IN BRIEF

ISSUE 2 SEPTEMBER 2012

GAS PROCESSORS ASSOCIATION EUROPE

SHALE GAS – A FUTURE IN EUROPE?

The sudden emergence of shale gas in North America has, in that overused term, been called the "game changer" in energy of the 21st century. Perhaps a preferable term to use is "inflection point" meaning almost everything we once knew about natural gas supply and demand has changed completely.

Until now, Europe has not been considered prospective for any significant hydrocarbon resources but the experience since 2004 in the United States shows the potential for a rapid reassessment. An excellent example was the emergence of the Marcellus Shale formation centred in Pennsylvania. As recently as 2006, it was thought to contain 4 Trillion Cubic Feet or 113 Billion Cubic Metres. It is now estimated to be the second most prolific gas field in the world at 400 TCF or 11.3 trillion cubic metres.

Image courtesy of Cuadrilla Resources

Although each shale "play" is slightly different, there is no geological reason not to expect similar resources are widespread in Europe.

As recently as 2006, the US was so concerned over security of supply in natural gas that several LNG import terminals were planned or even built on both coasts in the US, Canada and Mexico.

Even if shale gas development outside North America is not as rapid, the sudden subtraction of demand from North America, which consumes 27% of all natural gas entirely disrupts the economics of LNG, and is already lowering gas prices in Europe as a result, before so much as a molecule of shale gas has entered commercial production.

The shale revolution in the US has seen a parallel disruption to ethane and liquids markets, completely disrupting a conventional wisdom of US chemical industry in decline. On the contrary, the feedstock base of the US now makes it the most competitive in the world and we see what was thought unthinkable: new crackers in the heart of Pennsylvania and mothballed Gulf of Mexico capacity returning.

The US, and especially British Columbia which recently discovered the Liard Shale – even larger some say than the Marcellus, will from 2015 have significant exports of LNG that will inevitably lower prices and almost certainly break the price link to crude oil even in Japan, the market for one third of world LNG.

This could mean Europe will be swamped with LNG from the US Gulf Coast and possibly East Coast terminals near the Marcellus, all while traditional suppliers such as Qatar and Algeria still have plenty of gas to export.

But the true economic prize would be the development of our own shale resources in Europe. Judging by the North American experience, shale gas is easy to find, but hard to access, the opposite of conventional gas and oil. What if we could find gas in Europe? Twenty eight per cent of European gas comes from Russia at a rough cost of €40 billion a year and another €30 billion is spent on LNG imports. Imagine the economic potential of both removing those totals from the balance of payments and adding half of those figures in royalty revenue. The question is why is Europe not appearing in any rush to develop shale.

We're only in the first stages of exploration in Europe. The most advanced activity is in Poland and the UK, but significant geological potential is there in the three key markets of France, Germany and Spain. With shale reserves also noted as far apart as Denmark, Ireland, Switzerland and Ukraine, it appears almost every country in Europe has the potential for significant, if not total, security of supply in natural gas.

Shale resources in the hundreds of TCF are under assessment in Argentina, Australia and the true prize, China. Some observers believe that China has even more shale gas than the US, a development sure to usher in what the International Energy Agency calls "The Golden Age of Gas".

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Already in North America shale has gone from negligible amounts ten years ago to a third of production today, and the big issue is not supply but demand. Sources in the United States advise that even with what were only recently considered far-fetched developments such as total replacement of coal in generation, the "in-shoring" trend in chemicals and a roll out of Natural Gas Vehicles in trucking, there will still be surplus gas at moderate prices for decades to come.

More significant still will be a development even more tantalizing for Europe. The same hydraulic fracturing and lateral well techniques that unlocked gas are now working their magic in oil production, with North American oil independence predicted for 2020 or sooner according to a Citi report *Energy 2020 North America the new Middle East*, from March 2012.

Exploration companies are being even cagier about shale oil potential in Europe than for gas, but the Paris Basin is thought to hold billions of barrels of "tight" oil. The French basin has many geological parallels to the Bakken Shale of North Dakota. As recently as 2008, the conventional wisdom was of an exhausted oil field producing less than 10,000 barrels a day. This year North Dakota exceeded 500,000 barrels a day, making it a larger producer than OPEC member Ecuador. It then went to produce 620,000 barrels a day three months later. Whispers are of similar potential in Germany, Poland, the UK and Spain.

Numerous studies, as well as the experience of several hundred thousand wells in the US, show the risks of shale are nowhere near the widespread and severe ecological damage pretended by some opponents. Let's also be clear: The opponents are not only proponents of renewable energy, and many traditional green organizations are ahead of their base in seeing the benefit of immediate and substantial carbon reductions via natural gas. The quieter opponents who stress that shale is in some way "controversial" often include other generation technologies who see that the entire European energy conversation has until now been based on expensive and insecure natural gas makes their proposals appear affordable.

What we need in Europe is recognition that the facts have changed. Renewables especially have little to fear as they always needed to depend on natural gas for back up under present technology that cannot store meaningful amounts of power. Cheaper natural gas, which is used to back up the almost 70% of the time wind or sun is not providing power, actually makes renewables cheaper overall.

The French have a saying that Europe needs to take note of: "We may not have any oil, but we have ideas". Let's think of how Europe could change so much for the better if we could say "We have natural gas and we have ideas"

Report by Nick Grealy

Nick Grealy publishes the www.nohotair.co.uk web site which has been promoting the benefits of safe extraction of shale gas since 2008. He has a twenty year history in the energy industry and describes himself as a "recovering energy consultant". He believes that the greatest energy risk end users face is to get talked into believing they have one. Unfortunately, it's difficult for a consultant to make money telling people there are no problems.

Nick Grealy

VIEW FROM THE TOP

SHAREHOLDER OFFERS – BEWARE

By David Weeks, Chairman, GPA Europe

It is not my wish to turn In Brief into a consumer affairs magazine, but a series of telephone calls and emails which I received last year are worthy of a mention in this column, if only as a possible warning to others for the future.

One evening in late November, 2011, I reluctantly answered my telephone expecting yet another 'cold caller' who had somehow bypassed my home block on unknown numbers. I was not disappointed!

With an American accent this 'cold caller' politely greeted me and introduced himself as Michael Grey, claiming to work for the New York offices of a large mergers and acquisition company. Mr Grey said that he was fronting the hostile takeover of a major Oil and Gas company on behalf of an unnamed client. He stated that he already had a commitment for 43% of the shares in the Oil and Gas major from existing corporate shareholders and that his client required only a further 8% of the shares to become the majority stakeholder. The remaining 8% of shares was being sought from smaller share holders, of which I happened to be one.

I was asked if I would be interested in committing to sell my very small shareholding in this company for a substantial premium above the current quoted market value of the shares. Intrigued, I of course said 'yes'. Grey explained that, due to the sensitivity and secrecy of this deal, he could not inform me of further details without my signature of a Non-Disclosure Agreement. The legal-looking NDA arrived by email in early December and I duly read, signed and returned it three days later. The NDA obligated me not to discuss with, or disclose to, anyone any details and to maintain complete secrecy about the proposed deal for a period of six months from the date of signature.

During the evening of 5th December I received another telephone call from a colleague of Grey's. He confirmed receipt of my signed copy of the NDA and was calling to advise me of further information about the planned takeover. It was explained to me that because of the current vulnerability of this Oil and Gas major, its management had secretly authorised a five-for-one scrip issue of shares and that my shareholding had therefore increased five-fold without my knowledge or any public pronouncements.

Despite this setback, the M & A group's client wished to proceed with the hostile take-over and they made me a firm offer per share equivalent to 265% of the market trading price at the time. This offer was subsequently confirmed to me by email. Because of the financial size of the deal, the M & A group's client would insure against its possible collapse due to press leaks by contributing 90% of the cost of the insurance premium, with the remaining 10% of the premium paid by the shareholders who had committed to sell their shareholding. Individual insurance premium contributions would, of course, be refunded on successful closure of the take-over. Within two working days I therefore needed to deposit 10% of the offer price for my shares into an offshore account.

David Weeks

Needless to say I did not send any money and I have not heard a single word about this deal from anyone since.

You can all probably guess which troubled Oil and Gas major was the supposed target for this hostile takeover, although for legal reasons I have been advised not to disclose it in this article.

I have very little personal experience in buying and selling shares. As an engineer and financial layman, I have no experience at all in the fields of mergers, acquisitions and hostile take-overs. However, I never send my money to numbered accounts in overseas banks on the basis of a few telephone calls with complete strangers, no matter how large the pot of gold at the end of the rainbow may seem to be!

I don't know if the process which I have described above is a true description of how genuine, hostile takeovers are conducted. If it is, then it seems to me as a layman, that it needs to be re-examined by the appropriate authorities as it seems wide open to abuse by scam artists, conmen and tricksters and inevitably it will be small shareholders who are most at risk of losing their hard-earned money.

