In Brief...

GAS PROCESSORS ASSOCIATION EUROPE

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THE FUTURE OF THE WORLD AS WE SEE IT

We believe the fundamentals of growth are unchanged, growth is just around the corner and fortune will favour the brave.

In common with nearly everyone in the world the Gas Processors look out on a very uncertain future. Never has the saying 'The man who forecasts the future is wrong, even when he is right' been more true.

There are few people alive who can recall macro economic statistics so extreme: World GDP falling by its fastest rate since 1929; Japan posting its first trade deficit for 30 years; the insurance company AIG adsorbing more government support in one year than the equivalent of the GDP of Denmark; GE reducing their dividend payout for the first time since 1938; 40% of Spain's under 30's forecast to be unemployed; total UK government debt not back to normal until 2035 – when 30% of us will be dead. The list goes on and on. While hardly a privilege to witness, nonetheless a breathtaking vista and one that we may never see again.

But then the curate takes a closer look at his egg and sees the 'green shoots of recovery'. Ben Bernake forecasts that the recession will end this year; Barack Obama agrees. Closer to home the movers and shakers of the oil and gas industry are making some very bullish statements: Jeroen van der Veer of Shell has been quoted as saying 'To invest or not to invest – that is the question. The answer at Shell is that we keep investing'. Rex Tillerson, EM's CEO, 'ExxonMobil will continue investing at record levels, despite the economic downturn and plunging oil and gas prices that have reduced spending by some competitors'; King Abdullah of Saudi Arabia 'The [Saudi] Kingdom plans to invest $100 billion in the oil sector until 2014'.

The question on everyone's lips is, of course, what does the Gas Processors Association think?

We think that the curate is right. In the coming years some of the egg will be bad, but not all, and certain elements will indeed taste good.

We believe that, conditioned by so many years of growth, a large number of us have forgotten that boom and bust was never cured, and it never will be. Boom and bust is as much a part of life as spring and autumn, chalk and cheese and Arsenal and Tottenham.

But right now we are looking out on a grim vista. Like the cartoon character

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GPA Europe Admin Office prepares to pass the baton

Wendy and Don Cooney

Sadly, Don Cooney recently announced to the ManCom his and Wendy's decision to retire from the role of Administrator for GPA Europe by November 2010. Theirs will be large and friendly boots to fill, so don your thinking caps!

Are you looking for a career change? Would you be interested in filling this vacancy? Do you know someone who might be interested in assuming the GPAE Administrator role? If so, please contact a member of the Management Committee.

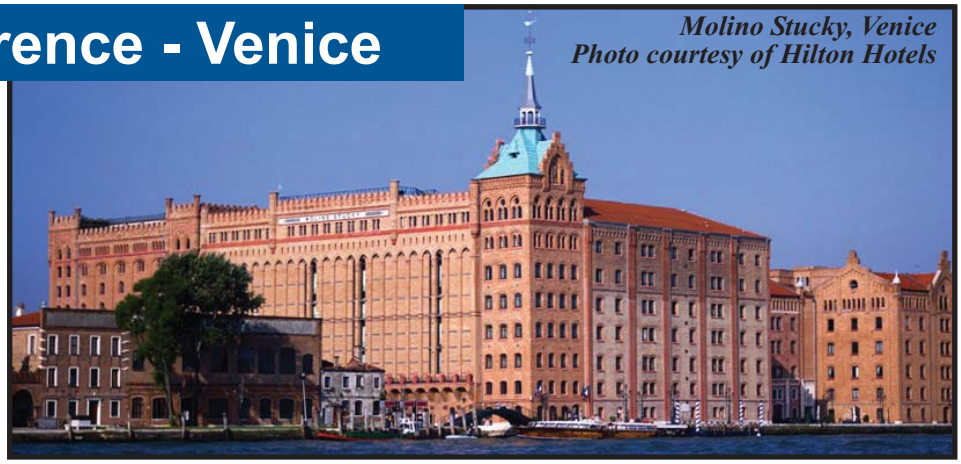
This key position within the GPAE organization will be advertised following formal announcement of Don and Wendy's retirement plans to the general membership at the November AGM.

Annual Conference - Venice

GPA Europe will again be hosting the Annual Conference in September, this year in Venice (for details see back page). Along with the core technical presentations will be the chance to review the current commercial assessment of gas/LNG and discuss the future. The Conference, to be held at the Molino Stucky Hilton, is kindly sponsored by:

ABB Pietro Fiorentini®

Molino Stucky, Venice
Photo courtesy of Hilton Hotels



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who keeps running, not recognising that he has run off the cliff edge, we have yet to see the bow wave of a crisis of finance: unemployment will increase – everywhere, including our industry. Labour rates, which have fallen already, will fall even further. For the guys without exceptional skills or allegiance it will become tough. Companies will again look at their navels and debate why they exist, and will recognise that, after all, we are people and only people, and people do make the difference.

Conversely, for our industry we do see hope amidst the gloom. Now why would we say that? Several reasons: We believe that the boom of the last few years was driven by the incremental growth in living standards of the two most populous nations in the world, and they continue to grow; Boom will most certainly follow bust and in our case, when it comes it is our industry that will see it first as the per capita demand for energy again picks up! For in gas and energy, our industry is based on the most fundamental of needs and the most tangible of assets. We supply the energy that warms and cools our homes and offices, the fuel that feeds the world's transport and industry systems and above all else, we are the solution to the world's next crisis – global warming. So what do we say to the world of gas processing? For sure this is a time to cut costs. Alan Greenspan was right, our exuberance has indeed been irrational, we have been over indulging at the smorgasbord of capital investment, but our hour is nigh.

- We believe that this is the time for counter cyclic investment;
- To listen to the movers and shakers;
- Resist the tendency to bank your assets or buy your own shares;
- Go out there and hire the engineering graduates no longer wanted by the financial crowd;
- For those with cash in the bank, invest it in technology development and in shrewd acquisition.

Above all we believe that the fundamental drivers of the last boom are alive and well. While temporarily delayed by some ill informed investments, growth is just around the corner and fortune will favour those brave enough to prepare for it now.

