



IN BRIEF

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GAS PROCESSORS ASSOCIATION EUROPE

LNG EVOLUTION - MODULAR & DIGITAL

By John Repasky, Senior Engineering Leader, and Alicia Trent, ssLNG Product Leader, GE Oil and Gas

The LNG industry continues to evolve with new challenges and ongoing volatility.

New technologies, unconventional resources and offshore discoveries are restructuring trade patterns, pricing dynamics, and business models, creating new opportunities and challenges for natural gas development.

Recent LNG mega-projects have also experienced cost overruns, schedule delays, logistical and other project-specific issues that have jeopardized project economics. While natural gas and LNG continue to be preferred fuels aligned with environmental, performance, and cost drivers, the next generation of LNG liquefaction projects faces increased risk in an environment of low energy prices and political uncertainty. Modular design small- and mid-scale LNG technologies and their product line designs are finding traction as an alternate solution to the conventional large scale baseload plant. Advanced controls including remote plant access, condition-based maintenance,

and performance optimization enable safe and efficient operation of these assets – whether operated as distributed assets or as multiple trains combined on a larger site.

Modular design and fabrication of LNG liquefaction facilities with repeated use of standard modules enables paradigm shift in efficiency and reduced risk across an entire LNG liquefaction project, including project

development and technology selection, engineering and design, supply chain and equipment procurement, shop manufacturing, site assembly, commissioning and start-up, and maintenance. Initial project development of a typical large-scale stick-built facility begins with site selection and significant pre-FEED engineering work

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Figure 1. Modular LNG Liquefaction Facility

INSIDE



3 VIEW FROM THE TOP
New Chairman Steve O'Donnell with his vision for the future



5-14 ATHENS ANNUAL CONFERENCE
A round-up of the sessions and opinions



15-18 LONDON TECHNICAL CONFERENCE
The talking points from the event

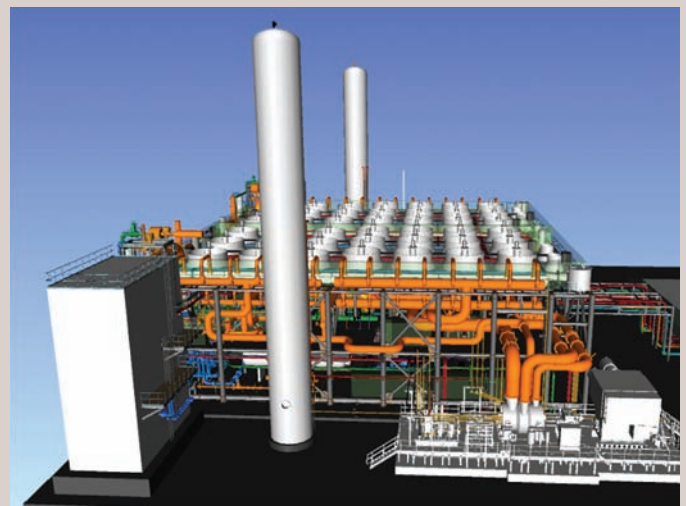
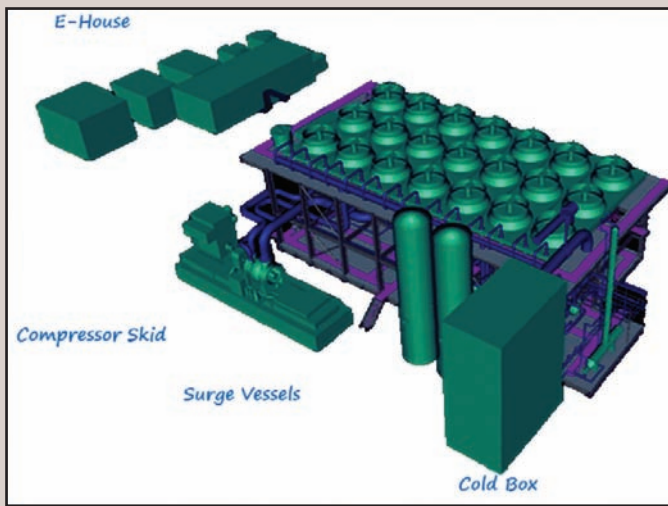


Figure 2. Project specific configuration (right) shows maximum module re-use and only minor site-specific layout modification of GE’s next-gen standard arrangement LNG liquefaction train (left).