Following legal advice, names of individuals and companies involved have been either changed or omitted from this article by the author.

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THE INAUGURAL EUROPEAN GAS PROCESSING SHOW (EGPS)

The show is now on the road and the Call for Papers has been published on the GPAE website as well as a specific EGPS site (http://europeangasprocessing.com).

Publicising the show is well under way and brochures are being distributed at major gas processing events around the world. Selling of the Exhibition space has begun in earnest and GPA Europe member companies can now book space at a discount.

In addition to the exhibition, where more than 100 exhibitors are expected, there will be two days of Conference organised by GPAE and DMG. The themes for the conference cover many important aspects of the European Gas Processing Industry including:

- Environmental and Legislative issues
- Supply shifts
- Diversification and security of supply
- Demand shifts and the future of gas in Europe

Day One will focus on commercial and regulatory aspects and Day Two will focus on the technical response and initiatives necessary to meet commercial and consumer challenges.

In addition to the main conference, exhibitors and interested parties will have an opportunity to make short presentations in the Exhibition Hall Theatre (similar to the CoTE events at GasTech). Here the focus of the papers can be directed more at describing specific technologies and services.

A major focus of the show is to encourage the engagement and development of Young Professionals in the Industry. John M Campbell is sponsoring a 2–3 hour session introducing the basics of gas processing technology and GPA Europe is planning an event focusing on the wider aspects of the Gas Processing industry in Europe.

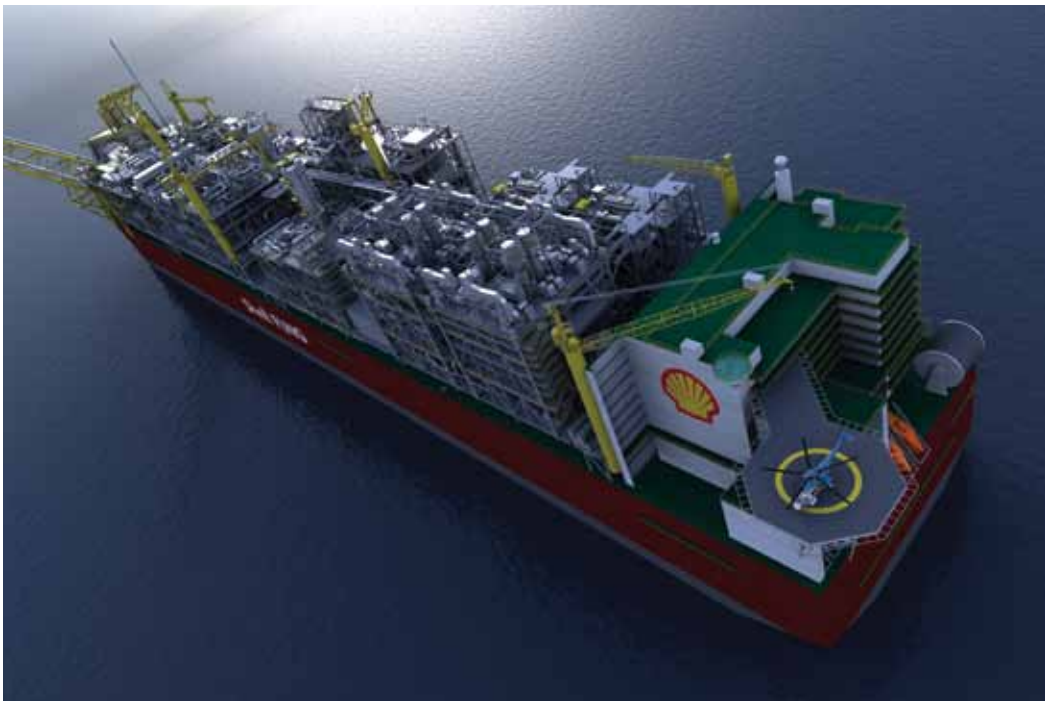
Check out the websites for further details and consider joining us by taking exhibition space or offering a paper. Contact GPAE Administration office for further details.

Contributed by John Sheffield

SHELL FLOATING LNG

To meet the world's growing energy demands, bringing new supply sources to market is critical. Gas resources are plentiful, and geographically diverse. Globally we see strong demand for natural gas - the cleanest burning fossil fuel.

In May 2011, Shell announced final investment decision on the world's first Floating LNG project – Prelude FLNG. FLNG will allow Shell to produce, liquefy, store and transfer LNG at sea, opening up new business opportunities for countries looking to develop their gas resources and bring more natural gas to market.



We believe that FLNG will enable the development of gas resources ranging from clusters of smaller more remote fields to potentially larger assets via multiple FLNGs. This can mean faster, cheaper, more flexible development and deployment strategies (including managing hydrocarbon maturation) for fields that were previously uneconomic.

FLNG is an idea whose time has come. The idea is to station a floating processing and storage facility above an offshore gas field so that the produced gas can be cooled into a liquid on site. Ocean-going carriers then offload the LNG as well as other liquid by-products for delivery to market.

Until now, the liquefaction of offshore gas has always involved the piping of gas to a land-based facility for liquefaction. This can be prohibitively expensive. An undersea pipeline has to be laid, offshore compression platforms are needed to push the gas to shore, and often a port has to be built. An FLNG facility avoids the need for these and can make such gas projects economically viable or more attractive. Avoiding the construction of pipelines, offshore platforms and ports can also help reduce the impact on marine and coastal environments.

It all sounds simple enough. But the challenges lie in working out all the practical details.

That's where Shell comes in. We are a pioneer and a leader in the LNG industry; we helped design and build the first commercial onshore LNG plant in 1964 – and have been designing and building such plants ever since. We have a long track record in innovation and technology and we are at the forefront of massive floating production and storage facilities as part of our deep-water oilfield developments. This wealth of experience stands us in good stead as we bring an FLNG facility to reality.

Our LNG expertise goes beyond liquefaction plants. We're involved in every stage of the LNG value chain: from the upstream (finding the fields and extracting the gas from them) to the downstream (liquefying the gas), shipping, turning the LNG back into gas and distributing it to customers). We also have the necessary logistical, contractual, financing and marketing skills to put together a complex LNG mega-project and make it happen. That breadth of expertise is essential in creating confidence with key stakeholders: investment banks, contractors, partners and resource-holding nations.

One of the main design challenges for FLNG is how to make all the necessary components fit together in a limited space. The Shell FLNG engineers have managed to fit everything onto an area roughly one-quarter the size of a conventional onshore LNG plant. Even so, the Shell FLNG facility would be the largest floating facility in the world today. When fully equipped and with its cargo tanks full, it will weigh more than 600,000 tonnes – roughly six times more than the largest aircraft carrier. Its length is more than four soccer fields laid end to end.

The Shell FLNG facility is based on a generic design that can produce up to 6 million tonnes per annum (mtpa), with the amount of LNG, LPG and condensate produced dependent on the gas composition of the field. For example Prelude's total production will be around 5.3 mtpa. Given Prelude is a "liquids-rich" gas field, this includes 3.6 mtpa of LNG – enough to easily satisfy the total annual natural gas consumption of Hong Kong – plus 1.3 mtpa of condensate (a very light crude oil) and 0.4 mtpa of liquid petroleum gas (LPG).

While we are involved in a number of projects, the first deployment of Shell's FLNG technology will be at the Prelude field 200 kilometres offshore the northwest coast of Western Australia. We are very excited about the Prelude FLNG Project which is expected to be the first of many. Such projects spur us to combine gas processing and marine technologies in novel ways to bring more natural gas to market.

Report by Ed Bras, Shell

TECHNICAL MEETING ANTWERP 2012

23RD FEBRUARY • MORNING SESSION

The February Technical Meeting was held in Antwerp, Belgium and focussed on the topic of *'Moving Fluids – The Latest Developments in Machinery'*. The use of machinery in gas processing, whether it be for compression, expansion or pumping is an essential part of processing facilities and often constitutes a significant portion of the capital expenditure and on-going plant operating costs. The need to improve energy efficiency, as well as the requirements of new processing areas such as CO_2 capture and storage is pushing the development of machinery and potentially changing the way we evaluate the overall gas processing cycle from reservoir to product or disposal.

The GPA Europe Chairman, David Weeks opened the morning session with some 40 delegates in attendance.