Malcolm Harrison

View from the Top

Justin on holiday sailing in Milford Haven. Sandy, his wife, was heard to comment "Why do engineers not understand the concept of vacation sight seeing?" as they rounded the South Hook LNG Jetty for the 13th time! Photo courtesy of Alison Lewis

As must be clear to us all by now, the developed world is addicted to fossil fuels. The rest of the world has taken note of the benefits and is catching up fast. Britain currently obtains 90% of its energy from fossil fuels, and only 5% from renewable sources, mainly wind. Although the UK government is committed to increasing this share to 10% by 2010, delays and inaction now make this unlikely.

Around the world, coal consumption is on the increase. According to the latest BP Statistical Review, China's coal consumption has increased by 7.1%, adding 366 million tons of extra CO_2 emissions. Russia's consumption has increased by 8.3% and India's by 8.7%.

Unsurprisingly, the generation of electrical power accounts for more than 80% of all greenhouse gas emissions (Source - IEA). Most of us are clear what should be done – phase out unsustainable fossil fuels while phasing in the energy we generate from renewable sources. As responsible citizens, we are encouraged to "do our bit" and avoid committing an eco-crime by unplugging our mobile phone chargers.

So far, so good, but where can we turn for an insight into this challenge? What exactly *are* these renewable resources and how much can they really contribute? Perhaps a good place to start is a book by David MacKay entitled "Sustainable Energy – without the hot air"*. The title couldn't be more appropriate. This is a very unusual book on such a serious subject, as it is clearly written, easily accessible to the non-specialist and even available to download for free.

MacKay simplifies the mumbo jumbo that surrounds this important debate by quantifying the potential contributions made to the national energy mix by different "renewable" technologies, and relates them to our current power demand.

He then attempts to answer two questions:

1. *Can a country like Britain conceivably live on its own renewable energy sources?*

and

2. *Will a switch to "advanced technologies" allow us to eliminate carbon dioxide pollution without changing our lifestyles?*

The conclusions in response to the first question are startling. For any renewable facility to make an appreciable contribution, it has to be country sized. For example, to provide 4% of our current energy consumption from wave power, we

View From The Top

would require 500km of Atlantic coastline to be completely filled with wave farms. Theoretically, we could provide 40% of our energy requirement by covering 5% to 10% of Britain's land area with photovoltaic panels, and another 40% by building off-shore wind farms that would cover an area twice the size of Wales. To appreciate the scale of the challenge, this would amount to five times the current wind-generated power in the world today. However, the question is – "would the British public accept and pay for such extreme measures?" and if not, MacKay concludes that the current power demand will never be met by British renewable energy sources.

To answer the second question, various strategies are explored to eliminate the gap between our consumption and renewable energy production. The first part deals with reducing demand, and involves population reduction, lifestyle change and changing to more efficient technologies, all of which are political "hot potatoes". The second part examines different strategies to increase energy supply, including "clean coal", nuclear power and importation of carbon-free power from abroad. Once again, the conclusions are startling: any plan that does *not* involve nuclear power or "clean coal" will have to balance the energy books with imported renewable power from abroad, probably solar-generated power from faraway deserts.

What does this mean to us as gas processors? When it comes to burning fossil fuels to generate power, we need to consider the comparative "harm" done to the environment by natural gas, oil and coal. By far the worst of these is coal – it emits nearly 70% more CO_2 than an equivalent amount of natural gas (Source - BP). While burning any fossil fuel is ultimately unsustainable in the long term, and none are CO_2-free, natural gas has by far the smallest CO_2 impact per MW generated.

Another fact of life seems to be that politicians can be relied upon to delay the most unpopular decisions so that they must be made by their successors in office. In addition, we are part of a population that embraces new technology with an enthusiasm best described by acronyms such as NIMBY, CAVE and BANANA**. It is to be expected that the prospect of "unsightly" wind farms, and roofs covered with solar collectors, will meet stiff resistance and result in long delays before any changes are implemented.

As a result, we can be very sure that natural gas, an increasing amount of which will enter the UK and the rest of Europe as LNG from several sources, will continue to make up a significant part of the European energy mix for years to come.

(By the way, unplugging a phone charger saves around 0.01kWh per day, which is approximately the power consumed by the average car in one second.)

* David J.C. MacKay *Sustainable Energy - without the hot air* UIT Cambridge, 2008 ISBN 978-0-9544529-3-3 Available free online from **www.withouthotair.com**

** NIMBY = Not In My Back Yard
CAVE = Citizens Against Virtually Everything
BANANA = Build Absolutely Nothing Anywhere Near Anything

Justin Hearn

Obituary - Colin Biggs

Colin Biggs very sadly passed away on the 29th March after a long and gallant struggle with cancer, having given 50 years of his life to the Industry.

Colin has long been associated with the GPA, serving as a management committee member from 1999 until 2008. Colin retired from Foster Wheeler after almost 20 years, and is fondly remembered there for his enthusiasm for process engineering, a perpetual cheery outlook on life, a willingness and joy that he found in helping to teach others and an endless inquisitive nature which left him constantly searching for the best "mouse-trap".

Following his degree in mechanical engineering, Colin moved to Scotland with Babcock & Wilcox and then to the Central Electricity Board and on to Gibb Ewbank. In 1970 he worked for Shell and started his LNG career with the design of the Sembok LNG terminal in Japan, progressing to Trinidad, Canvey Island (UK), and Arzew (Algeria). He then moved on to work for Prichard Rhodes, Ameron, Manderstam and Ewbank Preece, before moving to Foster Wheeler. After his retirement he continued to work as a consultant for Energy and Power.

He was an excellent process engineer and process consultant and a real specialist in gas processing and LNG. All of us who had the privilege of working with him would say that he was a gentleman, a real process professional, a team player, excellent to work with and good fun too.

Colin leaves behind his wife Jane and family and although he will be sadly missed by all, he has left his mark indelibly printed in the hearts and minds of hundreds.