Continued from page 1

to optimize and develop scope, all the while appreciating the lengthy construction schedule and risk management for the single potential large-scale capital investment that lies ahead; in fact, multiple pre-FEED studies are often conducted for multiple project sites and down-selected for the final investment. In contrast, technology selection and optimal module arrangement can happen much more quickly in the pre-FEED engineering stage of a modular project. Schedule and costs are further reduced in the engineering FEED stage, where modular designs are essentially off-the-shelf complete through unit operation designs, piping isometrics, valve specifications, controls, and 3D plant models. Rather than focusing on the custom design of a new train or custom equipment, the engineering team focuses on rating existing designs (which are continuously updated offline in a product-based approach) and optimizing the liquefaction process and equipment selection based on the feed gas composition, site conditions and client goals. Once approved, modular projects kick-off quickly and initiate equipment procurement under pre-negotiated supply agreements – project cost and schedule are reduced again, this time through repeat purchases in

established supply chains. Equipment is received into a controlled shop fabrication environment for repeat manufacturing and assembly. In fact, larger manufacturing sites have the capacity to assemble the majority

MODULAR CONSTRUCTION OF MULTIPLE LNG LIQUEFACTION TRAINS ENABLES PHASED CAPITAL INVESTMENT TO MATCH SUPPLY WITH DEMAND

of an entire LNG liquefaction train for fit-up, validation, and pressure test before ever leaving the shop and shipping to site (shown in Figure 1). Once at site, modules are set on foundations and re-assembled. Construction time in the field is minimized, along with the risks associated with local geography,

weather, workforce, and political environment unique to each site. Commissioning and start-up of the one or multiple LNG trains is essentially a repeat process, rather than being entirely unique to each site. Once operational, maintenance and spare equipment inventory continues to be advantaged by the modular supply chain and repetitive spare strategy.

While the engineering, manufacturing, start-up, and maintenance synergies of repeat modular construction are generally well-known, macro-scale benefits are often overlooked. Rather than concentrating natural gas supply, project construction, and future demand risks in a single large capital investment, modular construction of multiple LNG liquefaction trains enables phased capital investment to match supply with demand – project schedules are shortened and capacity can be expanded as demand grows. This advantage is particularly attractive toward mid-scale projects and smaller gas fields amidst today’s tight market demand and pricing.

The advantages of modular construction often outweigh economy of scale of large stick-built facilities with their longer field construction schedules and greater financial exposure. Today’s modular LNG plant designs with standard train sizes up to 1.2 MTPA show advantages over stick built facilities in the small- and mid-scale range, up to a site capacity of around 2.4 MTPA of LNG. Multiple modular designs can also compete attractively at large-scale LNG facilities.

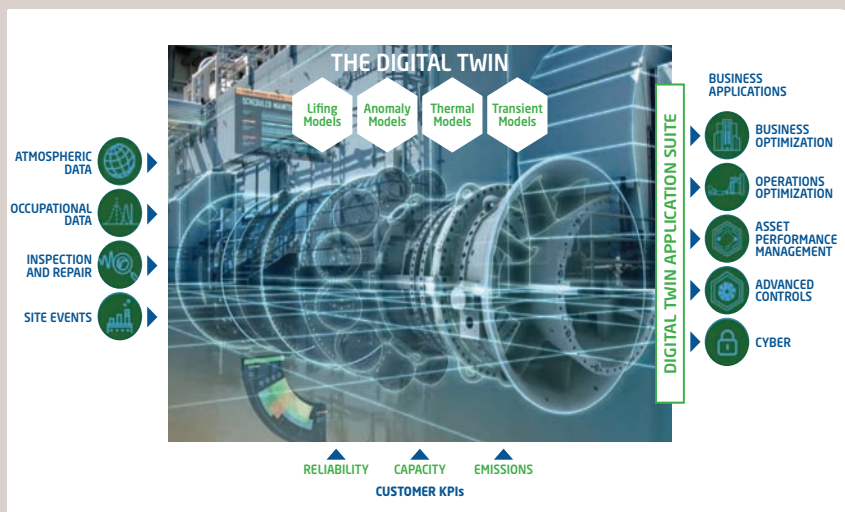


Figure 3. GE’s PREDIX™ cloud operating system includes Digital Twin capabilities to monitor and optimize real-time performance and condition-based maintenance requirements of industrial facilities. Design, manufacturing, operating, and maintenance history of an asset is stored in its Digital Thread.

Advanced controls and the Industrial Internet of Things, enabled by low-cost sensor technology, diagnostic algorithms, and cloud computing are enabling further paradigm shift in the operations and maintenance of LNG liquefaction facilities – whether they are modular or large-scale stick-built design.

The energy sector has witnessed development and proliferation of sensor technology and advanced plant controls over the last two decades, and the next generation of capabilities continues to expand. The development and manufacturing of sensor technology has matured, sensors have proliferated themselves into our everyday personal lives (e.g. cameras, security, automobiles), and custom devices can often be developed for new industrial applications at reasonable cost. The Internet of Things (IoT) has exploded from 0.5 billion devices in 2003 to nearly five billion devices in 2009, and approaching 30 billion devices today – including your home, your car, the traffic signal on your way to work, and much of industry – sensors and data are everywhere around us.