The speakers and moderators

Compression of Acid Gas with Reciprocating Compressor and Diaphragm Pump

The first paper of the day was *Compression of Acid Gas with Reciprocating Compressor and Diaphragm Pump* presented by Rainer Dübi from Burckhardt Compression (Co-author Anke-Dorothee Braun, LEWA Pumps and Systems). Carbon Capture and Storage schemes typically require injection pressures over 100-150 bar leading to high power demands and thus the necessity to improve the efficiencies of such schemes. Two CO_2 compression schemes were evaluated; one conventional compression and intercooling up to the injection pressure; the other conventional compression to 70 bar and then cooling, liquefaction and pumping to injection pressure. In the case illustrated, the combined compression and pumping configuration significantly reduced the power requirement. However, this result is not universal as the total energy requirements are dependent on the final pressure, the available cooling temperature and the quantity of H_2S in the acid gas stream. Materials of construction in H_2S service and the importance of avoiding condensation of the 'acid' gas to avoid corrosion are important aspects in the design. The safety aspects of containing the CO_2/H_2S streams have been addressed in the equipment design with suitable seal systems on the reciprocating compressors to prevent contamination of the lube oil or the environment.

Rainer Dübi

Improved Submerged Motor Pump Performance to meet Environmental Cost Mitigation

The second paper of the day, *Improved Submerged Motor Pump Performance to meet Environmental Cost Mitigation* was presented by Dennis Chalmers of Atlas Copco JC Carter Pumps. Dennis opened his presentation with an excellent introduction to the submerged motor LNG pumps used in the LNG supply chain. For each service, typical sizes and efficiencies, together with scope for improving efficiency was covered. An increment of 5 mtpy LNG requires a total pumping power of 8 MWe (excluding boil off gas) at an overall efficiency of around 65%. This in turn (with the boil off gas) results typically in emissions of 42,000 tpy CO_2. With the world LNG production being around 280 mtpy in 2010 and increasing at a rate of some 33 mtpy over the next 5 years, an improvement of 12% in the efficiency of new pumps would save 40 MW power generation each year and an associated reduction on CO_2 emissions of about 2 mill. tpy. Although development costs of higher efficiency pumps will need to be covered by higher CAPEX, there will be a reduction in overall life cycle cost with the added environmental benefit.

Dennis Chalmers

Transfer and Storage of Flammable Liquefied Hydrocarbon Gases

The next paper continued the topic of submerged motor LNG pumps, with the paper *Transfer and Storage of Flammable Liquefied Hydrocarbon Gases* presented by Joel Madison of Ebara International Corporation. Firstly Joel covered the three main design considerations for handling cryogenic fluids: low temperatures affect material selection and use of bearing grease and O-rings; hydrocarbon viscosities at low temperatures limit the use of the product to lubricate moving parts and affect dynamic seal stiffness properties; product flammability requires that specific design codes are met (e.g. ATEX directive 94/9/EC) and precautions must be taken to reduce the potential of hydrocarbon gases reaching the atmosphere.

Joel Madison

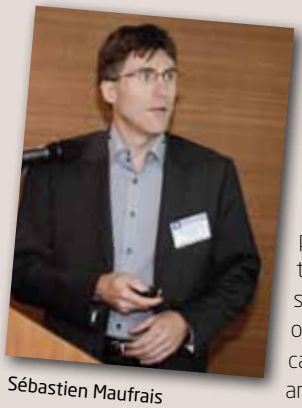
These considerations for cryogenic fluids make the use of submerged motors the major feature of current successful designs. The submerged motor, mounted on the same shaft as the pump eliminates the need for a mechanical seal, thus reducing leakage and improving reliability. In addition as the motor is isolated from the atmosphere and not located in a hazardous environment, it is better in terms of regulatory compliance and meeting safety concerns.

The extension of the submerged motor technology into cryogenic liquid expanders

gives an increase in LNG production of about 3-5% compared with the more conventional JT valve. Additionally the recovered energy can be exported from the submerged generator as electric power of the order of 1.5-2 MW.

Yemen LNG – Refrigerant Compressors Study for Capacity Increase

Following the morning coffee break, Sébastien Maufrais of Technip presented *Yemen LNG – Refrigerant Compressors Study for Capacity Increase* (co-authors Dominique Gadelle, Technip, and Jean-Claude Garcel, Total Exploration & Production). The Balhaf LNG Plant comprises 2 x 3.35 MTPA trains. The liquefaction design is the APCI C3MR/Split-MR™ process. Following the first year of successful operation at 100% capacity, TECHNIP and TOTAL studied several options to increase plant capacity, including one to assess how to improve the use of the available refrigeration capacity.


Sébastien Maufrais

The study was carried out using a calibrated HYSYS model taking actual site data and incorporating the utility balances (incl. fuel gas and power) as well as the process and refrigerant streams. A spreadsheet interface was built to allow modification of all main process parameters and other parameters were automatically calculated. The first option to increase LNG production was through the continuous use of the helper motor up to maximum power (10 MW on each shaft). Although the overall MR flowrates were increased by 20% with the increased power, light MR pressure drops increased by 250%; equipment design capacities were exceeded and the maximum increase in LNG production was only 2.25%, with consequent loss in production efficiency.

The second option was to upgrade the LP MR Compressor to increase head, in addition to the use of the helper motor. This only resulted in a further 0.2% increase to an overall 2.45% increase in LNG production. The conclusion from the study is that by using the additional power from the helper motor, there is little scope for increasing LNG production. This is because the hydraulic design is critical for the system capacity, and with an optimised design there is limited design margin allowed.

Assessment of Safety of Higher Hazard Machines and Rotating Equipment

The final paper of the morning was *Assessment of Safety of Higher Hazard Machines and Rotating Equipment* presented by Jeremy Lewis of ABB Consulting. Jeremy, in his first appearance of the day, described several machinery failure incidents leading potentially to major chemical release, death or massive system damage and process disruption. These types of incidents can arise from the failure of one part of the system where the consequences on the overall system is not fully understood, or when the system has been altered without, also, recognising the impact elsewhere.


Jeremy Lewis

Failures in machinery and rotating equipment in high hazard environments has led to the development of a series of guidance notes from the UK HSE to provide a broad appreciation of equipment and a framework for assessment. ABB has been carrying out such reviews to identify higher hazard machinery as critical equipment with the need for more focussed assessments on integrity and risk. It was demonstrated that the safety of rotating equipment is dependent on many separate layers of protection within the system and cannot be decided by analysis of equipment in isolation.

Report by Lorraine Fitzwater, Petrofac

23RD FEBRUARY • AFTERNOON SESSION

LNG Production and Transportation Demands Lead to Development of Larger Frame sized Turbo-Expanders

First up after the rigors of lunch and networking was Ian Mather, from Atlas Copco Gas and Process with a paper that examined the use of larger frame size turbo-expanders to service the capacity needs of FLNG applications.


Ian Mather

Traditionally, a shaft power around 11 MW with a gas flow of 15 mmNm^3/d has proved sufficient to meet the needs of a wide range of gas processing applications, but recent developments, particularly in the FLNG area, require higher powers and capacities. Ian's paper noted that high reliability and thermal efficiency have become standard over the last thirty years as has the use of active magnetic bearing systems over the past twenty; and with many offshore applications, single large units were preferred over multiple smaller ones. To meet today's FLNG needs, Ian informed that shaft powers of 20MW are required.

Whilst alternative liquefaction processes are common, the use of a nitrogen cycle is popular due to operational simplicity and flexibility at part load conditions. Maximum availability can be achieved using dual trains, however, due to the high reliabilities and availabilities now achievable, the desire to minimize plot space and equipment weight sometimes govern overall design. For similar reasons active magnetic bearings are preferred with their weight and space savings as well as obviating the need for lube oil.

Turbo-expander/compressor packages are typically designed to allow for 30 to 40% increase in flow; however efficiency drops with increasing excursion from the design point, though this can be mitigated to some degree using variable geometry inlet guide vanes (IGVs). For parallel operation, the control system, utilizing the IGVs and appropriate piping design, ensures that both turbo-expander/compressors operate at the same speed.


Question time

For a larger flow single machine operation, a lower speed must be used to keep the rotating parts' stress levels low and maintain similar turbo-expander performance and efficiency levels to dual machine operation. The key design parameter to achieve this is Specific Speed; for the single 100% unit, speed will be about 70% of that of the 50% unit, and impeller diameter will be about 40% greater.

The Control of Ignition Sources Arising from Gas Processing Machinery

The second paper of the afternoon was presented by Steve Sherwen of ABB Ltd, discussing a risk assessment methodology to ascertain the suitability of existing equipment for compliance with ATEX 137 Directive criteria. Certified electrical equipment has of course been available for many years but certified *mechanical* equipment is relatively new.

Steve Sherwen

As an example Steve noted that for a typical centrifugal pump, an ignition source could arise from seven scenarios, all during normal operating conditions, and considered to be expected or rare failures. Guidance on assessment is described in EN 13463-1:2009 and is based on hazardous area zones in which equipment is located, but definition of expected and rare failures is unclear.

To add clarity to these failure types a boundary probability was assigned, taking guidance from IP15 (3rd Ed), thus determining in which hazardous area equipment failures would be acceptable. To establish whether an equipment item is suitable for use in its hazardous area, the methodology used fault trees and applied a failure rate to each sub assembly. The base failure rates were derived from all causes of the failure, i.e. the sum of them, with no mitigation applied.