Malcolm Harrison/Brian Songhurst

Colin Biggs - at a GPA Meeting with Ron Coultrup and Christine Etherington

London Technical Meeting - Offshore Processing

The theme of the February conference held in London this year was Offshore Processing, followed by a Knowledge Session on "How to improve reliability and integrity of offshore processing". Onshore gas processing has been widely covered over the past few GPA conferences, so it was an opportune time to review some of the issues that are important to the gas industry but have a different and perhaps more complex impact on the design and operation of offshore gas processing facilities.

The first paper, *Design of an LNG FPSO*, was presented by Kishan Nayak of CB&I Lummus. Floating LNG is the current hot topic in the LNG world with a number of companies and concepts vying to be the first to implement a floating LNG production facility. Although there has been a slow down in the pace of these projects due to the current economic climate, many companies are still continuing to develop their ideas and designs to overcome some of the technical and execution issues around such developments. Kishan's paper covered the NicheLNG^{SM} process, using a dual expander with methane and nitrogen refrigerant loops, targeting small to mid scale LNG applications up to 2 MTPA. Even on these so-called mid scale FPSO LNG applications, hull dimensions of 380m x 60m are required to support the topside facilities and provide sufficient storage for the LNG and condensate products.

Kishan described how the design was progressed ensuring the necessary safety integrity, high availability, small footprint, high overall efficiency, easy operation and maintenance. A key aspect of making the floating LNG concept work is the issue of marinisation, i.e. ensuring equipment, particularly columns, reboilers and heat exchangers, perform under the expected motions of the FPSO. Kishan described current vendor experience and pilot scale testing that has been carried out in order to mitigate the risk of under performance of these equipment items.

The second paper, *How molecular sieve designs can answer to Amine unit performance*, presented by Peter Meyer of CECA, continued the topic of floating LNG but this time focused on the drying and CO_2 removal aspects of an LNG facility. Clearly, whilst molecular sieve units are not impacted by hull motions, the performance of the upstream amine unit can be. Peter's presentation addressed the implications on the design of the molecular sieve system if the amine unit performance is impacted by the FPSO motions resulting in an excursion in the CO_2 content in the treated gas. Peter highlighted that to remove CO_2 resulting from slippage through the amine unit, has a significant impact on the design and size of a molecular sieve unit. If this is not addressed in the initial design, the consequences of under performance of upstream systems and equipment on the downstream cryogenic process cannot be remedied by the molecular sieve unit. As an example, a system designed to remove both water and limited CO_2 required vessels with internal insulation rather than external insulation as well as bed diameters 50% greater than a system that is only designed for the standard water removal.

Kishan Nayak

Peter Meyer

Volker Giesen

The third paper of the morning session, *Seasick? How many times can you afford to clean up the cold box?* was presented by Volker Giesen (co-authors Torsten Katz and Gerd Modes) of BASF, and continued on the earlier themes but focused on the operation of the amine unit in a floating LNG design concept.

Volker discussed how only a small degree of maldistribution can have a significant impact on the downstream processing plant of an LNG FPSO. As an example, a 1% slippage of feed gas containing a CO_2 concentration of 2% would result in a minimum of 200ppmv CO_2 in the treated gas. This is at a level sufficient to freeze and block cryogenic sections of the plant. This highlights that in the design of the CO_2 absorber there is both a need to ensure even distribution at the top of each bed and to minimise the maldistribution within the packed beds.

The next paper, presented by Rob Hockley of Aspentech, *Application of Rate Based Column simulation in Offshore Applications such as CO_2 and SO_2 Removal*, offered a simulation tool that could potentially reduce the technical uncertainty in the design, and hence performance, of such systems in an offshore environment. Rob described the limitations of the conventional

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Rob Hockley

Helena Hill

Bernt Henning Rusten

approach to column design using equilibrium modelling; the equilibrium assumption is never satisfied in practice, it fails to accurately predict temperature composition profiles for rate-limited columns, and it uses uncertain quantities, such as efficiency and HETP, to correct for the departure from equilibrium. Rob described how a rate based modelling approach could simulate actual column performance more closely. A rate based model has more accurate predictions over a wider range of operating conditions especially for absorption and gas scrubbing processes, thereby enabling tighter designs with confidence. Rob then gave an example of CO_2 absorption, based on MEA, using the rate based modelling technique, and compared it to pilot plant data for different types of packings and CO_2 loadings. The results confirmed the superiority of model predictions of the rate based models over the traditional equilibrium-stage models, in particular for any absorption or gas scrubbing application.

The final paper of the morning session, *New configurations for Offshore High Pressure CO_2 removal*, was presented by Helena Hill on behalf of co-authors John Mak, Curt Graham and Nick Amott of Fluor.

Helena discussed the Fluor Solvent propylene carbonate process technologies that can be specifically developed for offshore designs where the gas can contain high levels of CO_2. Helena described how the process can be adapted to suit the particular level of CO_2 in the feed gas and how it can handle fluctuations in CO_2 content. The Fluor Solvent process is energy efficient as it has no heating requirement. It requires minimal equipment maintenance and operator attention, and as it is a physical solvent, it is non-corrosive, not toxic and biodegradable, experiencing no corrosion problems with carbon steel equipment. Helena also described how the process can be configured to produce CO_2 streams at higher pressures to reduce the power demand should the project require the waste CO_2 streams to be compressed and re-injected for either sequestration or enhanced oil recovery.

Martin Mayer

The afternoon session included four excellent papers building on the themes discussed before lunch. There was a late cancellation by one of the presenters, so before we plunged into the main programme John Sheffield took the opportunity to introduce the new forums feature on the GPA website. John explained how to use the site and encouraged everyone to try it out and make a success of this tool. If you haven't tried it already then do give it a go.

