the first time since 1983, according to a US Energy Department report.
- Gas has declined 59% from July's 30-month high of $13.7 per MMBTU on the New York Mercantile Exchange.
- Prices of LNG in Asia, which are linked to crude, declined 40% from a record $20 /MMBTU.
- Lower oil and gas prices mean that developing marginal projects will no longer be attractive, at least in the short term.
- Fewer LNG projects than expected have received the green light during 2008. Spiraling steel and equipment costs, coupled with a shortage of skilled labour, have clearly played their part. In some regions, the additional factor of political instability has deterred commitment - and funding - from the energy majors.
- Other related industries are also suffering. Shipyards, riding on the back of the LNG boom and the increase in global trade, enjoyed boom times from 2005 to 2008. A 38% plunge in orders for freight and LNG carriers has now signaled the end of their party.
- Meanwhile, the suits running the world's larger financial institutions have incurred eye-watering losses of more than $1 trillion since the start of 2007, prompting banks to put the brakes on lending. The liquidity crunch, and the resulting reduction in available project financing, will most likely push the industry towards balance- sheet funding. This in turn will favour the larger energy companies with cash in the bank - although hopefully not an Icelandic bank.

Justin Hearn
GPA Europe Chairman

So far, not much good news for new, capital-intensive projects in our industry! On a more positive note, the demand for gas in general, and LNG in particular, spurred on by the increasing use of gas-fired power stations and the shutdown of nuclear power plants in Japan, has grown at a rate three times that of oil last year, according to BP's Statistical Review of World Energy. This would lead one to think that any new project that promised to deliver LNG at a low unit cost, and which could minimise political uncertainties, would be much more attractive.

Are there any such projects presently on the drawing boards? The answer is an emphatic, *"Yes!"*

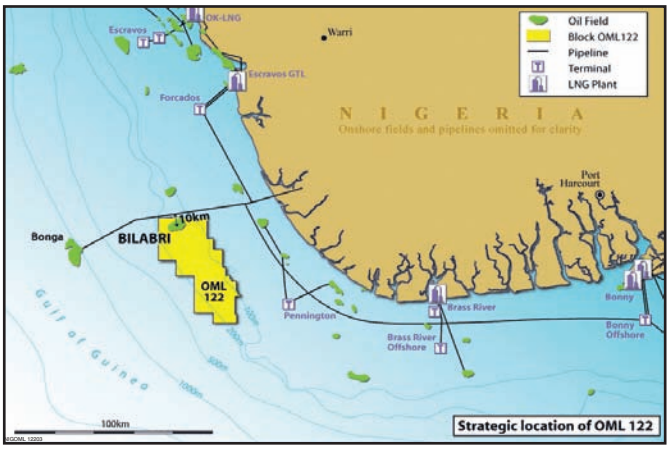
Floating LNG (FLNG) is a concept that has been hovering at the fringes of our industry for quite some time now. The attraction of FLNG is obvious, as there is the option of economical removal to another site if production does not work out as predicted, or the addition of production from subsequently drilled wells as production and discovery results warrant. As little as eighteen months ago, the impression may have been that there was still much interest, but no real commitment, from the potential investors. This has now changed:

- Flex LNG are developing several small, ship-based FLNG projects, and have already ordered four ships with a capacity up to 1.7 MM tonnes/y.
- Brazil's Petrobras is considering an order for at least one FLNG vessel, to develop one of the biggest oil discoveries in recent years. For each barrel of oil in the offshore Tupi field, there are around 900 cubic feet of gas that can be liquefied on a floating structure.
- ConocoPhillips and Shell, among others, are looking at much larger FLNG projects, built on barge-like structures, which are as big as recently completed land-based LNG plants. These LNG leviathans, measuring over 450 metres long and 80 metres wide, will probably cost around $5 billion each.

There is one small caveat - so far nobody has yet managed to take a plant the size of 150 football pitches, which requires 50,000 cubic meters of concrete and over 5,000 tonnes of structural steelwork, shrink it to 5% of its original size and then send it up to 250 miles (400 kilometres) offshore. The promoters of several FLNG projects say they can do just that.

At this point we should recall that, largely due to the huge investment required in a conventional, land-based LNG project, there has been little history of investors being willing to take risks, or be early-adopters of new ideas. Technology, equipment and construction techniques that have not already been successfully applied to previous LNG plants are rarely specified. The few operators who have been "brave" enough to try something new have encountered costly delays, so there are good reasons for caution.

So where will the financing come from? Current estimates suggest that smaller FLNG projects may cost $550 to $800 per ton of capacity, compared with $1,500 for onshore projects. If correct, this would be a healthy cost advantage for FLNG. Assuming the piracy problems currently affecting shipping off the coast of Somalia can be solved, FLNG projects could also neutralise the effects of onshore political unrest.



Flex LNG and Peak Petroleum plan a 1 MM t/y FLNG Project, West Africa

View From the Top

"The credit markets are tough but for LNG projects the window is still open if projects are structured correctly," said Flex LNG's CEO recently. Flex plans to focus on energy companies, rather than banks, to raise as much as $400 million next year. However, if a potential partner is not awash with cash, the project must be financed with debt from somewhere, and this is usually a bank.

Wood Mackenzie Consultants believe that FLNG will remain a *"niche play"* because of the small size of the plants. With masterful understatement, a senior figure at Lloyd's Register Asia, which inspects and certifies ships for safety, said that, *"Operating in the hurricane-prone Gulf of Mexico is tougher"*. The FLNG carriers will initially operate in benign sea conditions with predictable wind directions and low wave heights. Even then, without a suitably "marinized" design, it is clear that anything rougher than a flat sea may cause operational problems not normally encountered on dry land. Few current plant designs are sufficiently robust to tolerate either wave-generated rolling movements or the permanent tilt that can accompany offloading.

A more upbeat view is that FLNG ventures may boost LNG supplies by 12 million tonnes /year by 2015, slightly more than the growth in global demand last year. Société Générale suggests that they may find it easier to raise money compared with traditional LNG developments due to *"lower costs, shorter development time and less environmental impact"*. Citigroup agreed, noting that offshore projects may take *"less than half the time to build compared with onshore units"*. However, we should bear in mind that neither SG nor Citigroup have been "reading the tea leaves" particularly well of late!

So when will an FLNG project actually kick-off?