In an example used related to a bearing failure, it was noted that there is minimal time between onset of a failure and the resulting ignition source becoming viable, and this illustrates a fundamental difference between the way that hazardous area electrical and mechanical equipment must be managed.

The paper then considered how mitigating factors in various categories can be used to reduce the probability of failure, how these could be applied in the semi quantitative model, and hence determine whether an equipment item is suitable for ongoing use.

Maintaining Fluid Cleanliness for Process and Machinery Efficiency

The third paper of the afternoon was presented by John Krogue of PECOFacet (co-authors Allen Walker and David Burns), who discussed how the removal of particulates and liquids from gas streams can be engineered to provide improved pipeline and plant performance. Key to the application of separation and filtration equipment is not only meeting the required cleanliness levels, but also having a good understanding of the nature and quantity of contaminants.

He outlined the various types of equipment available namely, Vane/Wire Mesh Scrubbers, Cyclonic Scrubbers, Filter/Separators and Vertical Coalescers, and the differences between them in terms of key parameters, namely Capital Cost, Differential Pressure, Element Change out Costs, Efficiency and Turndown. (Discussion on separation technologies can be found in the GPSA Engineering Data Book).

With equipment and process developments over the years, filtration requirements do in fact change, and John cited three examples of this:

- The use of formulated amines has an increased foaming tendency in the presence of liquid hydrocarbons and particulates compared to primary and secondary amines.
- Low NOx burners require very small orifices at the burner tip, and high efficiency gas liquid coalescers are required to remove particulates which might lead to plugging and coking at the burner tip.
- Modern diesel engines with much reduced emissions over earlier ones require injection pressures exceeding 2,000 barg, and this requires increased fuel cleanliness.

In-depth discussions over coffee

John then explained in some detail the range of nature of contaminants. These can vary from large hard sand particles to fine shear sensitive iron oxide or sulphide; from large water or condensate droplets to semi-solid fine asphaltenes or waxes; and even solid sulphur in the absence of sour gas (!). Another aspect is the degree of cleanliness required by the downstream equipment to be protected. Over -specification of filtration results in unnecessary expense.

He then explained the advantages and disadvantages of various filtration equipment types, and their applications, and noted that in the gas processing industry the cartridge filter for liquid applications is most prevalent. The paper then concluded with four field examples covering the range of applications previously described.

John Krogue

Beyond Reliability: Using RAM to Optimise the Design and Operation of a Compression System

The final paper of the day saw Mayowa Akinrinlola of GL Noble Denton present a detailed paper extending the concept of reliability to holistic aspects of overall plant design and operation. Initially citing large unspared rotating equipment as often being amongst the largest contributors of system unavailability, he described what is meant by the terms reliability and availability, often and mistakenly considered synonymous, redundancy and maintainability, before bringing in the often thorny issues of system isolation and design complexity.

Managing these parameters to maximize asset production is inherently linked to whatever planned maintenance strategy is adopted by a facility owner, and that can be modeled using GL Noble Denton's OPTAGON tool for RAM studies. Part of that strategy will consider logistic delays, addressing location and spares holding, and operational constraints including, for example, ramp up time and cool down time for an LNG facility, in addition to active repair times.

Mayowa Akinrinlola

To demonstrate further the holistic nature of comprehensive RAM analysis, Mayowa brought in aspects of contracts strategy (eg. buyer's or seller's nomination contracts), and operational strategy covering daily contracted quantity and make up provision.

He then illustrated the theory with a case study which showed how modeling can optimize the availability of an LNG supply chain. The chain included all components from gas production through to liquefaction and shipping operations. The model addressed such questions as:

- How much LNG can be delivered?
- What are the major items contributing to lost production?
- How does shipping affect LNG production?
- What is the likely impact of adverse weather on shipping operations?
- How much bulk storage should be provided?
- How do upstream operations affect liquefaction?
- What options exist to improve performance?

And with those questions all safely answered, the day was brought to a close, and a lubrication schedule implemented for all, even for those proponents of magnetic bearings.

Report by Jon Lewis, Worley Parsons

KNOWLEDGE SESSION ANTWERP

24TH FEBRUARY

The Knowledge Session following the Antwerp Technical Meeting was entitled "*The Application of Surface Jet Pump Technology to Enhance Oil and Gas Production*." This was presented by Dr Najam Beg, Technology Director of Caltec Ltd.

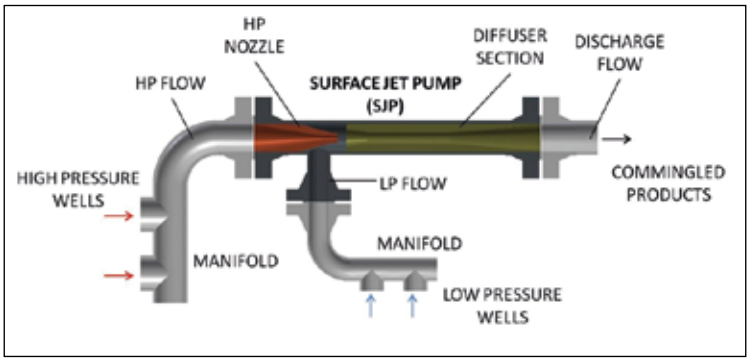
Dr Najam Beg

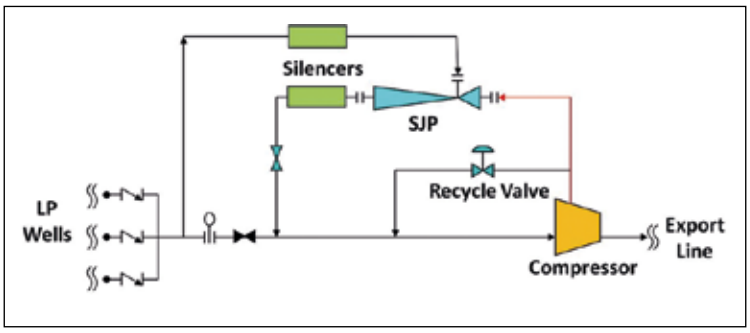
The session opened with an introduction to Surface Jet pumps, also known as Ejectors or Eductors. These are devices with no moving parts that utilise an available high pressure fluid source to boost the pressure of a low pressure stream. Dr Beg presented the factors affecting the design performance (pressure and flow ratios) and illustrated the performance design curves.

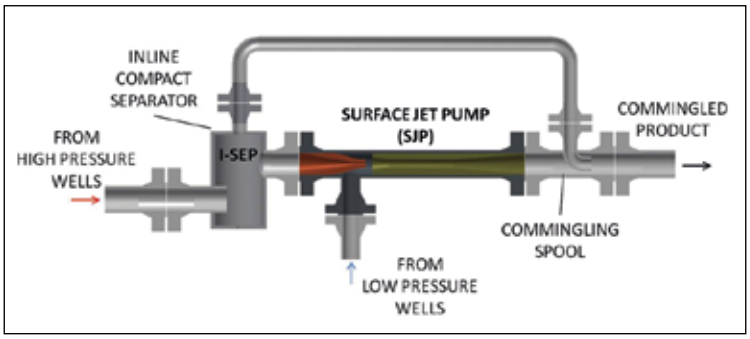
The use of surface jet pumps in gas and liquid applications was then discussed, focussing on the applications to enhance production. In the vast majority of oil and gas fields, production is restricted as the reservoir pressure drops. The problem is further aggravated as water cut increases and production from satellite wells or platforms is introduced. In order to maintain or increase production and total recovery, a boosting system is required. Lowering the flowing bottom-hole pressure is an effective way to achieve these objectives. In the figure above, high pressure wells can be used to boost the pressure of the low pressure wells, both flowing into the same production manifold, while the bottom-hole pressure associated with the low pressure wells is reduced. In one example, reducing the backpressure on LP wells by 5 bar achieved an extra 22 MMscfd of gas (a production increase of 110%).

As flowing wellhead pressures decline and flow rates drop well below plateau there may be capacity in one of the compressor stages to boost low pressure production. In one example illustrated here, a Universal Jet Pump was installed in the recycle line of the existing Compressor to lower the FWHP whilst also boosting the pressure to eliminate the requirement for a 1st Stage Compressor. The total gas production increased by 91 MMscfd and there was a saving in capital cost for a new compressor of £10 million.

A number of other cases in gas production applications were also illustrated showing how SJPs can be used in conjunction with existing compressor configurations to increase gas production, reduce fuel gas consumption (by replacing compressor stages with a SJP) or eliminate the need for new compressors or compressor re-wheeling (reducing or deferring capital expenditure).







A further application in gas production is to eliminate flaring from a low pressure separator by using a source of high pressure gas to boost the pressure to fuel or export.