Bernt Henning Rusten (Co-authors Lars Henrik Gjertsen, Even Solbraa, Trond Kirkerød, Toril Haugum and Svein Puntervold) of Statoil Hydro in Norway then kicked off the session in earnest and presented *Determination of the Phase Envelope - Crucial for Process Design and Problem Solving*. Bernt Henning described how the phase envelope can have a significant impact in the correct specification of processes and equipment, both to avoid liquids in pipeline / receiving facilities and to achieve sales gas specifications. Underprediction of

A wonderful setting, lunch and company

London Technical Meeting - Offshore Processing

the cricondenbar is particularly an issue in systems with recompression from a lower separation pressure. The inaccuracy of the commonly used prediction methods is often covered up by using design margins; reduced cost or extra capacity may therefore be achieved with the use of more accurate predictions. Bernt's presentation was an interesting summary of an in-depth paper backed up with substantial field and lab analysis. It included a discussion of methods for gas sampling and experimental work, a comparison of dew point predictions using various thermodynamic equations of state as well as sharing some experiences related to the importance of accurately predicting hydrocarbon dew points.

Moving on to a theme of equipment design for the next two papers, Mike Smith, presenting on behalf of Sacha Sarshar and Najam Beg of Caltec Ltd in Scotland, gave us *Applications of Jet Pump Technology to Enhance Production from Gas Fields*. Practically all mature gas fields face a significant reduction in the reservoir pressure as they approach the end of field life. This, together with production of liquids, restricts production and limits total field recovery. Jet pump technology can be a cost effective way to enhance production and in many cases uses energy which would otherwise be wasted. The technology can be effective/economic even when the source of HP gas is only available for a relatively short duration. Mike gave an overview of jet pump technology and talked the audience through examples of their uses in offshore gas processing. Using his experience of recent field applications, Mike also highlighted a number of operation and design issues to be aware of.

Bart Prast

Rob Turner

After some discussion over coffee, we returned to equipment design issues with Bart Prast (co-authors Marco Betting and Hugh Epsom) of Twister BV in The Netherlands, presenting *Improved Choke Valve Design for Debottlenecking Gas Processing Facilities*. Bart gave an overview of the Twister SWIRL valve technology as well as demonstrating the benefits to downstream separation with the use of field data from the NAM Opende Oost gas production facility. The SWIRL valve establishes a vortex motion rather than distributed eddies as in a conventional valve thereby avoiding excessive break up of liquid drops. In addition these micron-sized droplets are concentrated around the perimeter of the flow path, thus enhancing the coalescence to larger, more easily separable droplets. Bart explained that as well as significant capacity benefits compared to a conventional labyrinth trim valve (over 20% increase was achieved in the tests at which point the fiscal export meter became limiting), the cold separator temperature can be reduced by 4 - 5°C allowing a reduction in the plant feed pressure by about 3 bar.

Last but by no means least, Rob Turner of ABB Engineering Services in the UK presented *Alarm Management - a key element of process safety*. Rob gave an overview of the importance of good alarm management in HSE protection with several examples of what can happen if we get it wrong. The audience were

Mike Smith

A chance to discuss the presentation

London Technical Meeting - Offshore Processing

challenged to think where their organisations or projects are in terms of the "four ages" of alarm management and then given examples of possible benefits of a comprehensive alarm management system backed up with offshore case studies.

All in all, four interesting and well presented papers with plenty of questions to keep the presenters on their toes. GPA Europe Chairman, Justin Hearn, closed the session, congratulating, to warm applause, the day's speakers on their efforts and for the quality of the papers. *Matt Park*

Session chairmen Martin Mayer and Matt Park with the speakers

London Knowledge Session - Offshore Processing

The technical conference was extended into the Friday morning when the GPA Europe again provided a "Knowledge Session". These meetings are increasingly being recognised by our company members as a valuable resource in giving training and updating the understanding of people in the industry, particularly those newer to our work. The session topic was tied into the overall theme of the conference and was presented by Ron Hewson, Paul Dennis and Alan D'Ambroglio of ABB Engineering Services who also kindly sponsored the meeting. The topic of the session, *How to Improve Reliability and Integrity of Offshore Processing,* was highly pertinent.

After a brief introduction to the company and their services, Ron kicked off with a subject dear to the heart of operating companies with ageing assets. As an offshore facility draws towards the end of its design life, how can we extend the operation of the facility safely and with optimum reliability yet in a cost effective manner? He took us through the approach to assessment of the asset life. Some excellent graphics combined with the in-depth knowledge looked at how the facility deteriorates with time and measures that can be taken. The issue centres on managing the integrity of the facility and risk management. This was reinforced with some case studies to help ground the theory.

Paul Dennis then moved us on to look at how we can asses the reliability of an ageing asset and improve on that reliability. Total Plant Reliability® is the term used by ABB and he took us through the issues related to Process, People, Equipment and Measurement. He pulled no punches in regard to the work involved, but also highlighted the rewards if the reliability improvements possible are achieved in ageing facilities.

The GPA Europe would like to thank ABB Engineering Services for their support of the Knowledge Sessions and the three presenters. Please look out for future Knowledge Sessions!

Nick Amott

Venice - here we come!

Well Boss, Don Cooney said to take the right into the Guidecca Canal for the Hotel, but I took the left and lost a bit of baggage over the side"

Justin, are you sure this is the water taxi to the hotel?

Spring Conference, Sitges, Spain

Over 75 participants beat the travel restrictions imposed by many credit crunched companies in the industry to participate in the Sour Gas Conference - the latest offering from GPA Europe. The Spring Conference was held at the Dolces Hotel in Sitges, Spain, on 14th May, 2009. The morning session, moderated by Murtaza Khakoo of BP Exploration, UK, presented six excellent papers on sour gas processing topics which included sulfur recovery, acid gas injection, carbonyl sulfur/mercaptan removal and on corrosion/material selection.

First on the podium was Ken Allan (co-author Robin Street) of Worley Parsons who presented *"Supersize me" - Worldscale SRU/TGTU goes Operational in Kazakhstan*, a paper describing some of the challenges in the design and installation of the world's largest sulphur plant at 2350tpd for TengizChevroil. The paper covered limitations in fabrication of components such as the tube-sheet for the waste heat boilers, sulfur condenser, reaction furnace, acid gas burner, large air blowers and valves. The project also had to consider the challenges of transporting the equipment (up to 506te) through the Volga-Don canal to the Caspian and then 600km by rail to site. Designed for 99.9% S recovery, the single sulfur train extended over 0.5km and Ken showed some awesome pictures of the equipment and installed unit. Key issues in operation have been the complexity of the control system with parallel reaction furnaces.