ADVANCED CONTROLS AND THE INDUSTRIAL INTERNET OF THINGS ARE ENABLING FURTHER PARADIGM SHIFT IN THE OPERATIONS AND MAINTENANCE OF LNG LIQUEFACTION FACILITIES – WHETHER THEY ARE MODULAR OR LARGE-SCALE STICK-BUILT DESIGN

Today's new paradigm is in how data enables better and more informed decisions. Two major trends are in Performance Optimization and Predictive Maintenance (also referred to as Condition-Based Maintenance, or CBM) – and these trends are already growing well beyond individual assets to spread across entire industrial supply chains, inventory management, and distribution. At an initial level, this digital environment enables increased visibility, providing remote plant access and an environment for optimization

and collaboration. At the next level, advanced applications enable real-time Performance Optimization and comparison of individual asset performance against other assets and industry benchmarks – while this level of integrated real-time performance optimization is core to managing today's electrical grids, significant opportunity continues to exist across the energy sector, including LNG. Advances are also occurring in Predictive Maintenance, where existing or low-cost sensors can be implemented to measure and correlate degradation in equipment performance and make recommendations to improve economic, environmental, and reliability performance of the overall asset. These recommendations can range from advisory which may be best for unique large-scale assets, through a fully automated supply chain solution including parts distribution and service calls which may be attractive for distributed or modular assets.

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VISION FOR THE FUTURE

VIEW FROM THE TOP

Steve O'Donnell presents his view for the future, as he takes over the role of GPA Chairman from Paul Openshaw.

Firstly I would like to take this opportunity to personally thank Paul for his amazing contribution and leadership over the last two years and for making my job incredibly easy. I'm not sure that I will be able to reciprocate for Martin Copp but I'll certainly do my best.

We've all had to come to terms with the lack of investment in our industry caused by the downturn in the world energy markets and the inevitable outcome of projects being cancelled or seriously delayed, job cuts, cut-backs and restrictions. This has meant that we've all had to try and adapt our business models or look elsewhere for projects and even look outside our industry or usual client base.

What's uncertain is just how long this is going to continue and what shape our industry is going to be in by the time it's finished. We've already seen huge cuts in the number of people employed and the latest estimates for the UK alone, issued by Oil & Gas UK recently, put this number at around 120,000 since 2014. This figure can obviously be multiplied for the rest of Europe.

So what's the future for our industry? We still need energy and we still need electrical power. With the UK alone producing approximately 30% of its power requirements from natural gas and the future expected decline of nuclear reactors, gas should be the most natural choice to make up the difference. It is certainly the cleanest and greenest of the fossil fuels, relatively easy to transport and still one of the most economical sources of supply.

Whilst it is true that in maybe 100 years' time we won't have an energy mix that is reliant

upon hydrocarbons, it is equally true that today this dream is a long way away. There is currently no infrastructure in place to allow an alternative viable energy source to be used. If all transportation was converted to electrical energy tomorrow, we wouldn't have anywhere near enough electrical generation capacity to get these recharged. Green energy such as hydro, solar and wind can't generate the required level of power consistently at this moment in time so we're going to be reliant on hydrocarbon electricity or nuclear for some period of time to come.

If oil and gas production stopped tomorrow just think of the chaos that would occur within the world. The general public would be in absolute uproar. Mankind can't live a life that they now expect without oil and gas at this current time in our history.

Gas is the cleanest form of fossil fuel power generation cost there is and should therefore be welcomed as the main power generation source to provide the bridge between where we currently are and the fossil fuel free future society seems to want to have.

Developments such as tight gas should be encouraged. Not only is gas the lowest carbon emission fossil fuel used for electrical generation, it also burns most efficiently in vehicles and is important feedstock for chemical and plastic production.

Developing use of the greenest hydrocarbon source can also help European economies gain a growth burst and reduce reliance on imports from politically unstable countries.

So what can GPA Europe do?

The oil & gas industry does not seem to have anyone spreading the good news about what our industry brings to society. Quite the converse, there only seems to be news about the harm that oil and gas does.

I believe we should try to emulate GPA USA or GPA Midstream as they're now known and try



Steve O'Donnell

to become a voice for the industry. It is difficult, if not impossible for companies alone, no matter how large they are, to influence political decisions, but standing together as an industry we may be able to provide the necessary input.

Maybe GPA Europe should act as a lobby group to make the public aware of the benefits of the "green" fossil fuel and the benefits to the political stability and economy of the countries that can benefit from gas exploration and production. I would welcome your views on this.

I do not want to overshadow the basic principles on which GPA Europe was founded and that is **"To Promote Technical and Operational Excellence and Serve as a Forum for the Exchange of Ideas and Information for all Participants in The European Gas Processing Industry"** but today we find ourselves and our industry in difficult times and perhaps this may be an opportunity to try and do something different to effect change.

We continue to provide excellent opportunities for our young professionals and this is something that I believe we should put even more emphasis on and certainly want to enhance over the next two years. The future of our industry is in their hands and we need to do everything that we can to ensure that they are properly equipped to deal with future needs.

Lastly I'd like to say a big thank you to the members as without you there is no GPA Europe. Your continued support at our conferences is highly appreciated and we value your input, so please feel free to contact me and share your concerns or ideas and together let's see where we can take our excellent organisation.