Next, applications for Oil Production were covered. In the same way as HP gas wells can be used to boost LP gas wells, a similar configuration can be applied to multiphase boosting. In the WELLCOM System, the HP well production is separated in the compact I-SEP, and the liquid used as the motive force in the SJP to lower the back pressure on LP wells. The gas from the I-SEP is comingled with the production from the SJP downstream of the SJP. In one case it was possible to lower the backpressure by up to 11 bar and achieve a net oil gain of 350 bbl/d with an additional 1.5MMscfd of gas. The total production was delivered at 55 barg.

In reviewing options for maintaining gas or oil production as the reservoirs decline, options using Surface Jet Pumps are worth considering. Looking at the various options presented in the Knowledge Session, ways of incorporating a SJP are not always obvious and Caltec will provide advice and sizing on possible alternatives for particular cases.

The advantages of the SJP are simplicity, small plot and weight requirements (compared with compression systems) for retrofit offshore and minimum maintenance, leading to an economical, cost effective solution with short payback period. This is essential as these units are often only required for a short period as the reservoir declines. The SJPs are designed with removable inserts to match current design requirements; and with changing reservoir characteristics, the inserts can be easily changed out to extend the reservoir life further.

For more information, Caltec has now produced a booklet on 'How to use surface jet pumps' which is available from the website, www.caltec.com.

Thank you, Najam, for a very interesting and informative knowledge session covering the wide range of possibilities using Surface Jet Pumps in production applications. The previous concept of '*add a compressor as production declines*' will not be viewed in quite the same way again.

Report by Lorraine Fitzwater, Petrofac

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2012

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Excel Centre, London

GASTECH

- GPA Europe Exhibit
- Full day's presentation at Centre of Technical Excellence on 9 October
- GPA Europe Attendee's Dinner
- Accommodation Packages available

Call for Papers Open –
Closing Date 13 April 2012

November 29

Hilton Metropole Hotel, London

ANNUAL GENERAL MEETING AND TECHNICAL MEETING

Knowledge Session - Influence of Contracts on Design

Call for Papers Open –
Closing Date 30 September 2012

2013

March 13-15

Marriott Rive-Gauche Hotel, Paris, France

TECHNICAL CONFERENCE

Knowledge Session on "Subsea Processing"

Call for Papers Open

- Full day of Technical Papers
- Conference Dinner

May 15-16

Dusseldorf Messe, Germany

EUROPEAN GAS PROCESSING CONFERENCE AND EXHIBITION

- In Collaboration with dmg::events, GPA Europe will provide one day of technical papers as part of the Conference
- Special attendance rates for GPA Europe members

Paper Offers welcome

September 18-20

Edinburgh, UK

30TH ANNIVERSARY ANNUAL CONFERENCE

- One and half day of Technical Paper
- Special Half-Day Young Professionals Training
- Conference Dinner
- Companion's Tour

Paper Offers welcome

November

London

ANNUAL GENERAL MEETING AND TECHNICAL MEETING

Paper Offers welcome

CORPORATE MEMBERS

This listing of current Corporate Members represents the status as at the end of 2011. In addition there were 280 active individual members

Corporate Level 1 – Premier

Aker Process Systems, France
Amines & Plasticizers
Atlas Copco Energas
BASF SE
Bechtel
BG Group
BP
Compressor Controls Corporation
Costain Energy & Process
DOW Oil & Gas Europe
EON-Ruhrgas AG
ExxonMobil Norway
Fluor
Foster Wheeler Energy
Gas Technology Centre NTNU-SINTEF
Gassco AS
GDF Suez
GE Oil and Gas ESP
GL Noble Denton
KBR
Kellogg Brown & Root
Lurgi GmbH
M-I SWACO Production Technologies
National Grid
offshore design engineering
OMV Exploration & Production
Pall Corporation
PBG SA
PECOFacet EMEA
Perenco
Petrofac Engineering
Saipem SpA
Shell Global Solutions Int BV
Siemens Industrial Turbomachinery
Sime
South Hook LNG
Statoil A.S.A.
Technip
Total
WorleyParsons

Corporate Level 1

ABB Engineering Services
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AMEC
Burckhardt Compression AG
Cameron Ltd
CB&I
CB&I Nederland B.V
CECA SA
ENI Div E&P
Evonik Industries
Grace GmbH
Johnson Matthey
Koch-Glitsch (UK)
MOL Hungarian Oil and Gas Co
NORIT Nederland BV
Shaw Energy & Chemicals
Siirtec Nigi SpA
Sulzer Chemtech
Taminco
Techint
Technimont KT
TNO ENERGY
Vopak LNG Projects
Wintershall Holding AG

Corporate Level 2

BASF Catalysts Germany
Bryan Research And Engineering
Chart Energy and Chemicals Inc
Criterion Catalysts and Technologies
Danfoss A/S Oil and Gas
E.I.C. Cryodynamics Division
Enerflex (UK) Ltd
Energy and Power Consultants
Escher Process Modules
Exterran
Fives Cryo
FLEX LNG Management Ltd
Frames Process Systems BV
G.I. Dynamics
g3
GDF Suez E&P Deutschland GmbH
Granherne
Hamworthy Gas Systems AS
Heatric
IMA Ltd.
Inprocess
ISG
IV-Oil and Gas
John M. Campbell & Co
Johnson Controls Inc.
Kanfa Aragon AS
Maxoil Business Solutions
Mott MacDonald
MSE (Consultants)
Oil & Gas Systems Limite
Optimus Services Ltd
P S Analytical
Peerless Europe
Penspen
PGNiG SA Oddzial w Odolanowie
Pietro Fiorentini
Procede Group BV
Process Systems Enterprise Ltd.
Prosernat
px (TGPP) Limited
Refrigeration Engineering Pty Limited
Rotor-Tech, Inc
SBM Schiedam
Siemens Nederland NV
SPT GROUP LTD
TGE Gas Engineering GmbH UK Branch
Tracero Ltd
Tranter
Twister BV
UOP NV
VTU Engineering GmbH
Weir LGE Process
WinSim Inc
Zeochem AG
Zeta-pdm

Corporate Level 3

Gamma Business Solutions Ltd
Infochem Computer Services
KIRK Process Solutions Ltd
Matrix Chemicals BV
McMurtrie Limite
MPR Services
O&GBISS BVBA
OAG Energy Consulting
Optimized Gas Treating
Rowan House
Softbits Consultants
ZETA Technologies (UK) Ltd

Academic Level

University of Surrey

GPA EUROPE ANNUAL CONFERENCE BERLIN, 23–25 MAY 2012

YOUNG PROFESSIONALS TRAINING SESSION – WEDNESDAY 23RD MAY

For many years GPA Europe Ltd. has given a high priority to finding ways to engage with the young professionals in the Gas Processing Industry.

This has taken many forms of which the half day Knowledge Sessions have proved to be one of the most popular. However, this year at the Annual Conference in Berlin, we embarked on a new initiative inspired by Soufyane Teffahi, a young engineer working for BP. Soufyane's concept was to use modern communication techniques, such as Facebook, LinkedIn and Twitter to develop a network of young professional engineers and then invite them to a session organised by GPA Europe at which invited speakers would present papers to explain some of the fundamental concepts of Gas Processing.

It was a tribute to Soufyane's enthusiasm that not only did he attract 5 excellent speakers, but also 43 young professionals were given the opportunity by their Companies to attend this Training Session. Together with a further 15 speakers and GPAE members they formed a lively audience which nearly filled the splendid conference room in the Palace Hotel, to participate in the chosen topic of Acid Gas Removal

The session was moderated by John Sheffield, who opened by offering thanks to Soufyane for inspiring the event, to Sandy Dunlop for taking care of the arrangements, and to all the speakers for stepping up to the plate.

The first contribution was by John Morgan of John M Campbell who, in his inimitable style, outlined the issues around Acid Gas and why it is so important and difficult to remove these components from natural gas before it can be used.

Tom Cnop

Luke Addington

The second paper was a double act by Volker Giesen and Justin Hearn of BASF, who explained the use of amine systems. Volker clearly described the chemistry of amine systems and showed visually how the molecules of acid gases are captured! This was followed by Justin who described the key principles of the design and operation of AGR units, stressing the importance of ensuring the system is clean and kept free of contaminants.

Tom Cnop of UOP gave a very comprehensive explanation on membrane systems detailing their manufacture and role in acid gas removal, along with the theory and design of membrane systems and illustrations of operating issues with case studies of actual installations.

Jan Lambrichts

Design and simulation of amine units was covered by Luke Addington of BRE who set out the principle operating parameters for the design of gas sweetening units. His paper outlined the unit operations, set out the best design practices, and stressed the importance of parametric studies.

The final paper was presented by Jan Lambrichts of Dow Oil & Gas who covered the subject of operations and trouble shooting of amine based acid gas removal units. He described and defined the key operating parameters and stressed the importance of preventing fouling. He then put forward a series of guidelines for trouble shooting: setting out problems; describing their probable causes; and proposing potential solutions.