Flex LNG and their partner, Peak Petroleum, are currently in the final stages of planning a 1 MM tonnes/y FLNG project, appropriately named "Progress LNG", to be located above the Bilabri– Orobiri fields in the Gulf of Guinea, West Africa. If the financing can be secured, and the final investment decision (FID) follows in the first half of 2009, LNG production could begin as early as 2012.

If things go to plan, this will be at least one piece of news about which our industry can be very happy!

Justin Hearn

Editor's note: Justin put this article together during the Christmas break. Recognizing the current financial situation and the rate of change in global markets and company strategies, it is not surprising that factors affecting our business are dynamic and change on a day-to-day basis. Please respect that in reading his views!

Knowledge Session, Paris

Global Warming and Climate Change

The Knowledge Session - held on Wednesday 24th September in Paris, was kindly presented by Professor Helge Drange. In addition to being a Professor at the Geophysical Institute at the University of Bergen, Helge is a contributing author to the United Nations Intergovernmental Panel on Climate Change (IPCC). The Knowledge Session was a fitting start to the GPA Europe 25th Annual Conference, and was well attended by around 80 delegates.

The Presentation set out to address whether human activity is responsible for climate change. Helge presented a wealth of data to support the conclusion that it is. There are many alternative explanations often offered for climate change, and many of these were discarded by Helge as being myths. For example, solar irradiance has actually been decreasing over the past 30 years together with the distance of the sun from the earth increasing.

After demonstrating human activity as being the cause of climate change, Helge then presented the various global impacts of climate change. These impacts include reduction of Arctic sea ice, with a forecast that the Arctic may become essentially free of summer ice anytime between 2020 and 2050. Also Helge used animated models to present the expected decreases in rainfall across vast continental landmasses, leading to a potentially devastating impact on food supply. Additionally, the melting of glaciers and subsequent reduction in melt water contribution to rivers is expected to affect the water supply for more than 1 billion people.

The 2003 heatwave was used as a vivid example of the impact of climate change. We were reminded that this heatwave, which was previously considered as a 1 in 400 year event, claimed 30,000 lives. The

Professor Helge Drange

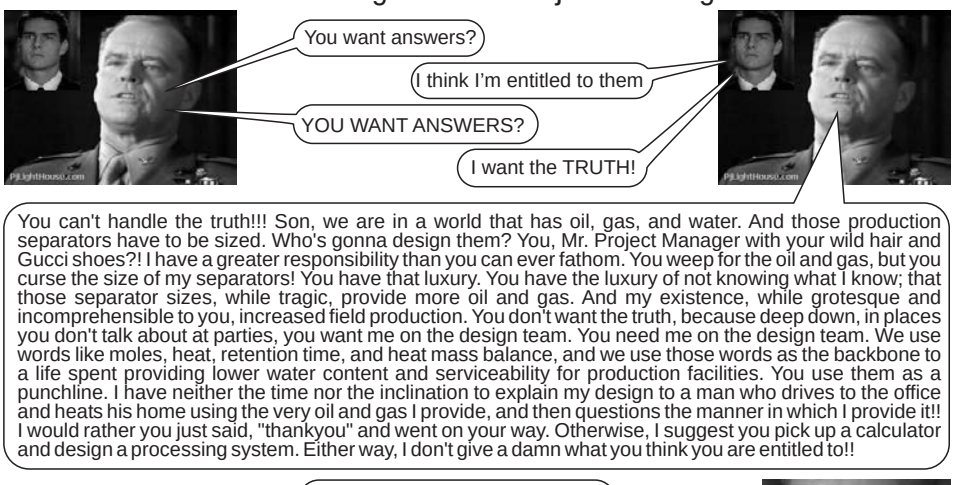
consequences of climate change will include increased likelihood of these heat waves.

Interestingly, Helge presented results from earlier climate models run at the turn of the Millenium and compared the results with the actual measured data now available, and showed that earlier models were underestimating the effects of climate change. Helge concluded with the adaptations necessary to human activity. The current EU-target is to limit the increase in global surface temperature to 2°C above that recorded in 1850. This is thought to require a minimum 50% cut in global emissions by 2050.

The Knowledge Session ended with a Question and Answer session which Helge expertly handled. The subject of the knowledge session was also referred to during the following day's Keynote Session, leading to some very tricky questions for the presenters.

Justin Alexander

Process Engineer v Project Manager



25th Anniversary Conference, Paris, France

The formal part of the 25th Anniversary Conference opened with an address by Bob Dunn, GPA President and four Keynote presentations. Summarised on the front page, the session was a great success. Our thanks go to the speakers (pictured below.)

Conference Keynote Speakers
Xavier Preel, Total; Halfdan Knudsen, StatoilHydro;
David Wells, Shell and Dave Simmonds, BG Nigeria

GPA US President Bob Dunn and past President Gene Thomas catch up with past GPAE Chairman and keynote speaker Dave Simmonds

Keynote Session Chairmen, Christine and Ed, chat with two of the speakers

It was appropriate that Total, a French company, was chosen to ensure the exquisite quality of the French Cuisine, as sponsor for the traditional Conference Networking Lunch. This event, along with the thoughts shared by the pre-lunch executive keynote speakers, formed a sound basis for the first traditional session of this 25th Annual Conference. The afternoon's first topic, Commercial Issues, was introduced by Session Chairman Sigbjørn Svenes of StatoilHydro, pointing out the challenges imposed on the industry in times of extreme price volatility including all time high prices and variations and the onset of a financial crisis.

The first paper of the afternoon was presented by Steve Robertson of Douglas-Westwood. His presentation entitled *Outlook for the Oil and Gas Sector, The Next 25 Years*, gave a comprehensive overview of current markets and long term trends for a broad spectrum of oil and gas industry related products and services. Steve started off describing general issues and trends regarding hydrocarbon source ownership and oil price, showing the reversal of share of ownership of resources from International Oil Companies to National Oil Companies and referring to statements by some companies of oil approaching the 250 US$ mark in the foreseeable future *(Editor's note - but that was in September 2008)*. He then turned to the natural gas sector specifically emphasising the importance of natural gas as a fuel of choice with a growth potential in the coming years whether it came as pipeline gas, LNG, GTL or CNG to meet local market shortages. In this sense he also noted the potential in recovering the vast amount of natural gas flared around the world exemplified by Nigeria still flaring more gas than its LNG production.