GPA EUROPE AND GPA GCC JOINT ANNUAL CONFERENCE ATHENS, 21–23 SEPTEMBER 2016

TECHNICAL CONFERENCE – AFTERNOON SESSION 21 SEPTEMBER

The 2016 GPA Europe Annual Conference was held jointly with GPA GCC. A decision was taken a few weeks before the conference to move the venue from Istanbul to Athens. Many thanks are extended to Sandy and Anne for the excellent arrangements they put in place at such short notice.

Moderated by Colin Woodward, Woodward International

Technical Conference - Afternoon Session 21 September 2016

Delegates were greeted at the conference and invited to register over Welcome coffee kindly sponsored by BASF and Kelvion.

So many high quality abstracts had been offered for presentation at this conference that the organisers decided to add a five-paper session on the Wednesday afternoon. Pleasingly, most of the delegates were there in time to attend from the start.

Sales Gas Storage in Saudi Arabia

The first paper was presented by Rashid Al-Othman on behalf of his group in Saudi Aramco's Research & Development Center, Dhahran (co-authors Mohammed B. Bu Hassan, Yuguo Wang and Cemal Ercan). Rashid explained that the KSA wishes to maximise liquid hydrocarbon exports whilst retaining



Rashid Al-Othman - Saudi Aramco

enough sales gas for domestic use, principally for power generation. Current gas production is around 12 bscfd and this will increase to around 14 bscfd in 2019 with the commissioning of new production/processing capacity. Consumption, however, in the hot, summer months is double that in winter because of the demand for air-conditioning and there are also big diurnal demand variations. Historically, the extra demand has been met by burning liquid hydrocarbons. Various initiatives are being implemented to alleviate this problem by increasing the availability of natural gas. As a possible alternative to CNG and LNG, Rashid described in detail an adsorption-based process, using a zeolite-templated carbon, developed in collaboration with the Korean Advanced Institute of Science and Technology (KAIST), for a 300mmscf/d above-ground gas storage facility near a power generation plant aimed at coping with the local demand fluctuations. The Capex and Opex requirements of this novel process are now being compared with those of alternatives.

Use of CFD Modelling to Optimise Capital and Operational Costs of Molecular Sieve Units

Rashid was followed by Sandeep Jain of CECA SA, France (co-authored by Assaad Ghoussoub, CECA SA, and Thomas Boucheres and Leonel Gomes, ARKEMA SA) who described CFD models and their applications to optimise the adsorption and regeneration phases of molecular sieve-based dehydration systems. He explained that, although empirical models are adequate for assessing some operating parameters, the greater power of CFD modelling enables more comprehensive analysis and optimisation of processes. He illustrated this with some fascinating animated CFD simulation models - which accounted for the size (> 100MB) of his PowerPoint presentation. After discussing the optimisation of molecular sieve system designs with respect to bed configuration, hydrodynamics, etc., Sandeep illustrated the application of the CFD model by discussing case studies looking at important design factors such as vessel sizing, distributor



Sandeep Jain - CECA

design, adsorbent loading, etc. and operational problems including support grid failure or leakage, channelling during regeneration, liquid carryover, retro-condensation, use of the bottom head for debottlenecking and vessel design optimization, coking and the effect of molecular sieve bead sizes.

Heat Recovery from Hot Wet Regeneration Gas in Dehydration Unit - Badak LNG

The third paper of the afternoon was presented by Zaki Arif (co-authored by Wibisono Triatmojo and Muhammed Hatta) of Badak LNG, Indonesia, a facility which, since its start-up in 1977, has expanded to eight



Zaki Arif - Badak

trains with total LNG production capacity 22 million tonnes/year. The paper illustrated the point that clever engineers can always find scope for more process improvements even in "old" plants. In this example, heat from the hot wet regeneration gas, after its passage through the molecular sieve dehydration beds, is recovered in a new heat exchanger for use as pre-heat for the regeneration gas instead of releasing it to atmosphere. The estimated benefit of this relatively simple modification (installation of one heat exchanger and two control valves) is a saving of 12,500 tonnes of high pressure steam per train per year which is worth approximately US\$ 260,000 per year plus small increases in LNG, propane and butane production because less fuel gas is needed for the boilers.



Taib Abang - Saudi Aramco

Membrane Application for NGL Production Enhancement

After a welcome coffee/tea break, the session resumed with Taib Abang of Saudi Aramco (co-authors Milind M. Vaidya, Iran D. Chary Prada, Sebastien A Duval, Jean - Pierre R. Ballaguet, Ahmed Fadzil Mohammad and Faisal D Al - Otaibi, also of Saidi Aramco) describing field pilot testing and evaluation of commercially available rubbery membranes to increase C₂₊ feed to a cryogenic NGL recovery unit from both wet sour gas and dry sweet gas at a major gas plant. Rubbery membranes reject nitrogen and concentrate heavy hydrocarbons in the low pressure permeate stream. After successful field testing, the Aramco team evaluated various membrane configuration options for deployment at the specific plant to enhance C₂₊ production and concluded that, using different membrane types for the sour and sweet gases, they would be economically attractive for both wet sour and dry sweet gas applications.