The four hour session proved to be a lively and interactive event with enthusiastic participation from the audience. All of the speakers acquitted themselves well and a special mention must go to Volker who magnificently covered a 10 minute technical hiatus whilst the next presentation had to be reloaded. Special thanks must also go to all of the young professionals for their participation and to their companies for the foresight to encourage them to attend and become a vital part of the GPAE family.

Volker Giesen

Justin Hearn

TECHNICAL CONFERENCE DAY 1

THURSDAY 24TH MAY • MORNING SESSION

Keynote Session: The German Gas Market - Meeting the Challenge of a Changing Energy Policy

The Technical Conference was kicked off to a great start with a fascinating keynote address by Keith Thomas of E.ON Ruhrgas entitled *The German Gas Market – Meeting the Challenge of a Changing Energy Policy.*

Keith Thomas

Following the Fukishima nuclear incident, Germany's desire to shut down nuclear plants (20% of the current country supply) by 2020 has revised their 2010 energy policy to make a big push into renewables, energy efficiency, biomethane, CHP, improving car/domestic heating efficiencies etc. With current pricing of CO_2, coal is the dominant energy source but there is an increasing opportunity for gas as CO_2 prices change and as renewables require balancing and support. The keynote discussed many renewable options and issues. On wind, variability will require developing the concept of "energy pump" – water storage; air-to-reservoir to peak shave; hydrogen & storage generation or other "power to gas" options. A major R&D program is underway in Germany that is assessing the practicality and economics of generating hydrogen, when excess renewable power is available: mixing with methane to form hythane (90% methane and 10% hydrogen); a fuel with properties that meets all requirements under German codes (in terms of gas quality specifications) and one that can be readily accomodated in the exisiting natural gas infrastructure. On biofuel, O_2 in gas would pose challenges in gas networks, and wave power was not seen as favoured given the small coastline in Northern Germany especially when the major power consumers are in the Southern part of the country. A good summary of new options, the European vision of energy mix, connecting gas and power grids etc, that will require an acceptance of the economic impacts to enable such developments to be realised in the short to medium term.

The overall summary indicated a positive future for gas in Germany (and probably the rest of Europe), as it is the cleanest fossil fuel, has a renewable share (biomethane), can be combined with geothermal energy (gas heat pump), offers proven technology to integrate solar power, enhances energy efficiency (via distributed generation) and can compensate local power fluctuations. The environmental footprint of natural gas can be improved by increasing the share of biomethane, by hydrogen integration from excess wind power and by applying CCS technologies.

Brian Songhurst

Offshore vs. Onshore Terminals: The Advantages & The Disadvantages

Brian Songhurst of E+P Consulting delivered the next paper entitled *Offshore vs. Onshore Terminals: The Advantages & The Disadvantages.* The paper gave overview of conventional LNG production, shipping, regassing and a typical LNG chain cost to introduce the increasing trend to use floating storage and regassing unit (FSRU) – with nine in operation today. Two concepts are currently favoured for offshore LNG regassification:

- FSRU with side-by-side LNG transfer and turret gas transfer to gas pipeline to shore.
- Near-shore FSRU i.e. jetty moored LNG ship with on-board regasser e.g. Dubai FSRU recently commissioned.

Both use conventional, well proven technologies.

There are two options for FSRU:

- new build favoured by Hoegh or Exmar
- conversion favoured by Golar.

Conversion of an existing LNG carrier is expected to be approximately 25% cheaper than a new build but as most LNG ships are now fully utilised in LNG trade this option is difficult to realise. Adopting an FSRU approach does permit faster development of LNG supply to countries and potentially has fewer environmental and political issues due to a minimal land requirement. There are also other issues to consider such as; limited capacity to approximately 3 MTPA (although larger FSRU 5-6 MTPA are being considered); limited storage; waiting time for shuttle tankers; the impact of weather conditions on unloading of LNG; security of supply; local content in terms of construction and the inherent difficulty to increase the capacity of an FSRU.

Advanced Compression Solutions for EOR, Refrigeration, Vapour and Offshore CO_2

Rolf Habel of MAN Diesel & Turbo SE discussed 3 options for CO_2 compression for EOR and CCS, using traditional piston type compressors, larger barrel type compressors with all impellers on one shaft and integrally geared (IG) compressors. Integrally geared types can achieve significantly higher efficiency with a multi-shaft design as there is practically no limit to the possible number of stages in one machine, intercooling is possible after each stage (impeller), and axial in-flow to each stage and the optimum speed can be selected for each pair of impellers. This however does result in an increase in complexity, i.e. there are more wheels leading to higher costs and more sealing. But there can be a significant saving in life cycle costs. MAN's experience suggests that for volume flows >12kg/s and pressures up to 250 bar, integral gear compressors have definite advantages over reciprocating or supersonic technologies and in-line centrifugals in most CO_2 service as well as for nitrogen compression service, although a barrel type design is recommended in applications with discharge pressures over 250 bar and offshore service.

Rolf Habel

The speakers and session moderators

Associated Gas for OMV Petrom G2P Projects in Romania

Next was Thomas Werth (co-authors Nicusor Nacu, Nikolas Trofaier and Jaroslaw Konieczny, VTU & OMV Petrom) with *Associated Gas for OMV Petrom G2P Projects in Romania*. The paper discussed the development of relatively small gas to power projects in Romania. OMV's "no flaring" directive and the potential to monetise stranded gas drove projects to examine associated gas disposal options. Gas to power was favoured and options using gas engine and gas turbine examined. Gas engines were selected to generate and connect electricity to grid and to include a heat recovery system to supply heat to consumers. The use of gas engines was driven by the variability of associated gas quality and presence of liquids in gas. The paper discussed the effect of methane number - knock resistance of fuel gas, on derating of generated power. Several units are now installed on a lease basis (another driver for gas engine selection), each generating between 0.6 and 1.2 MW using a wide range of fuel gas compositions.

Nikolas Trofaier and Nicusor Nacu

Gas Plant Process Control System Upgrade without Unnecessary Plant Downtime

Dave Bramley of ABB Consulting completed the morning session with his paper on *Gas Plant Process Control System Upgrade without Unnecessary Plant Downtime*. Most process plants require 2-3 upgrades of their process control systems due to obsolescence in 20-25 years of plant life. The ABB paper provided highlights of the activities in the staged process adopted for change out of the control system at the Sharjah Gas Plant in the United Arab Emirates.

Dave Bramley

During the "Select" stage, two options were developed:

- a shutdown option to effect the changeover
- a "hot" changeover method

The shutdown option was seen as the easiest, safest and lowest risk but rejected as concentrated activity was needed to minimise the shutdown period and also the start-up of the new control system was perceived as a major risk. The paper discussed the many FEED and Detailed Design activities that were necessary to define critical areas of the "hot" changeover option and the execution of the changes. These included the development of step by step cutover procedures, enabling an upgrade of a control system with no additional plant outage and no lost production with safety built into every step of the process.

Peter Hunt of ABB Consulting, generous sponsors of the Conference, then described the areas of expertise of ABB in a short presentation, before delegates headed off to the restaurant for lunch.

Report by Martin Mayer, CB&I

Discussing the papers over lunch

The Conference Sponsors

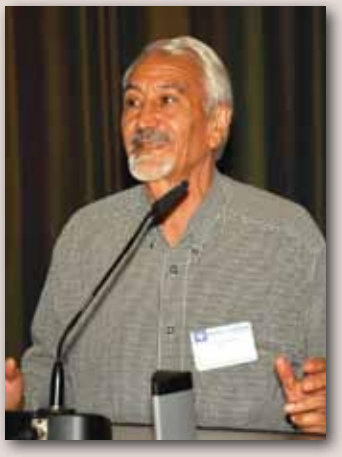
TECHNICAL CONFERENCE DAY 1

THURSDAY 24TH MAY • AFTERNOON SESSION

There was no let up from the excellent papers of the morning session and, after the sumptuous lunch at the Hotel Palace, the afternoon session offered an equally interesting set of 6 technical papers. The session commenced after a brief update by DMG Media on the preparations for the European Gas Processing Show planned to be held annually in Dusseldorf commencing 2013, reported separately in this edition of InBrief on page 3.

Some Novel Examples of the Use of Surface Jet Pumps (SJPs) to Enhance Production and Processing - Case Histories and Lessons Learned

First on the podium was Sacha Sarchar of Caltec to present a follow-up from the last GPA Europe Knowledge Session on Surface Jet Pumping (SJP). Using the preamble that production from many oil and gas fields becomes restricted as the reservoir pressure drops, Sasha described the use of SJPs to boost low pressure wells, revive liquid loaded oil and gas wells, as well as examples of preventing HP wells backing out neighbouring LP wells. Explaining that jet pumps are simple devices with no moving parts, hence reliable, and use the energy from a HP source to boost the pressure of a LP fluid by way of venturi effects. Applications are particularly effective where the LP fluid mass flow is small in comparison to the HP fluid mass flow. Production increases up to 25% are reported from the LP wells providing good solutions to increase recovery from aging reservoirs and delaying abandonment.