Steve Robertson

25th Anniversary Conference, Paris, France

Having set the scene with an energy hungry world led by the emerging economies in China and India, he outlined a bright future for suppliers within most sectors for the oil and gas industry *(Editor's note again - but that was in September 2008)* demonstrated by a forecasted 40% increase in expenditure within the global offshore industry. For future technology developments, subsea processing, arctic areas and biofuels were pointed out, before concluding that although there is a bright future, the challenges of access to skilled people, raw materials and key equipment items were still there.

Next on stage was Guy Maisonnier of IFP. The presentation, simply called *World Natural Gas Market Trends*, set out to review the major trends both on the product demand side and source of supply. The paper predicted a continued growth of natural gas usage, although at a slower pace than seen for the last decade or so. Growth is especially driven by the power sector, but level of growth is uncertain due to influences such as coal, which has a much lower base cost, and greater focus from consumers and policy makers on energy efficiency and management. Guy also focused on the impact from climate change policy and resources, noting that there is a scenario where the production of conventional gas could peak towards the middle of this century. To meet this challenge, a focus on technology is required to assist unconventional gas production, worldwide trading (LNG etc) and CO_2 capture. He rounded off by giving some thoughts on future international price trends as being governed by the Eurasian market and at price volatile levels perhaps seeing peaks around 50% above the higher bands seen in 2008 and before. Also the future increased dependency on unconventional sources would eventually lead to a higher minimum price of natural gas.

An attentive audience for the GPAE's 25th Anniversary Conference in Paris

Andy Flower, an independent consultant, mesmerized the audience all the way up to the coffee break with his paper *LNG, can Producers Respond to the Needs of Buyers?* Andy focused on the LNG chain alone, giving an analysis of current status and current trends within each part of the chain. He challenged the perhaps more optimistic view given by other speakers of the bright future of the LNG mega-trains. This was demonstrated by showing a current abundance in regasification capacity (50% utilization worldwide) and the shipping fleet increasing quickly and being made available for short term charters while liquefaction train capacity development was showing the signs of falling behind. Final investment decision levels have, for the past three years, fallen to 10-25% of the production capacity which were sanctioned in the early part of this century and lack of resources is being cited as a major issue for several delayed projects. Small scale production and floating LNG have been launched as possible means to fill the gap, but still these have to be commercially proven and the reserves have to be found to fill the demand which the market certainly calls for.

Sigbjørn Svenes

After the coffee break the programme moved on to the first of the technical papers. John Byeseda of Cameron gave an informative overview of the current state of the market in *Subsea Processing Technology, Systems and Applications*, covering multi-phase boosting, separation, seawater injection and compression. He then went on to present some interesting recent developments under the subject of enabling technologies. These included HIPPS (High Integrity Pressure Protection System), MARS (Multiple Application Re-Injection System) and the All-electric subsea production system. John concluded his presentation by summarizing his vision for subsea developments over the next 25 years.

Guy Maisonnier

Andy Flower

25th Anniversary Conference, Paris, France

Coffee break at the Rive Gauche

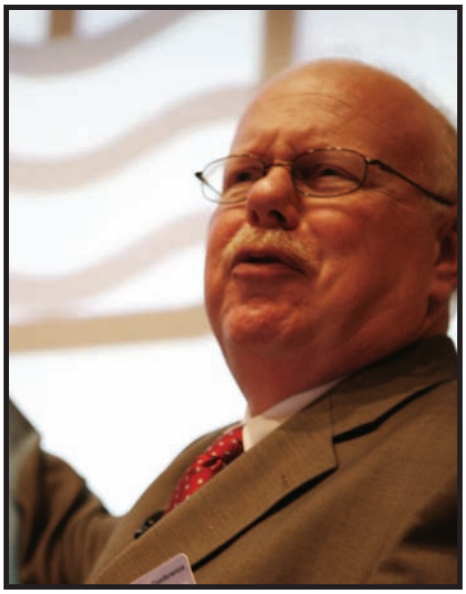
Nishant Gupta

Next Theo Klaver of Shell Global Solutions presented Shell's *Development of highly contaminated gas & oil fields, breakthrough CO_2/H_2S Separation Technologies.* The presentation began with a summary of the worldwide market for contaminated gas fields and gave economics as the main driver to develop more efficient separation processes in the form of three new technologies:

1 Condensed Contaminant Centrifugal Separation (C_3SEP) in which CO_2 is separated as a liquid in a device comprising a turbo expander, coagulation tube and a rotational particle separator.
2 Cryogenic Solid CO_2 Separation in which CO_2 is separated as a solid in a process consisting of a dehydration stage, a knockout stage, and finally a CO_2 separation stage.
3 Facilitated Transport Membranes in which CO_2 and H_2S can be separated from natural gas by the selective reaction with amine groups contained within the membrane. The inclusion of the amine groups within the membrane is the innovation leading to greater separation efficiency compared to current membrane systems.

The last paper of the day, *Start-up and operation of the Ormen Lange Flowlines,* was presented by Nishant Gupta of A/S Norske Shell, on behalf of authors Catherine Burns, Susan Lorimer and Micha Hartenhof, also of Norske Shell, and Torgeir Vanvik of SPT Group A/S. The Ormen Lange pipeline was brought into service in September 2007 and the presentation began by describing a number of the challenges that the project faced which included irregular seabed topography and sub-zero seawater temperatures. The method for bringing the flowlines into operation was described as well as feedback on the ongoing steady state operation. The presentation finished with a comparison of the actual performance in the field against the predicted performance during the design phase. The short number of questions at the end suggested that the delegates were looking forward to their Conference Dinner. *Simon Crawley-Boevey*

The first paper of the Friday morning session, chaired by André Le Gall and John Sheffield, was given by Michael Broadribb, Distinguished Advisor on Process Safety for BP International. This paper, *Three Years on From Texas City,* is a continuation of a presentation given by the author a few years ago in London, on the lessons drawn from the Texas City incident of March 2005. The executive leadership of BP has reviewed the fundamentals of the company's