How to Design Safe Processes - Learning from Others' Mistakes

To conclude the very varied session, Chris Flower of ABB Consulting UK, shared his conclusions from 22 projects reviewing safety aspects in the design of new build, and major modifications projects at FEED and Detailed Design and existing process plants. ABB's analysis showed that the design areas with most concerns were relief and blowdown and levels of protection (LOPA) in each of which about 50% of examples were assessed as "Design is demonstrably unsafe / major design flaw or significant documentation omission identified." While every project is different, it is clear that, in most, there is scope for improved communication between the client and the contractor as both parties try to "get it right



Chris Flower - ABB Consulting

first time" throughout the project design and implementation stages. Projects are complex and improvements in their implementation always can be made. Chris concluded by saying that providing clarity of requirements and robust constructive challenge are areas which can be improved and which will realise better results. This was a thought-provoking paper to conclude a very informative afternoon.

After a short break, delegates joined the evening Welcome Reception on the hotel terrace, jointly sponsored by ABB Consulting and IMA. This was an excellent networking opportunity for old friends to meet again and new contacts to be made. GPA Europe Chairman, Paul Openshaw, and sponsor representatives Claire Haycock of ABB Consulting and Paul Stockwell of IMA all took their turn to welcome everyone to the Conference. A very enjoyable evening!



Athens Speakers and Moderators

GPA EUROPE AND GPA GCC JOINT ANNUAL CONFERENCE ATHENS, 21–23 SEPTEMBER 2016

TECHNICAL CONFERENCE – MORNING SESSION 22 SEPTEMBER

Moderated by Nick Amott, Fluor

Morning in the beautiful Athens location gave us the chance to hear some keynote points as well as three excellent technical papers. Paul Openshaw, our Chairman, started proceedings by providing a thumbnail sketch of his perspective of our industry during this period of energy pricing uncertainty. He did not shy away from "telling it like it is", albeit with typical British understatement by saying that we are in "tricky times". On a very positive note he emphasised how great it was to have representatives and members from the GCC GPA Chapter who, despite the change of conference location and visa challenges, had risen to and overcome these, in some cases with remarkable aplomb and resourcefulness. The GCC presence was especially welcome because this is certainly one area of continued strength in the gas industry with gas processing investment undimmed. Paul also advised the audience about the changes in the US GPA branding and role as "midstream", a term which does not necessarily translate so well across the Atlantic, hence our decision to stay with our historic branding. Paul noted that in the US the GPA undertakes a prominent role in "advocacy" or as we might term it "government/legislative lobbying". He noted that we do not engage as such in this in an active way and do not plan to, although he is keen to hear from the membership if you feel there might be a role for the GPAE in this arena.

Paul handed over to the GPA GCC Chairman Ahmed A. Al-Ghamdi while acknowledging our thanks for the participation and partnership in the meeting. Ahmed echoed the view that it is good and important to foster these joint meetings. It was truly encouraging to hear from him about the major gas processing projects that continue on track in the Middle East. Ahmed closed out by highlighting two supreme



Ahmed A. Al-Ghamdi - GPA GCC Chairman

examples of project successes, the Al Hosn Shah project and the equally impressive Saudi Aramco projects. The audience responded with warm applause as we thanked Ahmed, his committee and GCC members for joining our conference.

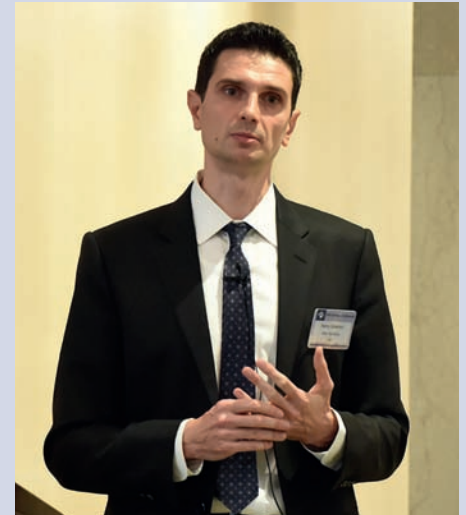
Keynote Speech - Challenges and Opportunities in the Canadian Marketplace for the Natural Gas Industry

Next up was another GPA Chairman and our first formal presenter for the day. Greg Bury is VP Business Development for Universal Pegasus International and Chair of the Canadian Chapter. Greg had attended our GPAE management meeting the day before and I knew that we would be in for some straight talking views on the state of play as he spoke on his title *Challenges and Opportunities in the Canadian Marketplace for the Natural Gas Industry*. Canada



Greg Bury - Universal Pegasus International

historically as a major gas producer has been chief supplier to its neighbour, the USA. With the genesis of the shale oil/gas industry and the remarkable success story for that resource in the USA, Canada finds its prime and most convenient market moribund. This has led to the fall of exports to the USA from 9 BCF/day to 6 BCF/day now and a forecast further fall to less than 4 in 2025. For a country whose production is 15 BCF/day, clearly this is a major problem. As the industry knows well, this has led to a plethora of prospective LNG export projects, which in another era would have made perfect commercial sense, but in the current energy climate becomes also a tough challenge. Greg however demonstrated why his paper includes the word "opportunities" in its title as he emphasised the unique position for Canada with ready geographical access to Asian natural gas markets, stable government, world class reserves and a history of executing major projects. Time will tell



Marco Gabelloni - Aker Solutions

Subsea Processing is Proven - What's Next?