Sacha Sarchar

Flowsheet Synthesis and Design of Demethaniser Processes

Muneeb Nawaz of Costain – Energy and Process, one of the group of young professional presenting at the conference, followed with a paper based on his University Thesis on flowsheet synthesis and design of the demethaniser process. With low temperature distillation remaining the most important route for the separation and purification of gas mixtures, the demethaniser system involves a complex distillation column with many side reboilers and other flowsheet components, such as a turbo expander, flash units, multi-stream exchangers and external refrigeration. The complexity of such a system can make simulation, design and optimisation a time consuming task. Muneeb shared a method using a stochastic optimisation approach (similar to Monte Carlo analysis) to identify the most economic flowsheet configuration. A flowsheet "superstructure" is developed and allows the calculation method to alter various possible configurations and operating variables simultaneously, to quickly optimise the scheme for the best economics.

Muneeb Narwaz

Technical and Economical Decision Factors for Optimising the Debottlenecking of an NGL Recovery Production Facility

The next paper by Wai Chin Hong and Craig Cook of Technip Malaysia on Technical and Economical Decision Factors for Optimising the Debottlenecking of an NGL Recovery Production Facility demonstrated the complexity of analyses in any application to real plants. The presenters discussed a case study where a 25% capacity increase in an existing NGL recovery facility was constrained by the need to minimise the impact of construction activities next to a live plant as well as the available space at the facility. Hysys modelling was used to review systematically modification options and equipment constraints to increase ethane recoveries from 68 to 93%. Capital cost profiles showed where the owner was making step changes in investment and best economic recovery. This systematic approach and sensitivity analysis provided an optimised return on investment.

Wai Chin Hong

Craig Cook

Questor - Next Generation Flare System

After the coffee break, Wim van der Zande of GI Dynamics presented Questor – incinerator. He asserted that the induced draught incinerator can also be used as an enclosed ground level flare in onshore and offshore gas processing applications. The system consists

Wim van der Zande

of a standard flare tip, at ground height, enclosed by a refractory lined steel vessel. The advantages he claimed of this flare type are similar to that of a traditional 'box' flare, in that there is no visible flame, noise or smoke emanating from the units. The technology has been successfully used at onshore sites in North America with a focus on acid gas combustion and well testing.

During the Q&A session, some of the underlying issues of the concept surfaced, with questions of how the Questor incinerator handled the mitigation for a loss of flare pilot/ignition; the ability to handle emergency loads; quality of combustion at varying loads; and gas quality etc.

Molecular Sieve Contaminants - Effects, Consequences and Mitigation

Alexandre Terrigeol of CECA cooled the discussions by talking about common problems associated with the operation of well proven molecular sieve (zeolite 3A, 4A, 5A) adsorption technology. His detailed presentation gave the cause, effects and solutions for each commonly observed contaminant such as oxygen, liquid hydrocarbons / water, salts, amine etc. The paper was definitely food for thought for idealist designers of a risk mitigated molecular sieve adsorption system to deliver the holy grail for even these well proven unit operations.

Alexandre Terrigeol

LOPA Sets New Requirements for HAZOP

The day's proceedings were wrapped up by ABB's paper on Layer of Protection Analyses (LOPA) setting up new requirements for Hazard & Operability (HAZOP). ABB presenter, Gerry Brennan, offered advice to practitioners and chairpersons on best practice for setting up such studies as well as how to avoid common pitfalls. He offered at least 8 learnings on the meticulous recording needed in HAZOP to enable LOPA studies to be followed. The LOPA exercise gives a more detailed estimate of the residual risk and is also used to meet the requirements of IEC 61508 for setting the safety integrity level (SIL) for a safety instrumented system.

Gerry Brennan

The 1st day session was brought to a close by the Chairman summarising the highlights of the day and looking forward to the night to come - the Conference Dinner complete with its now-customary quick witted dinner speech greatly enjoyed by all the attendees.

Report by Murtaza A Khakoo, BP Exploration, Sunbury

COMPANIONS' TOUR BERLIN 2012

The seventeen companions who participated in the tour of Berlin all had a most enjoyable and educational sightseeing visit. Rob, the only male participant, did a sterling job coping with sixteen females! The turn-out for the tour was lower than we had seen in previous conferences which we imagine was due to the May timing of the Conference as opposed to the usual September and we hope that many more will join us in Edinburgh next September to help celebrate the 30th birthday of GPA Europe.

Our day started a little later than planned as the coach for our drive and walk city tour was late, but our guide Simone took us all to the Memorial Church, close by the hotel, whilst we waited. The Kaiser Wilhelm Memorial church had been badly damaged in a bombing raid in 1943. In 1961 a new octagonal church designed by Egon Eiermann, made of concrete and coloured glass blocks, was built alongside the existing tower. A free-standing hexagonal bell tower was constructed on the site of the former main nave. The remains of the original church are surrounded in aluminium cladding to make it look like an office building, whilst necessary strengthening and renovation work proceeds. We managed to enter the building to view the memorial hall with its beautiful murals of the Hohenzollern family, alongside peace symbols such as a Cross of Nails from Coventry.

Maybe after all the walking we did in Prague the companions were grateful that the coach had been caught up in traffic because it meant that the walking part of the city tour was curtailed to a walk around the Jewish memorial. This moving memorial consists of 2711 grey slabs that bear

no markings, such as names or dates. The slabs undulate in a wave-like pattern. Each is a five sided monolith, individually unique in shape and size. Some are only ankle high while others tower over visitors. The paths that are shaped between the slabs undulate as well to create a feeling of instability and a sense of disorientation.

The coach drive showed us the city sights including the Zoological Gardens entrance, Victory Column, Brandeburge Gate, Pariser Platz, Reichstag, Postdamer Platz, Checkpoint Charlie, the TV Tower, and the Berlin Wall to name but a few. We then went for our lunch on a private dinner cruise on the River Spree aboard boat "Amsterdam". As we were not due at the afternoon attraction until 3.30 p.m, we were able to enjoy an extended relaxation in the hot sunshine on the deck.

A LUCKY WINNER

As a consequence of GPA Europe involvement in Gastech 2012 we received a complimentary ticket to access the Conference, which we decided would be used to encourage people to attend. A draw was held at the Conference Dinner to select the lucky delegate who would receive the ticket, which is valued at over £2,000 and enables the holder to attend all the events within the Gastech Conference.

Come the dinner at the Hotel Palace then, David Weeks was given the honour of drawing the name of the successful delegate out of the hat. The winner was Ed Bras of Shell Global Solutions International, but as he is based in India, he graciously allowed his prize to be redrawn. Tension rose as David's hand entered the hat for the second time and drew out the name of Viviane do Santos of SBM Schiedam who was very pleased to accept this prize and is planning to attend the Gastech Conference.

GPA Europe will be exhibiting in stand C 205 at the Excel Centre London during the Exhibition that accompanies the Conference and is responsible for managing and running the Centre of Technical Excellence (CoTE) on Gas Processing to be held in Theatre A on 9th October. GPA Europe's managed CoTE at the Gastech 2011 in Amsterdam last year was reckoned to be one of the best attended sessions and we expect no less in 2012. Full details of the papers available and accommodation packages arranged by GPA Europe to coincide with Gastech 2012 are available at the GPA Europe website.

L-R: David Weeks, Sandy Dunlop and winner Viviane do Santos

Contributed by Sandy Dunlop

We met up with Sigrid at the Charlottenburg Palace who took us on a guided tour of this beautiful palace. The largest in Berlin, the Charlottenburg has been reconstructed after being destroyed during the Second World War. It was originally built in the 1690's as a summer residence for Sophie Charlotte, wife of Fredrick III. We viewed the Royal Rooms including the Oak Gallery with its oil paintings, the Porcelain gallery with its mirrors and full of a fine display of Chinese and Japanese porcelain along with the famous Amber Room.

A wonderful day was enjoyed by all in Berlin!

Remember that September 2013 is the 30th Anniversary of the GPA Europe and I am already excited about what has been planned for the Companions' Tour. Early registration is recommended and I look forward to another fascinating Tour next year. However, Companions are always welcome at any meetings and I would love to have some company whilst the delegates are in their meetings.

Contributed by Anne Dunlop

TECHNICAL CONFERENCE DAY 2

FRIDAY 25TH MAY • MORNING SESSION

Simulation of the Benfield HiPure Process of Natural Gas Sweetening for LNG Production and Evaluation of Alternatives

The morning after the proverbial 'night before' Conference Dinner afforded the delegates a rich reward of both youthful adroitness and experienced wisdom.