John Byseda

Theo Klaver

Mike Broadribb

approach to process safety and operational experience; this evaluation has led to significant changes to improve safety and operations.
Some of these changes are already implemented, whilst it is also recognized that some in progress are still to be met and that the commitment of BP to continuous improvement will never really end.
The Independent Panel that analysed the Texas City incident gave recommendations that can be grouped under four main headings: Leadership (including executive management), integrated and comprehensive process safety management system, process safety knowledge and finally expertise and process safety culture. BP is going beyond the adoption of these recommendations in developing a long term plan to improving process safety management and safety culture around the 4 P's (Plant, Process, People, Performance).
The next paper, *A look Ahead to Proposed Changes in IEC 61508,* was presented by Clive de Salis from Rowan House Ltd, and is also a follow-up of numerous papers and knowledge sessions given by Clive on the subject of high reliability safety shutdown systems (or High Integrity Safety Instrumented Systems) covered by norm IEC61508/61511. Clive stressed the importance of competence throughout the entire chain of design, selection of components, installation and maintenance of any High Integrity SIS. This consideration is of paramount importance and will be added in the next revision of the current norms. Clive also warns against the apparent safeguard of having certified elements, or a certified expert, … This is not required by the norm, and could be misleading.
The first part of the morning session was concluded by a paper on the *Modernization of the Kårstø Gas Processing Plant*, given by Ola Trætteberg from Gassco AS, co-author Kjetil Ohm of StatoilHydro. The Kårstø gas processing plant is a keystone in the Norwegian oil and gas production system, processing and conditioning gas from more than 30 offshore fields. The current processing capacity is 88 MSm^3/day, with a production of NGL that makes this plant the largest NGL producing plant in Europe. The plant has been developed in phases in 1985, 1993, 2000, 2003 and 2005. After this period of expansion, focus is now made on upgrading and modernizing the oldest parts of the plant, to maintain safety and reliability, as well as compliance with the updated standards and regulations. Ola described the various projects under evaluation (Steam system projects, Process Control and Instrumented Safety Systems, Emergency Power Supply, …) and highlighted the methodology used to select the projects that will be part of the 1.3 billion US$ project sanctioned as KEP 2010.

André Le Gall

The final session of the Conference moved into the traditional areas of gas processing and kicked off with an intriguing insight into the control of turbo machinery, *A total intergrated approach*, presented by Nauman Islam of Compressor Controls Corporation (CCC), co-author Shaun Branley of ConocoPhillips Pty Ltd, Australia. Many of us are very familiar with the use of companies such as CCC to provide the control systems for compressors, but I suspect few really appreciate the true advantages. The primary objective of an Integrated Turbomachinery Control System (ITCS) can be summarised as preventing unnecessary process trips, downtime, disturbances and preventing damage from surge and overspeed. The system can then operate at the lowest possible energy level, minimise antisurge recycle and optimise load sharing between the machines. Compressor performance is limited by several constraints, including surge, process limits, speed, power and choke limits. The better the control system, the closer one can operate safely to these limits. It is also important to include all rotating machinery within the ITCS, including the GT drivers and turboexpanders. Nauman illustrated his concepts with reference to their application on the Bayu-Udan off-shore NGL extraction plant.

Ola Traetteberg

Clive de Salis

A chance to chat over coffee

25th Anniversary Conference, Paris, France

Bob Hubbard

The Conference then welcomed back Bob Hubbard of the John M Campbell Company who presented a paper on *Developments in Gas Dehydration*. The paper was co-authored by Paul Clinton of Shell Global Solutions, whom many will remember for taking us through the Chemical Engineering principles of TEG contactor design. Bob traced the history of gas dehydration from the early applications in low pressure distribution systems through to the requirements for high pressure transmission systems and for NGL extraction and LNG production. He focused on glycol dehydration as the most widely used natural gas dehydration process world wide, with TEG being the most widely used solvent, since its higher boiling point permits a higher regeneration temperature. In order to achieve the lowest possible water content, several innovative improvements have been made over the years including the use of stripper gas, the DRIZO process using a solvent to provide the stripping gas, Coldfinger, which reduces the water content of the glycol and the application of structured packing in the absorber column. He noted an increasing focus on the environmental issues associated with BTX emission and energy consumption. More recent developments highlighted are those like Vortisep and Twister which rely on available pressure drop to create a high level of centrifugal force to separate water and hydrocarbons. As for the future, there is an increasing need to dehydrate sour gas systems for either processing or reinjection, so there is a pressing need for better physical property data to facilitate the design process.

The final paper of the Conference, *Marine CNG - The Evolution of a New Natural Gas Technology*, was presented by Michael Hanrahan, MD of The Centre for Marine CNG, Newfoundland. The development of Compressed Natural Gas (CNG) technology as a means of transporting gas by sea has been under development for more than 10 years. The driving force has been to develop a robust technology that could be used to exploit stranded gas reserves which are believed to account for more than one third of the known gas reserves. Essentially the production technology required is very simple and relies on proven systems; it is the storage system that has proved to be the focus of the development efforts. There are six proponents offering concepts which vary from coiled steel tubes, steel bottles and composite bottles, and various ways of

Michael Hanrahan

integrating these into ship or barge hulls have been developed. Whilst the process is simpler and less costly than LNG, the quantity of steel involved, resulting in high ship weights, means that the economic shipping distance is currently seen as 1-2000 miles and is most applicable for small volumes (1 BCMA). Progress to date is that several concepts have Class Approval from ABS, DNV and BV; so far the economic arguments have yet to succeed. As has been found many times in the development of a Gas Project, one must have a business case as well as a sound technical solution.

So this ended a most successful Conference and one worthy of being the 25th for the European GPA, living up to the high standards of technical content and presentation as well as the spirited participation of the audience.

John Sheffield

Putting a key question

25th Anniversary Speakers and Session Chairmen

Networking Report, Sept 24th-26th, Paris

Network opportunities abound in the Rive Gauche Hotel for sponsoring corporate members and all delegates.

As our corporate members well know, if space permits they are allowed to display promotional leaflets at our conferences. Many companies consider our conferences as important events to be included in their promotional calendars and for this reason we offered our members the opportunity to sponsor certain activities at the 25th Annual Conference which were tailored to the sponsor's own requirements or company profile. Event sponsorship was even shared by like minded companies.

Sponsorship was recognised and acknowledged by company name and logo on our publicity material, pre-conference (programme and sign up forms) and conference materials. We also acknowledged sponsors throughout the conference itself and in "In Brief". Hyperlinks to sponsors websites were inserted on the GPA Europe website which promoted the company and further acknowledged the contribution to our event.

Sponsor companies were allowed to erect "pop up display boards" and "self standing display panels" in a large area right outside the meeting room and, in fact, a Mini Exhibition scene was created. All coffee breaks were taken in the area and conference delegates milled around, swapping ideas and information and it was also a focal point both before and after the Technical Sessions. Social events, which also provided many opportunities to network, were again sponsored. These included the Welcome Reception, Conference Lunch and Gala Dinner, as well as breakfast each day served in our own private room.