Our next presentation and first traditional technical paper was given by Marco Gabelloni of Aker Solutions, titled *Subsea Processing is Proven - What Next?* What followed was a master-class in the power of a strong presentation content using visuals, images and animations galore, which in no way detracted from the technical content but truly helped the audience get to grips with and understand the topic, as Marco took us through the successful implementation and start-up of the Åsgard subsea processing and compression technology. It was great to see this presented for the first time to the GPAE audience and is inspirational from the perspective of innovation and not being "phased" by a challenge that was seemingly unrealistic a few decades back. Yes the path has been slow, but it was certainly steady as at each step the approach and technology was not only developed but put through its paces in test facilities emulating the subsea environment. With successful start-up and trouble free operation with no downtime, this approach is now seen as a fully viable core technology in the "tool box" for project developers where any other solution would not be economically viable. Marco took us through the main process scheme, the component parts including not only the process unit operations but the all too important support systems such as power supply and the methodology to enable maintenance and capability to change out component parts/sub systems. Based on the success, the second part of Marco's paper title is clear and the "shop is open" for similar project solutions.

Value Added in Integration of Three Cryogenics Processes: NGL; NRU; and HRU

With the close of the stimulating first session, we broke for a lively time of coffee and chat, no doubt picking over the key points from the keynote messages as well as the subsea experience. The coffee break was generously sponsored by TRANTER.



Paul Terrien - Air Liquide

The second session kicked off with a paper from Paul Terrien of Air Liquide. On behalf of his co-authors Ludovic Grandos, Marie-Pascal Victor, Michele Murino and Pierre Costa de Beauregard, Paul presented *Value Added*

Integration of Three Cryogenic Processes, NGL, NRU and HRU. As well as taking us through the acronyms (the latter being Helium Recovery Unit), Paul described the three processing routes if implemented separately and then logically reviewed how Air Liquide is able to integrate the processes if implanted in a single plant yielding significant energy and capital cost savings. The trick is to also design for good reliability and availability which he described based on some FEED studies and their conclusions.

The Accidental Abatement of Black Powder in North American Pipelines

Our last paper before lunch allowed David Burns (co-author Bill Couch) of Peco Facet to introduce us to a topic that should (even if we do not know it) be close to the hearts of gas system designers and operators. For us in GP&E, we increasingly come across the subject, particularly in the Middle East so David's paper *The Accidental Abatement of Black Powder in North American Pipelines* was not only interesting but apposite. David gave a master class on the issues of Black Powder borne out of his many years in the filtration and pipeline industry. In summarising the effects of black powder (which are given in his paper) the phrase "the list goes on and on" comes out clearly. The conundrum that the Middle East is suffering more from the effects compared to North America led to the paper being written and in



David Burns - PECO Facet

addition to describing how filtration is a prime "tool" when tackling the issue, it seems that the "accidental abatement" of the title is probably down to operation in colder climates which in turn require gas dehydration, possibly combined with the application of more prevalent custody transfer metering with attendant filter systems. The paper is well worth a read if this is a subject that is bothering your design or operation.

After a very thought-inspiring morning, delegates enjoyed catching up over lunch, which was kindly sponsored by FLUOR and EASTMAN.



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GPA EUROPE AND GPA GCC JOINT ANNUAL CONFERENCE ATHENS, 21–23 SEPTEMBER 2016

TECHNICAL CONFERENCE – AFTERNOON SESSION 22 SEPTEMBER

Moderated by Taib Abang, Saudi Aramco

Energy Optimization of CO₂-Removal Amine Process by Increasing Stripper Pressure

The first paper was from Saudi Aramco on Energy Optimization of CO₂-Removal Amine Process by Increasing Stripper Pressure, by Mr. Ali Al-Hemaid, Hawiyah Gas Plant, Saudi Aramco. He shared Saudi Aramco's findings after they successfully achieved an energy reduction in amine regeneration for the Acid Gas Removal Unit. The optimization study concluded that with only a slight increase in the operating pressure of the Stripper, a significant energy saving was achieved. The actual field testing confirmed that the higher pressure had improved stripping by a combination of factors, including reducing the ratio of H₂O to CO₂ equilibrium partial pressures, and reducing latent heat of stripping steam.



Ali K. Al Hemaid - Saudi Aramco

Why Amine Systems Fail - Gas Processing Focus

Next up, Philip Le Grange of Sulphur Experts Inc (co-authors Mike Sheilan and Ben Spooner also of Sulphur Experts Inc) described the common threats on the failures of amine systems. The presentation highlighted findings



Philip Le Grange - Sulphur Experts

from analysis done for more than 400 cases of amine system failure investigated by amine experts over the last 17 years. The root causes were identified for various problems such as corrosion, foaming, hydraulic restrictions and off-spec product specification. Philip discussed key focus areas such as ensuring effective inlet separation, maintaining low lean loadings, avoiding under-stripping amine and maintaining good amine system hygiene. He advised that focus on these areas would reduce by half the likelihood of major amine system failure.