First to take the podium was Richard Ochieng, a Senior Graduate Student at the Petroleum Institute of Abu Dhabi. Richard's talk was entitled *Simulation of the Benfield HiPure Process of Natural Gas Sweetening for LNG Production and Evaluation of Alternatives.* The paper discussed problems faced in operation of the Benfield HiPure process (a hybrid arrangement of Benfield and amine units) at Abu Dhabi Gas Liquefaction Company Limited (ADGAS) and the use of a process simulation tool, ProMax®, to investigate and suggest ways of overcoming some of these problems.

Richard Ochieng

The ADGAS Train 3 plant on Das Island, processes high pressure natural gas containing 6-7 mole% acid gas. Gas is first contacted with a (Benfield) 30wt% potassium carbonate (K_2CO_3) solution promoted with a 3wt% diethanolamine (DEA), followed by contacting with a 20wt% DEA (amine) solution downstream.

A simulation of the plant was set-up using the "Electrolytic ELR-PR" property package supplied with ProMax to predict the liquid phase thermodynamic properties, due to the strong electrolytic effect of the Benfield solution. The amine system used the TSWEET kinetics to account for the relatively slow absorption of CO_2 by amine or carbonate solutions. The simulation was verified as closely matching the plant operating and design data and was subsequently used to perform parametric studies to better comprehend plant performance.

An Integrated Approach to Sour Gas Field Development

Mona Bhagat of Petrofac presented *An Integrated Approach to Sour Gas Field Development.* Mona drew on her experience of working on the entire life cycle of the South Yoloten Gas Field Development Project, from the Conceptual phase through FEED and then into EPC.

The field is a World-scale development of sour gas/condensate, containing up to 6% H_2S and 7% CO_2. Petrofac designed Central Processing Facilities (CPF-1) with a capacity of 10 BCMA (~1Bcfd) along with a gathering system for 20 BCMA and associated infrastructure and pipelines.

The development consists of wellheads tied back to 4 remote Gas Treatment Units (GTUs) where the gas is dehydrated with CPF supplied and regenerated TEG before being transferred back to the CPF. At CPF-1, the gas is split into 2 gas trains after passing through a slug catcher. Each gas train consists of: two parallel Acid Gas Absorption Units using amines (AGA) with corresponding Acid Gas Regeneration Units (AGR); followed by a single TEG Dehydration unit with regeneration; a single Hydrocarbon Dewpointing Unit prior to export. Condensate Stabilisation is provided for the liquid product. The acid gas from each AGR goes to a dedicated Sulphur Recovery Unit (SRU) and the molten Sulphur from each SRU combines and then feeds a common Sulphur Pelletisation and Bagging Plant. Sulphur is exported by rail.

Mona Bhagat

Mona described the methodology adopted for the development, which included approaches to: compositional uncertainty of well streams (in particular, acid gas, mercaptan and BTX levels); logistical and transportation constraints due to the remoteness and location of the worksite; and gas treatment technology selection.

Gas Treating Simulation – A Holistic Perspective

Keeping the audience stimulated before the coffee break was Nathan Hatcher of Optimised Gas Treating Inc. Nathan drew on experiences from his 18 year career in the field of gas treating and sulphur recovery for his discussion of the use of the ProTreat® mass transfer rate-based gas treating simulator as a tool for troubleshooting. Three cases studies were presented, each of which had problems that evaded detection for some time, despite having seemingly simple root causes.

Nathan Hatcher

A holistic approach to trouble-shooting was described, which recognised the challenges in incorporating plant data into simulation models: verifying plant instruments; acquiring plant data; difficulty in measurement (absorption of H_2S); and equipment performance.

The first case referred to a sharp unexpected increase in CO_2 content in a semi lean / lean ammonia plant syngas absorber using a piperazine-MDEA blend at semi-lean temperatures above 78°C. The simulator temperature profile was presented to demonstrate the 'operational cliff' that occurs as the absorber goes from lean-end to rich end pinched.

A post-combustion CO_2 capture plant was featured in the second case, where the simulation model was used to explain the scenario where two minima and a peak were observed in reboiler duty, when subjected to varying amine circulation rate.

The factors at play are again the lean end versus rich end pinch, accompanied by solvent net loading capacity versus solvent flowrate – two pairs of factors.

The final case described a similar issue in a random packed LNG absorber and educated the audience with the difference between the behaviour between packed and trayed columns in mass transfer performance.

Optimised Design for Tight Gas Gathering Systems

Following the coffee break Ahsan Iqbal of Worley Parsons took the GPA upstream with his paper on *Optimised Design for Tight Gas Gathering Systems*.

Ahsan used his knowledge of tight gas gathering networks in complex and difficult terrains gained from his recent involvement in Flow Assurance, to develop a methodology to assess and evaluate a tight gas gathering system from initial concept to first stage design development.

For tight gas developments, usually characterised by a large number of wells, the methodology presented addressed the requirement for the optimised design of an ideal gathering system to accommodate maximum flowrates with minimum line sizes. At the same time there is a need to remain flexible enough to accommodate variations within the sub-surface, such as drilling locations, varying phase flowrate, water to gas (WGR) ratio, condensate to gas ratio (CGR), flowing wellhead temperature/ pressure, and composition.

Ahsan Iqbal

Comparison between sophisticated fluid models such as OLGAS® and the simpler Beggs and Brill (1973) correlation revealed that the conservatism of the later was adequate for conceptual sizing.

The importance was stressed of the use of high resolution topography (5m vs 100m) for evaluation of liquid hold up and pressure drop in slugcatcher sizing.

The paper also considered material selection and cost in the optimisation of the gas gathering network. Factors to be considered were noted as material selection of carbon steel vs corrosion resistant alloy (CRA); chemical injection requirements; operability and downtime. Cost analysis should consider tonnage of steel; the number of pig receiver/ launchers; slugcatcher costs, connections and valving.

Why the Commitment and Involvement of Senior Managers is Critical for the Prevention of Major Incidents

Performing a unique double stint at a GPA conference, Gerry Brennan returned to present a paper discussing *Why the Commitment and Involvement of Senior Managers is Critical for the Prevention of Major Accidents*.

Antony Kane

Gerry used Texas City and Buncefield accidents as examples of recent process safety incidents to identify the critical role played by senior managers. Effective leadership is required if companies are to develop a positive safety culture that remains constantly vigilant towards the risk of process safety hazards, whilst avoiding the cost to both company reputation and the individuals involved.

The cross-industry effort (including UK HSE Regulators, Energy Institute etc.) to develop process safety management training for senior executives was discussed as a way of improving safety performance.

Key issues were highlighted that could lead to improved leadership in the major hazard industries, including Gas Processing facilities. These included: attitudes and decisions of senior managers affecting the safety culture of the organisation; reinforcing the importance of safety by personal example; thorough understanding of major accident hazards and key risk control systems; investigating process safety incidents and near misses to find the underlying causes; developing world class safety management systems; and identifying weaknesses in these systems using targeted performance indicators.

ADAPT Silica Gel Technology: Reasons for Selection on Gas Conditioning Plants

For the final paper of the conference, entitled *ADAPT Silica Gel Technology: Reasons for Selection on Gas Conditioning Plants*, we had a two-part presentation by Lorenzo Micucci of Siirtec Nigi & Antony Kane of GL Noble Denton.

Antony commenced with a technical discussion about the use of silica gel for simultaneous removal of water and small quantities of heavy hydrocarbons, making it ideal for cavern storage or other dry gas treatment, by explaining the fundamental principles.

The unique approach of the ADAPT technology offered by GL Noble Denton was explained as the use of a pulse heat regeneration method (periods of heating and no heat) to improve thermal efficiency of regeneration. ADAPT also permits optimisation of the number of absorber vessels to reduce the no of switching valves. The application of ADAPT was claimed to be able to extend catalyst life, lower OPEX and lower CAPEX when compared to a 'conventional' approach to silica gel plant design.

Lorenzo took over for the second part of the presentation, which focussed on the application of ADAPT silica gel technology for the World's largest silica gel plant at the Portovaya Terminal for the Nord Stream Pipeline Project. A total of 170 MMSm^3/d (6 bcfd) of pipeline gas is treated before it is compressed from 80 to 200bar for transit in 1224 km of underwater pipeline crossing the Baltic Sea. The J-T effect and cold water temperature in the subsea pipeline require treatment to reduce the hydrocarbon / water dewpoints from 0/-10°C to -20/-30°C respectively. Lorenzo discussed the selection of silica gel in preference to refrigeration (needed to drop gas pressure below cricondenbar) and turbo-expander (more costly). The project now comprises 4 silica gel trains, each with 5 adsorber vessels (3 on-line, 1 in regeneration and 1 on standby). Each vessel is sized at 5m diameter by 10m tan-tan.

The audience thanked all of the presenters for their contributions and the 2012 Annual GPA Europe Conference in Berlin was brought to a close.

Report by Jason Frost, Offshore Design Engineering