With a track record of over 90 technical presentations / 50 papers on Acid Gas Injection (AGI), John Carroll of Gas Liquid Engineering made the next polished presentation, *Acid Gas Injection - the Next Generation*. Referencing some of the 50 Western Canada and 20 US facilities as small scale AGI applications - less than 10mmscfd, John discussed how the AGI flowsheet has evolved - with/without dehydration, dehydration options; with reciprocating compressor only or plus dense phase pumps etc. In medium scale - up to 50mmscfd, John included CO_2 sequestration projects such as In Salah Gas, Sleipner, Snovhit together with acid gas applications such as La Barge, Kwoen and Qatar - each driven by Sulfur market constraints and space for blocking. In large scale (>50mmscfd), John discussed the mother of all projects, the emerging Shah project (1bcfd of sour gas, 23% H_2S, 10% CO_2) producing 330mmscfd of AGI, although the final concept selected large scale sulphur production which has an equally challenging technology application in the use of large SRU and 150km liquid sulfur pipeline - 4 x current scale. Key challenges for the next generation of large scale AGI were type of compressor - centrifugal vs reciprocating machine (up to ~35acfm); high pressures and the need for dense phase pumps, redundancy, turndown, reservoir with sufficient capacity, injection pipeline network and safety due to large inventory and multi-injection horizontal wells.

Saeid Mokhatab of Tehran-Raymand was next to present a joint paper, *Selecting Best Technology Lineup for Designing Gas Processing Units*, an over-load of technology options and selection for the design of sour gas processing plant. Three options had been considered: using open art processes; evaluating a combination of proprietary technologies from different licensors or choosing complete solution from a single

John Carroll

Saeid Mokhatab

Ken Allen

Time for a serious chat

Spring Conference, Sitges, Spain

Peter Meyer

Gauthier Perdu

technology provider/integrator. Examples provided on the process selection issues and for the 3rd option, showed the different solutions proposed by Lurgi, Shell and Total. Saeid then handed over to Peter Meyer of Ceca to review some of the opportunities presented in the use of Molecular sieves in the overall line-up. Given the constraint to source technologies, a limited selection of process options was covered but nevertheless key processing issues brought out.

Luke Addington (co-author Chris Ness) of Bryan Research & Engineering presented a well researched paper, *An Evaluation of General "Rules of Thumb" in Amine Sweetening Unit Design and Operation*. This paper reviewed four "rules of thumb" - sour feed gas inlet temp / lean amine approach (5°C); 0.12 kg/l steam; rich amine outlet temperature from lean/rich exchanger (99-110°C) and regeneration pressure limit of 2.1bar. Using tailored BR&E Promax programme simulations, Luke was able to demonstrate the requirement for the rule of thumb, although values can be tailored to specific applications to yield significant enhancement of amine unit design. He then provided two case studies which showed the benefits of Promax simulations.

In the fifth paper of the morning, Gauthier Perdu of Prosernat (co-authors J Kittel of IFP and M Bonis of Total) presented *Corrosion Control on Amine Plants Allows Compact Unit Design with High Acid Gas Loadings*. In the paper, made simple for process engineers, Gauthier discussed corrosion mechanism and best practice material selection derived from 66 Total/IFP/Prosernat DEA/MDEA amine plants including ones with high solvent loadings to 0.9mol/mol with predominantly CS material, some operating since 1972. Gauthier commented that the wider application of lessons in material selection was constrained by NACE H_2S partial pressure directives, although the 2007 revision reduced some of the constraints of the 2003 NACE version. Total/IFP/Prosernat have now performed tests to show that the influence of alkaline pH in amine solutions is different from the acidic assumptions in NACE and are following this up with the NACE committee.

Volker Giesen (co-author Torsten Katz) of BASF presented the last paper of the morning session on *The Challenge of Deep COS Removal: Which Options do we have?* Adopting a university don-style of presentation which helped to obscure a competing strong natural stimuli - lunch - he discussed the thermodynamic equilibrium of COS hydrolysis in water saturated feed gas with H_2S and CO_2. Volker explained the principle for COS removal in a-MDEA for deep CO_2 removal applications and explained the difference in mechanism for the physical or hybrid amine solution. Pros & cons of the two alternatives were discussed. The paper concluded with a short discussion on the route of COS removal in a Qatar gas processing plant line-up.

Each of the six papers for the morning session presented a different aspect of sour gas processing and a good advertisement of what makes sour gas processing an interesting field with lots of opportunity for creative solutions and designs.

Murtaza A Khakoo

After an excellent lunch, the afternoon session began with a presentation by Dr Glen Smith (co-authors Neil Tooley and Dr Arthur Cummings), representing the newest GPAE member, MPR Services Inc. Glen's paper, *Making Amine Systems Sing,* reviewed the various contaminants found in amine systems, the tools used to remove these contaminants and reclaim circulating amine, and the advantages and disadvantages of each approach. He began with a brief overview of the financial benefits of amine reclamation, pointing out that a survey had indicated a refinery processing 230,000 bbl/day

Luke Addington

Volker Giesen

anticipated annual savings of $30 million by reclaiming contaminated amine solutions. Glen then reviewed the effects of a number of different contaminants, as well as the advantages and disadvantages of several routes for contaminant removal including "bleed and feed", neutralization, ion exchange, distillation and electrodialysis.

The first contaminants considered were Heat Stable Salts (HSS). He noted that HSS are one of the leading causes of reduced capacity in amine systems, as well as contributing to corrosion, increased viscosity and foaming. "Bleed and Feed" is considered to be the easiest way to handle HSS contamination, although amine replacement and disposal costs have risen. Glen reported that ion exchange has been successfully employed by MPR over the years to provide a chemically clean and environmentally friendly method of removing HSS. Distillation is considered to have an economic advantage if HSS concentrations are high, but generates a concentrated waste that some agencies consider hazardous. He also reviewed the pros and cons of neutralization and electrodialysis for handling HSS. Glen then spent some time discussing the effects of amino acids, such as bicine, on amine systems. He pointed out that the presence of amino acids is of concern due to their corrosive nature at low concentrations. The same routes for contaminant removal were reviewed. He noted that "Bleed and Feed" is of little benefit due to the very low levels of contaminant.