A opportunity for networking during the breaks at the Conference

Gas Processors Association Europe is a non profit making organisation and our income from the sponsorship enabled us not only to keep our conference fees to a low level but also helped us to provide the Knowledge Session which was free to all Corporate Members, their staff and all Individual Members.

Our meetings bring together policy makers, corporate leaders, senior engineers and commercial staff from the whole of the Energy Sector and we regularly attract delegates from all over the world. This provided an ideal opportunity for networking and relationship building. From the feedback received we certainly hope to continue providing better networking opportunities at future conferences.

Don Cooney

Dawn Aungier presents the Aungier Award to Soufyane Teffahi

George Cheriyan receives the Best Paper Award 2007

Paris 2008 Conference Sponsors

25th Anniversary Celebration brings eight Past Chairmen out of "retirement"

Soft music to accompany dinner

25th Anniversary Conference, Paris, France

Companions' Tour

Hallelujah, the sun is shining, and we began the day with a visit to the Château de Versailles. Because of our large numbers it was necessary to split our group and have two tour guides. The division was made easy by those taking advantage of an early loo stop and those not - so far so good.

However Kitsch, it would seem, had arrived in Versailles with an exhibition by the American artist/sculptor, Jeff Koons. A giant red aluminium lobster hangs where the chandelier used to be in the Salon de Mars: a trio of Hoovers in a Perspex box has pride of place before a portrait of Marie Antoinette and the Hall of Mirrors has a new addition: a round petrol-blue convex reflector simply called "Moon". Is Versailles going to the dogs…?

Versailles decoration - from the sublime...

...to the ridiculous!

...Jeff Koons' bright balloon dogs - not to mention a pawing Pink Panther and a gold dipped Michael Jackson and his chimp, Bubbles. We were not only divided into two groups, but equally divided in our views, some shocked by this invasion of so magical a place as Versailles, with others seeing a "sense of unity". Food for thought soon turned to thoughts of lunch.

Reluctantly we left behind the sunshine and gardens of Versailles and headed for La Maison Fournaise, a restaurant and museum located on the Ile des Impressionnistes in Chatou, west of Paris. In 1857 Alphonse Fournaise bought land there to open a boat rental, restaurant and small hotel.

The Companions visit Versailles

The restaurant was a favourite of Pierre-Auguste Renoir who painted scenes at the restaurant including "The Rowers' Lunch" in 1875 and, from its balcony overhanging the river Seine, "Luncheon of the Boating Party", as well as several portraits of Fournaise family members and landscapes of the surrounding area; it is a familiar place to art lovers all over the world.

After a lingering lunch, and by now well behind schedule, we made our way hastily to the Rodin Museum passing by many famous landmarks and witnessing the first Christmas lights being assembled in the Avenue des Champs-Élysée. Well after all it is nearly the end of September!!

At the Rodin Museum we wandered indoors and outdoors as the spirit moved us, some preferring the gardens with The Thinker, The Burghers of Calais and The Gates of Hell, etc, and others going indoors to see his early works and sculptures such as The Kiss.

Perfect location for lunch

The Companions' Tour meet Renoir

5.00pm and one last thing to look forward to now: return to the Marriott Rive Gauche for a relaxing soak in the bath before the Gala Dinner. But would there be hot water, unlike yesterday when the district heating system was being repaired and we were without for much of the day? Our worries proved unfounded and hot water poured forth (hallelujah)!

Wendy Cooney

After a hard day sightseeing, bed looks a good option!

London Knowledge Session - Underground Gas Storage

The November one-day meeting tradionally combines the AGM with Technical and Knowledge Sessions.

Garth Raybould and Evan Passaris of Atkins Design and Engineering Solutions provided an excellent presentation of the issues associated with the creation of underground gas storage systems. These included analysing the risks and the design issues that need to be considered in what, to many present at the session, appeared to be a black art.

Garth began the morning with a discussion on the need for gas storage, pointing out that the UK in particular when compared with their European neighbours has a significant shortage of facilities to store gas to meet shortfalls. The UK has only 4 bcm of storage compared with an annual consumption of 103 bcm (4%), whilst France has a storage level of 24%. He pointed out that with the cyclical nature of gas prices, and the increasing reliance of the UK and other European countries on the import of this critical energy source, gas storage is essential in order to even out the demand and supply pattern and make allowances for future shortages.

With the exception of Liquefied Natural Gas storage, and high pressure gas storage above ground, he outlined the four main methods for underground gas storage, namely, salt dome cavity, embedded salt caverns, depleted fields and aquifers. Salt domes and aquifers are not common in the UK but much work is proceeding on increasing the available storage capacity by using depleted reservoirs and by creating cavities in embedded salt layers. Embedded salt layers are generally not as deep as salt domes, but do provide sufficient depth to allow the creation of large cavities and have been used over many years for petrochemical and LPG storage in the UK. Salt caverns can be up to 100 m in diameter and almost 200m high. In salt domes even larger cavities can be created.

The UK's largest existing natural gas storage facility, the Rough Field offshore Lincolnshire, is a depleted reservoir application. Critical to the selection of a suitable depleted reservoir is consideration of the permeability of the field, which Garth emphasised, was not the same as porosity. Permeability defines the speed at which the field can be filled or emptied of gas; usually if the original oil or gas has been extracted easily, the field is generally suitable for gas storage, but depleted reservoirs are generally more suitable for the storage of gas on a seasonal basis. Salt caverns, with their much greater cycling rate, are most suitable for daily or weekly cycling.

Garth then went on to discuss permitting issues associated with seeking permission to install an underground gas storage facility. Planning permission is required for most onshore facilities from the local authority and from the Crown Estates for offshore salt cavern developments. In the case of depleted reservoirs, the Gas Act of 1965 can be applied which can effectively bypass local objections, especially if the field has been subject to enhanced oil recovery by gas injection. Hazardous Substances Consents are usually required for the above ground installations.

The subject brought Garth on to the issue of risks associated with underground gas storage and he pointed out that many developers and permitting authorities have been quoted as stating that underground gas storage is risk free. Garth discussed a number of issues that must be considered to ensure that the gas will indeed be contained.

In the case of depleted reservoirs, there is a risk that overfilling of the field may allow the stored gas to migrate beyond the cap rock to other parts of the field where fault lines may allow the gas to seep to the surface, or indeed be lost. In the case of salt caverns, over pressuring may cause the salt cavern to fracture and allow gas to escape through fault lines in the overburden. Garth pointed out that previous field information may not be a guide to future performance. Depletion of fields may cause subsidence and fracturing of the geological structure, changing the geology of the field and developing routes of migration for the gas.