World's First Modular Seal-Less Compressor for Corrosive Gas Applications

The third presentation was delivered by Eyad M. Al Khateeb of Saudi Aramco and Marcel Buse of Siemens (co-authors Ibrahim S BuBshait, Saudi Aramco, and M. van Aarsen, Siemens). The paper on world's First Modular Seal-Less Compressor for Corrosive Gas Applications described successful efforts by Saudi Aramco in collaboration with Siemens in designing hermetically sealed integrated high-speed motor-compressors. The presentation shared the advantages of the machine which include operational flexibility, as well as significant reduction in instrumentation and plot space. Furthermore,



Eyad M. Al Khateeb - Saudi Aramco

it also provides greater reliability and availability with easy installation and commissioning. The improved design solved technical challenges to deal with sour and corrosive gases.

VOC Recovery in Onshore and Offshore Marine Loading of Crude Oil

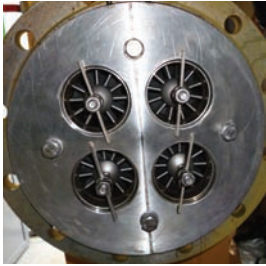
Following an opportunity to network over coffee, and view the exhibition area, the session resumed with a presentation on VOC



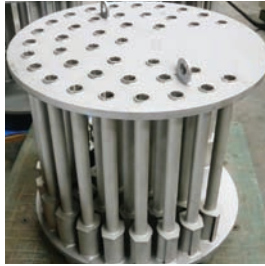
Marcel Buse - Siemens

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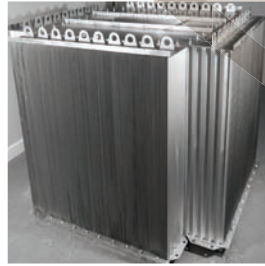
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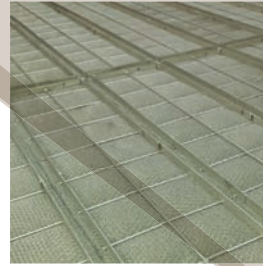
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Recovery in Onshore and Offshore Marine Loading of Crude Oil, by Grant Johnson (co-authored by Wil Lee and Mike Dodd) of Costain. Grant discussed various technical options for the design of Volatile Organic Compound (VOC) Recovery technologies by Costain. The



Grant Johnson - Costain

reference of the study was based on large European VOC Recovery installations. The presentation shared advantages and potential challenges related to available VOC Recovery technologies. Location of VOC Recovery is one of the major factors for technology selection



Mona Bhagat - Petrofac

to provide the most technically and economically attractive solution.

Gas Monetization in the Solimões Basin

The final paper of the day was presented by Mona Bhagat of Petrofac. Mona described a joint Gas Monetisation feasibility study between Rosneft Brasil and Petrobras, supported by Petrofac. The study highlighted various challenges related to gas development from this basin, such as environment and local requirements, on-going technical challenges related to the exploration, logistic issues and also remote distance from the market. All potential cases were analyzed covering low, base and high gas flow rates, with multiple routes to market and technical solutions. The study conclusions led to FLNG and Gas to Power routes being selected, while LNG alternatives were being looked at and the Gas to Power option was being considered to connect to the national grid system.

After a fascinating session, delegates relaxed in the superb hotel and stunning grounds before the evening's festivities, generously sponsored by CECA and PECO Facet.

2016 COMPANION'S TOUR

With thanks to contributor, Anne Dunlop
I always love the September Conference because it includes the Companions' Tour. It does mean that Sandy has to run the conference by himself (not an easy thing) but I love to socialise with the others.

We worked hard over a good six months planning the September conference in Istanbul only to have the decision to change destinations put upon us eight weeks before the event. Up for the challenge and Sandy worked hard to get everything in place. We relied on a local tourist agency for our tour. We arrived in Athens early to check all was well – only to be told our trip to Aegina Island had to be changed as there was going to be a ferry strike. The tour company bent over backwards to develop an alternative tour for us in two days.



The Mycenae Tour Party

The twelve companions met at 9 o'clock – sadly no Rob or John but we did have Manjunath and Abdelkader Lettat's two small extremely well behaved little boys. The coach took us out of Athens into the Peloponnese and the Corinth Canal. This impressive canal, completed in 1893, connects the Gulf of Corinth with the Saronic Gulf in the Aegean Sea. It cuts through the narrow isthmus at sea level so there are no locks and it is truly a marvel to see. Time for a quick coffee and then back onto the coach.