Dr Glen Smith

Gauthier helps the audience grapple with corrosion rates

Under the heading of ion exchange, some time was spent reviewing MPR's HSSX® process. He noted that ion exchange was particularly well suited to bicine removal. Other contaminants discussed were amides, diamines and ureas, solids and hydrocarbons. During the discussion of solids removal, Glen introduced MPR's new SSX® process. This is a regenerable filter that attracts particles rather than blocking them. The result is a filter system that has significantly less tendency to plug, although its drawback is that it may not remove all particles on the first pass. For hydrocarbons, MPR offers their HCX™ process which relies on attracting hydrocarbons on to a regenerable (by backflushing with hot water) surface. Lastly, Glen discussed the deleterious effects of foaming in amine systems and the ineffectiveness of defoaming systems. Instead he recommended MPR's Sigmapure™ process. This process takes a slipstream and deliberately initiates foaming in a separator. The amine drains from the foam and is returned to the unit. The foam is then discarded as waste.

The second paper of the afternoon was presented by Dr Gerard van der Zwet of Shell Global Solutions (co-authors Mark Claessen, Renze Wijntje, Prashant Patil, Armin Schneider and Craig Taylor). Gerard's paper, *Sulfinol-X - Leveraging the Advantages of Several Well-proven and Established Technologies in a Single Acid Gas Removal Process*, introduced Sulfinol-X, the latest product in a line of hybrid solvents such as accelerated MDEA and Sulfinol-D. As sweet gas reservoirs become rarer and sulfur contents become more stringently regulated, such as those in the new EU proposals for sales gas and LNG, the removal of trace contaminants such as COS, CS_2, mercaptans, H_2S and others becomes more critical. The acid gas recovery unit (AGRU) is typically employed to remove H_2S and CO_2 using solvents such as DEA, MDEA, DIPA, etc. Hybrid solvents, such as the Sulfinol line, employ the advantages of amines in removal of H_2S and CO_2 together with other agents such as sulfolane to remove other contaminants such as mercaptans and COS. Additionally,

Gerard van der Zwet

accelerated MDEAs were introduced in the 1990s. These use accelerants such as piperazine to increase the reaction kinetics for absorption specifically of CO_2. In 2000 Shell introduced ADIP-X as a proprietary accelerated MDEA. However, in systems that have significant organic sulfides, additional processing beyond a-MDEA is required. For mercaptans, a typical plant layout would require a molecular sieve system for mercaptan adsorption. Other than the complexity of adding a solid adsorption train, the presence of such a unit can require a dedicated regeneration gas stream to avoid build-up of mercaptans in the recycle loop. As the regeneration gas is usually fed to a Claus unit, transient organic sulfides lead to varying concentrations of acid gas in the reaction furnace causing spikes in oxygen demand.

Sulfinol-X has been developed to eliminate the need for separate treatment of organic sulfides outside of the AGRU. This second generation hybrid solvent is a blend of MDEA, piperazine and sulfolane. Pilot plant studies were performed to compare Sulfinol-D (MDEA and sulfolane) to the new Sulfinol-X. The two solvents showed comparable mercaptan removal, but the addition of piperazine to Sulfinol-D has also enhanced the reaction kinetics with respect to the adsorption of COS. Sulfinol-X also demonstrates significantly reduced energy consumption due to favorable performance in solvent circulation rate and CO_2/H_2S desorption energy, the two factors that largely influence energy consumption. The DIPA-base of Sulfinol-X reacts 2:1 with CO_2 compared to the MDEA base of Sulfinol-D (1:1 reaction with CO_2) leading to higher loading capacity and reduced heat requirement. Gerard then gave some examples of plant studies comparing Sulfinol-X in a solvent swap (from Sulfinol-D in an existing plant) as well as the design of a new plant. In the solvent swap example, Sulfinol-X is recommended for companies currently using Sulfinol-D and looking for reduction of energy consumption, lower chemicals consumption and tighter gas specifications. In a new plant, Sulfinol-X was compared against accelerated MDEA in the design for an LNG project. The plant design utilizing Sulfinol-X showed lower capital cost and overall required a much simpler process stream. Finally he reviewed two AGRUs that have swapped to Sulfinol-X formulation from Sulfinol-D "on-the-fly" by adding MDEA and piperazine separately or by swapping the solvent to ADIP-X.

Nick Amott

The Chairman discretely reminds Volker of the punchline

The third paper of the afternoon session, *The DAP and STREP Processes for Acid Gas Enrichment and Claus Tail Gas Treating,* was presented by Nick Amott (co-authors Vincent Wong, John Mak and Thomas Chow) of Fluor. His presentation focused on two Fluor patent-pending technologies, DAP (Double Adsorption Process) and STREP (Selective Treating Regeneration Enhancement Process). These two processes are designed to reduce energy consumption and equipment count when dealing with lean acid gases containing ammonia, BTEX and cyanides. The process also enhances sulfur removal when compared to conventional processes. The DAP is designed to remove H_2S from lean acid gas streams. The H_2S is selectively removed by MDEA or sterically hindered amines. The solvent is then stripped and the H_2S added back to the gas to produce a rich acid gas for processing in a Claus unit. A variant of this process integrates the DAP configuration with a tail gas unit to reduce the overall project cost. The semi-lean solvent from the tail gas absorber is reused to reduce the overall solvent circulation and eliminate the need for a dedicated regenerator.

The STREP process is designed to provide flexibility and improve energy efficiency by treating two separate lean solvent streams with different lean loadings. The process flexibility comes from the ability to adjust lean loadings of lean and ultra-lean solvent streams to eliminate over-stripping, thereby reducing energy consumption. The absorber tower is split into two sections, with the upper section receiving the ultra-lean solvent and the lean solvent being introduced into the middle section. The different DAP and STREP configurations are suitable

Spring Conference, Sitges, Spain

Peter Hawes

Steve Massie

for a wide range of applications that need to meet more stringent emissions requirements.