In order to ensure that the facility is acceptable for use as gas storage, a range of studies are required to determine the geomechanics of the field and the overburden and ensure that the complicated structure of the rock formation is in fact suitable. Development of this static model will be based on whatever information is available such as gas production history, reservoir geology and reservoir dynamics. Garth made the point that there is never enough information available and work needs to be done to match the theoretical assessments to empirical evidence to come to the best conclusions available.

Garth Raybould

Failure to carry out a suitable assessment can lead to catastrophic results and Garth referred to the Yaggy Incident in Kansas in 2000. A salt dome, previously used for liquid storage, was converted to a gas storage facility. A failure in the piping leading to the salt dome resulted in gas migrating through the overburden some 10 miles from the storage site where the gas came to the surface and exploded, causing considerable damage and two deaths in a trailer park. This, he pointed out, was the only known case of death associated with underground gas storage, but served to emphasise the need for caution and careful examination of the geological issues before commencing operation. In summary, expect the unexpected.

Garth concluded his presentation by offering some fascinating insights into the behaviour of fault lines, often cited as a major possible migration path. In fact, whilst untrained observers might consider that fault lines are perfect planes of rock sliding over each other, this is not the case and the natural curvature between faces of the fault will cause the faces to grind against each other developing a fault gouge with particles of rock between the faces. In the presence of clay, this material can significantly decrease the permeability of the fault and indeed seal the fault.

After a break for coffee, Evan Passaris presented information on the geomechanics of gas storage in salt caverns. Salt caverns are generated by washing out the salt bed with a flow of fresh water, which is enriched with salt as it flows through the cavity and returns to the surface as brine. This brine is then disposed of in rivers or estuaries or is injected into suitably deep rock formations. Two methods of solution mining are used, direct and indirect, the use of each determining the ultimate shape of the cavity created. Sonar logging of the cavern as time proceeds assures that the desired shape is developed and that the cavity will be sufficiently gas tight in operation.

The Marriott Marble Arch is becoming a reliable regular London venue

London Knowledge Session - Underground Gas Storage

Detailed review of the salt formation is necessary before solution mining commences to ensure that the salt is suitable. Rock salt is the perfect material for gas storage as the material exhibits visco-plastic behaviour which allows it to "self-heal" in the event of micro-fracturing. The key to optimising the cavern performance is in determining the minimum allowable pressure that will limit microfractures from coalescing and growing uncontrollably. Laboratory tests to determine the compression and tensile strengths of the material are necessary to ensure that under operation, the cavity will be sufficiently robust.

An important aspect of the design of the cavity is also to consider the effect of temperature. When gas is pumped into the cavity, the temperature will rise and when gas is withdrawn, Joule-Thompson mechanics will result in a depression of temperature. Evan pointed out that traditional thinking would assume that the cavity would expand on heating and contract on cooling. In fact the opposite is the case. The linear thermal expansion of rock salt is very high so the rock salt formation around the cavity changes dimensions causing the cavity to contract under heating and expand on cooling! The data developed in laboratory testing is used to develop a numerical analysis of the design of the cavity and enables a detailed review of the possible stresses on the cavity surrounding to be calculated, thus ensuring that correct cavity design can be developed and solution mining methods adjusted to achieve the objective.

Evan also discussed the long term issues associated with ultimate decommissioning of the salt cavity. Current thinking is that the cavity would be filled with brine and slowly allowed, over geologic time, to close, but more work is required to determine the equilibrium balance and the ultimate fate of the remaining brine.

When considering the design and suitability of Depleted Reservoirs for gas storage, similar considerations must be taken into account with the maximum operating pressure depending on in-situ geostatic stresses, stresses induced by pressure changes in the reservoir and the mechanical properties of the reservoir and surrounding geological material. As noted by Garth earlier, previous history of the operation of the field can assist in determining the maximum pressure that can be used, but further review to ensure that the overburden is not compromised and does possess the necessary integrity to contain the gas is essential.

Evan Passaris

Sandy Dunlop

London Technical Meeting - Gas Storage Issues

Following on from the 'Introduction to Gas Storage' in the morning, an excellent lunch and opportunity to converse with colleagues and our AGM, the afternoon Technical Session 'Gas Storage Issues', chaired by Lorraine Fitzwater, opened with some 96 attendees.

Hans-Guenter Behrendt and Dirk Heyer from PSE Engineering opened the afternoon session with a joint paper covering *Caverns - Big Tanks in the Salt* and 'associated Compression Systems'. Hans-Guenter took us through developments and challenges for the sub-surface and surface facilities as well as the current European gas storage situation. For example, salt caverns take some 2-2.5 years to leach; require a volume of water some 7 times the cavern volume; and a Leaching (Surface) Facility comprising pumping station, blanket gas facility and settling basin. The largest caverns today are up to 600,000m^3. Overall, a new project will take some 3-5 years to operation. Production facilities comprise gas drying and compression. Dirk then compared the possible compression systems stressing that a flexible and stable configuration is necessary to handle the varying range of flow, suction and discharge conditions. With the transition of 'gas storage' to its potential in the gas trading market, reciprocating compressors have been selected for a number of new storage projects.

The second paper of the afternoon was from Dominik Uznanski from Gaz de France Suez with the innovative *Lined Rock Cavern (LRC)*® technology. The LRC allows storage of natural gas under high pressures in caverns excavated in

Business continues over lunch

Hans-Guenther Behrendt

London Technical Meeting - Gas Storage Issues

Dirk Heyer

Mike Healy

solid rock at a shallow depth. Each cavern is equipped with a steel liner, which serves as an impermeable container for the gas. Thus the surface facility does not need gas treatment facilities such as dehydrators. Dominik outlined the progression of R&D, testing and industrial implementation, carried out by GDF SUEZ and E.ON Sverige from a 125m^3 cavern pilot plant to the Skallen LRC demonstration project in southwest Sweden at 40,000m^3 which has been in commercial operation since early 2004. LRC technology has a number of potential advantages including: location where there are no traditional underground storage formations, high working gas volumes (near 90%), and gas can be injected and withdrawn frequently to answer peak-shaving needs. Additionally, novel applications of the technology are being developed including a compressed air energy system, in which the LRC storage allows a timely and cost efficient production of electricity using air turbines. GdF SUEZ is now looking to implement the LRC technology commercially worldwide.

The final paper of the afternoon *Underground Storage in Cheshire: the Costain Experience* was presented by Mike Healy from Costain Oil, Gas and Process. Mike outlined two large underground salt cavity storage projects in Cheshire. The salt cavities have been leached specifically for the projects. In Cheshire, the brine from leaching is used as a chemical feedstock and thus affects the project economics as well as limiting the leaching rate. Operational aspects of the storage cavities were discussed. Gas from the NTS is injected into the cavern dry, however moisture from the caverns needs to be removed before the gas is reinjected into the NTS. With varying moisture content, and temperatures within the cavern and pipework dependent on storage time and depth, hydrate control is necessary. Selection of the hydrate control method involves an evaluation of capital and operating costs. At 600m storage depth, the storage pressures straddle the NTS pressure requiring gas compression for injection and withdrawal. Finally, planning, regulatory requirements and environmental aspects for the projects were discussed.

The afternoon session ended with the audience enthusiastically showing their appreciation for all the speakers and we once again would like to thank them for their contribution to the GPA Technical Conference. *Lorraine Fitzwater*

Justin Hearn thanks Ed Bras for his two years as Chairman

Martin Meyer receives the Best Paper Award for 2006 from Ed Bras

Martin, of KBR presented his paper, *Egypt's LNG Project Establishes new Industry Benchmarks,* at the Antwerp Technical Conference. The paper was co-written by Gonzalo Fernandez of SEGAS, Ricardo Villanueva of Union Fenosa Gas and Don Hill and Charles Durr, also of KBR.

Dominick Uznanski

London Meeting Presenters and Session Chairmen

GPA Europe Chairman's Report 2008

Ladies and gentlemen, colleagues and fellow members of the Gas Processor's Association, Europe. It is my pleasure to make the Chairman's presentation to the 2008 Annual General Meeting. 2008 was another excellent operational year for the GPA Europe. In summary, financial figures are very healthy (more about that later), membership numbers are up and we held three successful conferences and of course there is one in progress.

The Management Committee held five meetings this year to ensure smooth operation of the GPAE activities. From this place I would like to thank the members of the Management Committee for their work and commitment during the year. I also would like to thank the members of the Programme Committee who prepared the various events we had during the past year. I have talked to many people about our conferences, including people from outside Europe, and they speak highly of our events and unanimously agree that the quality of our technical papers is outstanding. Although the Programme Committee make the final program selection, of course this not entirely the work of the program committee. In the end of the day the papers are being produced by you, fellow processors. We have this year been in a luxurious position of having more papers than timeslots, so we had actually something to choose. This is thanks to you. I believe that as a gas processors community we are doing very well in having four conferences packed with papers and presentations each year.

Whenever there is an issue cropping up during our mancom meetings that is too delicate or difficult to deal with, we pass the hot potato to a sub committee. I would also like to thank the sub committee members who put in some extra time.

We had four resignations from the Management Committee this year. First Ron Coultrup and Christine Etherington, who served for many years in the GPA and we all know very well since they were almost always present during our events. Colin Biggs, also with a long history in the GPA, has had to step down, because of health problems. Finally Phil Hagyard had to leave us since he moved on to a different job and it was impossible to combine that with GPA activities. I would like to thank those individuals for their effort and support to the GPA over the past years.

Ed Bras recognises the dedicated service of retiring committee members Christine Etherington and Ron Coultrup

The retiring Treasurer and Chairman guide the AGM

Just a little about our events that we held this year. We kicked of with our February meeting in Amsterdam, which had the theme of "Treating your Gas". The meeting was well attended by 104 members. Traditionally we also had a knowledge session, attended by 70 delegates, which gave us an overview covering early production facilities for the oil & gas processing industry.

In May we went to Ashford and the conference had the title "What's new in LNG". Although the location was a bit more difficult to reach, the conference, interesting site visit and of course our GPA golf tournament drew a good crowd of 80 delegates to the event, which was above average for a May meeting.

Then the highlight of the year, or should I say the highlight of the past 25 years was our Anniversary Conference in Paris. The theme for the Paris Conference was an overview of Gas processing over the years and some vision of what the future may bring. A record number of 197 people attended the conference and I am sure that those who attended will agree with me that it was a great event and, looking at the scorings, I conclude that the papers were of a high standard. The knowledge session, which was attended by 126 delegates, discussed 'Climate Change' and presented us with some doom scenarios of what could happen if we do not act. The gas industry is acting and I know that a large number of us work on GHG related projects. Whether the action is enough remains to be seen. The formula of having keynote speakers followed by a panel session proved to be a great success and it brought an extra dimension to this special occasion. Keynote speeches were delivered by senior representatives from StatoilHydro, Total, Shell Gas & Power and the BG Group. We are studying the idea of using keynote speeches again at our next Annual Conference, albeit in a slightly different format. We were also pleased to have the company of representatives of the GPA US, Johnny Dreyer - GPA Staff, Gene Thomas and Bob Dunn, former and current President of the GPA US. Bob was kind enough to deliver an opening speech at our Annual Conference.

Membership numbers are rising and we have now 114 corporate and 228 individual members, which are about 4% up from last year's figures. Since last year we have included a "Premier" membership level that has been taken up by 19 companies compared to 12 last year.

Before I close my report I would like to thank Don Cooney and his wife Wendy for their outstanding work to ensure that our events, conferences as well as all the other meetings we have had, ran smoothly. I am sure everyone agrees with me that they have succeeded extremely well. One last remark: keep an eye open for our conferences next year, we have a lot of very interesting places we will be visiting.

I have been Chairman of the GPA Europe for two years, which means that I will, at the end of the AGM, hand the mantle of chairman over to my successor, Justin Hearn. Ladies and gentlemen, I would like to thankyou for your continuing support of the Gas Processor's Association Europe. It's your Association and I and the other members of the Committee feel privileged to be able to represent your interests in the operation of the GPA Europe. *Ed Bras*

New Corporate Members

Welcome to our new Corporate Members up to 31st Dec 2008

Level 1 PREMIER

PALL CORPORATION, Portsmouth, UK

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Level 2

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The Centre for Marine CNG Inc. is the world's first research and development corporation for large-scale marine transportation of compressed natural gas. The Centre is located in St. John's, Newfoundland and Labrador, Canada, and brings together oil and gas companies, shipping companies, class societies, regulators, technology proponents, scientists and governments, all focused on innovation in the field of compressed natural gas.