After a short break, the session resumed with a presentation by Peter Hawes of Zeochem titled *Mastering Mercaptans*. Peter started with a short review of the history of Zeochem and the adaptation of their 13X molecular sieve to improve mercaptan adsorption, particularly in the areas of kinetics and process stability (resistance to coking). He described the initial commercial plant at South Pars 1 with special reference to the concerns regarding minimizing the high quantity of regeneration gas. He described a problem with carryover of glycol into the mercaptan removal unit (MRU). Although the glycol was initially caught on the protective layer of alumina, the low regeneration flow rate caused glycol to build up in the protective layer and eventually wash down into the molecular sieve bed and decompose. The solution was to alter the processing order by re-piping the MRU to be after the dew-point control unit (DPCU). The DPCU effectively removed all the glycol from the gas, which allowed the unit to run smoothly and within specification, producing gas with less than 1 ppm S. Zeochem continues to monitor and adjust the MRU and has recommended a layered bed of molecular sieve. The new bed design has an upper layer of 4A to remove moisture, a middle layer of 5A to remove lower MW mercaptans and a bottom layer of 13X to remove the high MW mercaptans. Zeochem has recently brought a portable mass spectrometer on-site to analyze the outlet streams and the percentage of the different mercaptans present.

Peter indicated that the new bed design will be part of the Lurgi Omnisulf® integrated process to be utilized at South Pars 12 and the Iran LNG project. Omnisulf combines an Acid Gas Recovery Unit, Sulfur Recovery Unit, a molecular sieve bed to remove mercaptans and a Purisol unit to take the high mercaptan content of the molecular sieve regeneration gas. Total sulfur capture of >99% is projected. Finally Peter reviewed Zeochem's continuing development of 13X with particular emphasis on adsorption of COS.

The final presentation of the day was given by Steve Massie of Criterion Catalysts. The presentation, entitled *Low Temperature Tail Gas Treating - It Saves More than Fuel!* reviewed Criterion's experience with their new Criterion 734 spherical tail-gas catalyst. Steve briefly reviewed the technology behind hydrogenation tail-gas units utilizing catalytic reduction and hydrogenation to convert the sulfur compounds in the

The Speakers, Session Chairmen Murtaza Khakoo and Ray Racher join Programme Committee Chairman Lorraine Fitzwater and GPAE Chairman Justin Hearn

Spring Conference, Sitges, Spain

Claus tail gas to H_2S,which is then absorbed by the downstream amine systems and recycled to the Claus incinerator. Efficiently operating Claus and tail gas systems recover 99.8-99.9% sulfur. He then described the history of Criterion's 234 catalyst with particular emphasis on the reduction of reactor inlet temperature from the standard 280°C to 240 and lower, with the attendant energy and capital cost reduction. However, there may be "secondary" benefits of the LTTGT, even when the unit is designed to run at conventional Reactor Inlet Temperatures (RIT).

Steve described several examples, the first was of a reducing gas generator burner where the owner experienced high levels of vibration. Because of the option of using Criterion 234 at low RIT the owner reduced the burner firing rate, at which time the vibration ceased. Another example looked at reducing the RIT to regain control of the air demand in a Claus plant. The third example described the operation of the TGT at low RIT after a loss of efficiency in the indirect fired heaters due to coke formation. After decoking the tubes, the owner kept operating at low RIT to reduce the chance of a recurrence. LTTGT is also useful in flame-out situations. The SO_2 reduction reaction provides some heat and, in one example of flame out, the high activity of the catalyst maintained sulfur emissions below environmental regulations even though the top bed temperature had dropped as far as 182°C. Steve's last example related to plants which routinely run their Claus units at increased H_2S:SO_2 ratios to remove sulfates. This operation also generates sufficient hydrogen to feed the tail gas process, so that plants with limited or no hydrogen production can still use LTTGT with indirect heaters. To wrap up, Steve reviewed the development of the spherical TG catalyst Criterion 734. He noted that this catalyst shares the very low pressure drop characteristics of Criterion 534 but also demonstrates improved activity with regard to COS conversion.

After the technical papers, Alf-Eric Wischnat of BASF gave a brief overview of BASF Catalysts and prepared the group for the following day's site visit to BASF Tarragona.

Ray Racher

New Corporate Members

Welcome to our new Corporate Members who have recently joined

Level 1

GDF SUEZ, Paris, France, one of the leading energy providers in the world, is active across the entire energy value chain, in electricity and natural gas, upstream to downstream. The Group develops its businesses (energy, energy services and environment) around a responsible-growth model to take up the great challenges: responding to energy needs, fighting against climate change and maximizing the use of resources.

Level 2

MAXOIL SOLUTIONS Aberdeen, Scotland, provides a global consultancy service to the Oil and Gas Industry, targeting all aspects of process performance optimization via a practical troubleshooting approach.

Cripps Sears and Partners, London, UK, is an energy practice that has been evolving since the late 1970s. Cripps Sears is a global firm focussed on a global industry. Network and reach are further complemented by a working relationship and collaboration with the World Search Group, an affiliation that supports their capacity to provide their clients with global insights as well as local knowledge.

Level 3

Optimized Gas Treating, Inc. (OGT), Oklahoma, USA, was established in 1992 for the single purpose of providing a commercial version of a Windows-based software package for simulating acid gas removal with aqueous alkanolamines that uses a fundamental mass and heat transfer rate approach to column modelling.

MPR Services, Devon, UK, enhance gas treating systems in refineries, gas plants, ammonia plants, steel manufacturing and LNG facilities. They supply technically advanced mobile and permanently installed equipment, patented processes, and analytical services for cleaning and recovery of gas treating solutions with a corresponding economic and environmental improvement in plant operations.

The Officers of the GPA Europe for 2009

Chairman:	Justin Hearn, BASF SE
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Spring Conference Site Visit - BASF Tarragona

Following what can best be described as a magical mystery tour, for which we had duly rolled up at the appointed hour, we eventually arrived and were warmly welcomed by BASF for a visit to their Tarragona facility. BASF is one of the world's leading chemical companies manufacturing products supporting the natural gas and oil industries, and ranging from petrochemicals and innovative intermediates to high-value-added chemicals, crop protection agents and pharmaceuticals.

BASF were established in Spain in 1966 and the Styropor® (expandable polystyrene) plant was commissioned in the Tarragona industrial estate in 1969. After successive extensions of the facility over many years a multitude of products are manufactured, with energy efficiencies being advanced by the shared nature of the Tarragona complex. After an introduction to BASF and the Operation in Spain, we were taken on a tour to see some of the facilities which are predominantly speciality chemicals. The Tarragona site, whilst centred around BASF, also hosts some third party and JV facilities so we were able to see the large 350,000 t/y Propane Dehydrogenation facility which is a partnership with Sonatrach; some of the product feeds a polypropylene plant which is located in the centre of the site but is now owned by third parties. We also made a circuit round the recently installed RWE 350 MW Cogeneration plant which supports the integrated nature of the facility. Finally we were given a tantalising glimpse of the BASF polypropylene catalyst preparation facility; the process inside the building is secret so we satisfied ourselves in other ways with a lunch kindly provided by our hosts.

BASF Tarragona

Thanks again to the BASF team for their generous hospitality.

Jon Lewis/The Editor

Photos on this and following page are both courtesy of BASF

Call for Papers

For Future Conferences 2009 - 2010

September 2009, Venice, Italy – Open Theme Conference

November 2009, London – Multiphase Pipelines

February 2010, Paris, France • May 2010, Vienna, Austria • September 2010, Lisbon, Portugal

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

Spring Conference Site Visit - BASF Tarragona

BASF Tarragona. The site is divided by the railway line. In the foreground is the reception area. Beyond the PP product storage area and silos is the Propane dehydrogenation unit. The centre shows the power plant and to the left in the foreground is a group of complex plants including the Polypropylene unit and the catalyst manufacturing area. Finally there are the specialty chemical facilities.

Entrepreneurial Investing, Credit Crunch…what Credit Crunch!

Young Chuck moved to Texas and bought a Donkey from a farmer for $100. The farmer agreed to deliver the Donkey the next day.
The next day he drove up and said, 'Sorry son, but I have some bad news, the donkey died.' Chuck replied, 'Well, then just give me my money back.' The farmer said, 'Can't do that. I spent it already.' Chuck said, 'OK then, just bring me the dead donkey.' The farmer asked, 'What ya gonna do with him?' Chuck said, 'I'm going to raffle him off.' The farmer said 'You can't raffle off a dead donkey!' Chuck said, 'Sure I can - Watch me. I just won't tell anybody he's dead.'
A month later, the farmer met up with Chuck and asked, 'What happened with that dead donkey?' Chuck said, 'I raffled him off. I sold 500 tickets at two dollars a piece and made a profit of $998.' The farmer said, 'Didn't anyone complain?' Chuck said, 'Just the guy who won. So I gave him his two dollars back.' Chuck now works for an investment banker.
Submitted in the week that Goldman Sachs and JP Morgan reported Q2 profits of $3.4 Billion and $2.7 Billion respectively.

NOMINATIONS FOR THE 2009 CONSTRUCTION AWARDS

FORTHCOMING EVENTS

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

Conference Sponsors:

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12th November 2009
Marriott Marble Arch, London
Multi Phase Pipelines and Processing
- Knowledge Session
- AGM
- Technical Meeting

24th -26th February 2010
Marriott Rive Gauche,
Paris, France
- Technical Meetings
- Knowledge Session

19th - 21st May 2010
Hilton Vienna Danube,
Vienna, Austria
- Unconventional Gas Conference
- Possible Site visit

22nd - 25th September 2010
Lisbon, Portugal
27th Annual Conference
- Knowledge Session
- Technical Sessions
- Conference Dinner
- Possible Site visit

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GPA EUROPE

CORPORATE MEMBERS

This listing of current Corporate Members represents the status as at the end of June 2009. All companies are UK based unless otherwise stated.
In addition there were 225 Individual Members

Corporate Level 1 PREMIER (19)

BASF SE	**Germany**	**M W Kellogg Ltd**	
Bechtel Ltd		**Pall Europe**	
BP		**Shell Global Solutions Int BV**	**Netherlands**
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Foster Wheeler Energy Ltd		**Total**	**France**
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Lurgi AG	**Germany**		

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ABB Engineering Services		JSC TNK-BP Management	Russia
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Amines & Plasticizers Ltd	India	NORIT Nederland BV	Netherlands
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BG- Group		SAZEH Consultants	Iran
CB & I Ltd		Siirtec - Nigi S.p.A.	Italy
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Eni Div E&P	Italy	Tehran Raymand Consulting Engineers	Iran
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GDF SUEZ	France	WorleyParsons	
ILF Consulting Engineers			

Corporate Level 2 (51)

Aibel AS	Norway	Maxoil Business Solutions	
Atkins Oil and Gas		Mott MacDonald	
BASF Catalysts Germany	Germany	Newpoint Gas Services Inc	USA
Bryan Research And Engineering	USA	Oil & Gas Systems Limited	
Cameron Petreco Process Systems		P S Analytical	
Centre for Marine CNG Inc	Canada	Peerless Europe Ltd.	
Cripps Sears and Partners		Penspen Ltd.	
Criterion Catalysts & Technologies LP	USA	Pietro Fiorentini	Italy
DtEC Services Limited		Prosernat	France
E & P Consulting		Purvin & Gertz Inc	
E.I.C. Cryodynamics Division		PX (TGPP) Limited	
Escher Process Modules BV	Netherlands	Rotor-Tech, Inc	USA
Exterran (UK) Ltd		SBM Offshore Gusto MSC	Netherlands
Fives Cryo	France	Siemens Nederland NV	Netherlands
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Hamworthy Gas Systems	Norway	Twister BV	Netherlands
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ISG	Italy	VTU Engineering GmbH	Austria
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		Zeta-pdm Ltd	

Corporate Level 3 (11)

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MPR UK Ltd			

Academic Level (1)

NTNU	Norway

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