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OFTSL is a global oilfield consultancy, providing specialist technical services in process, production chemistry, and environmental support to oil and gas asset operators and related organisations.

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Rowan House Limited, West Midlands, UK

Rowan House Ltd is an independent consultancy established in 1990 that has expertise in process plant design, control and safety, providing a national UK service

Technical staff are graduate engineers with operations and consulting experience. All are members of IChemE subject groups and are committed to the Institution's professional development programme. These are individuals whose leadership, expertise and experience is widely recognised in their respective disciplines.

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Call for Papers

For 2009 Conferences...

May, Sitges, Spain – Sour Gas Processing,
September, Venice, Italy – Open Theme Conference
November, London – Multiphase Pipelines

Papers on any aspect, technical or commercial, of the gas processing industry are requested and contributions from both operating companies and suppliers will be particularly welcome.

Papers may be offered by both members and non-members. Interested parties are requested to provide a title and abstract (100-200 words) as soon as possible. Please include your full mailing address, e-mail address, phone and fax number.

Paper selections will be advised in good time to enable preparation of the paper. Details for the presentation will be given to the speaker after the selections are made. Abstracts and other information should be sent to the Administration Office:

GPA Europe, 10 Shetland Way, Fleet, Hampshire GU51 2UD
email: admin@gpaeurope.com
facsimile: 01252 786260

The Officers of the GPA Europe for 2009

Chairman:	Justin Hearn (BASF SE)
Deputy Chairman:	David Weeks (M W Kellogg Ltd)
Hon. Secretary:	Jon Lewis (WorleyParsons)
Treasurer:	Martin Mayer(CB and I)

Management Committee members

Nicholas Amott	Fluor Ltd
Ed Bras	Shell Global Solutions Int BV
Jean-Claude Garcel	Total
Sandy Dunlop	Costain Oil Gas and Process
Adrian Finn	Costain Oil Gas and Process
Tim Goodhand	WorleyParsons
Malcolm Harrison	Foster Wheeler Energy Ltd
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Paul Seccombe	Invensys Global Solutions
John Sheffield	John M Campbell & Co
Christian Streicher	Prosernat
Sigbjorn Svenes	StatoilHydro ASA

Ex-officio members of the Management Committee are:

Membership Secretary:	Vacant
Programme Committee Chairman:	Lorraine Fitzwater, Petrofac Engineering, UK
Immediate Past Chairman:	Ed Bras Shell Global Solutions International, Netherlands

Best Paper Award 2008

During 2008, the GPA Conferences covered a wide range of topics, and with some 36 papers presented during the period, ranging from Gas processing, LNG, market trends, HSE and Cavern Storage, there were many excellent papers to chose from. The GPA Best Paper award is selected by the GPA Europe Programme Committee on the basis of both Technical Content and Presentation.

The award for the Best Paper 2008 is made to Eddy Wheeler of CB&I with the paper presented at the GPA May Conference in Ashford, *Isle of Grain: From Peak Shaving to LNG Import*. This paper provided an introduction to the Isle of Grain LNG Terminal, the venue for the conference Site Visit. Eddy described the history of the site, located in a sparsely populated area, 60km east of London at the confluence of the Thames and Medway rivers and close to deep water. A refinery built on a 4 km^2 site was dismantled in 1982. The same year a small peak shaving LNG plant became operational nearby. This grew to one of the largest peak shaving facilities with up to 410 t/d liquefaction capacity, four 50,000 m^3 double wall storage tanks and regasification of 660 t/h. As the North Sea began to decline, the location and existing gas export infrastructure made it a good location for National Grid's UK LNG import terminal. The proposed facilities included a 3.3 mtpa Import Terminal and refurbishment of the four LNG tanks and other new facilities, with the first LNG cargo arriving in 2005. The challenges of expansion of an operational site were presented together with working around the protected water vole population. With increasing UK gas demand, the next phase being constructed for startup in 2010 comprised three new 190,000 m^3 LNG tanks, the world's largest above ground full containment systems.

This award will be presented at a GPA Conference later in the year.

FORTHCOMING EVENTS

18 - 20th February 2009
Marriott Marble Arch, London, UK
Offshore Processing
- Wednesday eve Welcome Reception
- Thursday all day Technical Meeting
- Evening Conference Dinner
- Friday am. Knowledge Session

13th - 15th May 2009
Dolce International Hotel and Conference Centre, Sitges, nr Barcelona, Spain
Sour Gas Processing
- Wednesday pm. Registrations
- Evening Welcome Reception
- Thursday all day Technical Meeting
- Evening Conference Dinner / Barbecue
- Friday am Site Visit to BASF Catalyst Facility, Tarragona, Spain

23rd - 25th September 2009
Hilton Molino Stucky, Venice, Italy
26th Annual Conference
- Knowledge Session
- Technical Sessions
- Conference Dinner
- Possible Site visit to Porto Marghera Refinery

19th November 2009
Marriott Marble Arch, London
Multi Phase Pipelines
- Knowledge Session
- AGM
- Technical Meeting

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GPA EUROPE

CORPORATE MEMBERS

This listing of current Corporate Members represents the status as at the end of December 2008. All companies are UK based unless otherwise stated.
In addition there were 224 Individual Members

Corporate Level 1 PREMIER (19)

Advantica Technologies Ltd		**M W Kellogg Ltd**	
BASF SE	**Germany**	**Pall Europe**	
Bechtel Ltd		**PBG SA**	**Poland**
BP		**Shell Global Solutions Int BV**	**Netherlands**
Compressor Controls Corporation		**Snamprogetti SpA**	**Italy**
Costain Oil, Gas & Process Ltd		**StatoilHydro ASA**	**Norway**
Fluor Ltd		**Technip**	**France**
Foster Wheeler Energy Ltd		**Total**	**France**
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Lurgi AG	**Germany**		

Corporate Level 1 (31)

ABB Engineering Services		Koch-Glitsch (UK) Ltd	
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Bryan Research & Engineering	USA	Peerless Europe Ltd	
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Centre for Marine CNG	Newfoundland	Perry Equipment Ltd	
Criterion Catalysts &		Pietro Fiorentini	Italy
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Corporate Level 3 (7)

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Infochem Computer Services Ltd	Rowan House
McMurtrie Limited	Softbits Consultants Ltd
OAG Energy Consulting Ltd	

Academic Level (1)

NTNU	Norway

Please persuade your company to join the GPA Europe and help support our activities.

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