We carried on to the north eastern Peloponnese heading for Mycenae. The archaeological site in Mycenae is linked to the Homeric epics, The Iliad and The Odyssey and consists of the Treasury of Atreus and the Tomb of Clytemnestra outside the citadel. The Treasury of Atreus or Tomb of Agamemnon is an impressive 'tholos' tomb on the Panagita



With thanks to GPA Administrator for a fabulous conference pulled together at short notice

Hill, constructed during the Bronze Age around 1250 BC. In its monumental shape and grandeur, it is one of the most impressive monuments surviving from Mycenaean Greece. The tomb is a semi-subterranean room of circular plan and once inside it really was amazing. How did they build the beehive tomb? The Tomb of Clytemnestra, Queen of the Mycenae during the Trojan War dates from about 1200 BC.

We continued down the Peloponnese to the north end of the Argolic Gulf to the seaport town of Nafplio. Hot and a little weary, we were all looking forward to lunch which was good but we later found out that perhaps we took it too leisurely as we were so far away from Athens that time was running out. We had left ourselves no time for shopping and only had a brief time walking in the town. Nafplio is now the capital of the regional unit of Argolis but it was the capital of the First Hellenic Republic and of the Kingdom of Greece from the start of the Greek Revolution in 1821. I was really jealous of the Holubs who



Nafplion



Mycenae



What an entertaining evening

were going to spend the weekend there. However, maybe the brief walk was fortuitous as it started to rain hard just as we approached the coach. We then drove back to Athens arriving in time for a rest and to get ready for the Conference dinner.

The Conference delegates were taken by coach into the hills surrounding Athens.

The dinner was held in a beautiful large white tent with panoramic views of the coast line. After a delicious meal, all were treated to a truly traditional Greek evening, complete with guitars, folk singing and lots of dancing for everyone to join in the fun in the great spirit of the evening. I am, however, happy to report that no plates were smashed during the evening. What a fabulous night to remember!



Fantastic Dinner sponsored by CECA and PECO Facet

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GPA EUROPE AND GPA GCC JOINT ANNUAL CONFERENCE ATHENS, 21–23 SEPTEMBER 2016

TECHNICAL CONFERENCE – MORNING SESSION 23 SEPTEMBER

Moderated by Christian Bladanet, Technip

Moderator Christian Bladanet opened the final conference session by wishing everyone had enjoyed the previous evening's festivities. He also thanked the evening's sponsors – Ceca, and Peco Facet for a wonderful night's entertainment.

Carbon Dioxide Utilized for Enhanced Product Recovery from a Natural Gas Field

To start the session, Angels Nolis Verges of Fluor Netherlands B.V (co-authors Jurgi Geurtz, also of Fluor Netherlands, and Nick Amott, Fluor Ltd UK) presented the results of a study investigating the technical solutions to recover hydrocarbons from a field where CO₂, captured from a power plant, is reinjected for enhanced hydrocarbon recovery, and the economic interest of such schemes.



Angels Nolis Verges – Fluor

In the effort to tackle gas emissions to the atmosphere, fossil fuels carbon capture and storage (CCS) can make an important contribution. The main challenge faced by CCS is the actual carbon dioxide utilization. One solution discussed could be to use the CO₂ captured for enhanced hydrocarbon recovery in the gas field.

In the study presented by Angels, the CO₂ captured from an existing power plant will be injected into an existing partially depleted gas

field. The objective of the study was to investigate whether hydrocarbons could still be recovered from gas extracted from the field, after CO₂ injection commenced. In order to recover the hydrocarbons, an existing natural gas liquid (NGL) production facility would be used.

Model-based Optimisation of the Operation of Integrated Natural Gas Production and Processing Networks

The second paper was delivered by Daniel Aluma of Basrah Gas Company. Daniel presented a novel methodology making use of physics-based models to optimize network operation and its application to the natural gas network of Basrah Gas Company.

Natural Gas/NGL supply chains usually comprise extensive networks of compressor stations pipelines processing units and other facilities. Their operation involves many degrees of freedom impacting efficiency, profitability and environmental performance.

Despite its underlying complexity, the application of rigorous mathematical optimization to detailed models of entire networks is now computationally tractable and can ensure that the solution obtained actually meets all constraints. The new methodology is applied to the natural gas network of Basrah Gas Company, demonstrating profitability improvements of 9%.



Daniel Aluma – Basrah Gas Company



Medhat Zaghloul – Compressor Control Corp

Enhanced Control Techniques for Cryogenic Turboexpander/Recompressors

Next up, Medhat Zaghloul from Compressor Control Corp underlined the features that are essential for achieving good results from Cryogenic Turboexpander /Recompressors, presenting the enhanced Control Techniques for this equipment to achieve safe and accurate operations while maximizing the production. The paper also discussed the association of turboexpanders with recompressors in parallel turbomachinery trains with their piping configuration and control challenges.

Antisurge control of a compressor in the turboexpansion train is often ignored. This can result in damage to the train and loss of valuable production. Traditional control systems for this type of machine are primarily designed to protect individual units from working beyond the operating envelope. However, control strategy used in various parts of a plant can be used not only for the protection of machinery but also to maximize the production capacity of a gas processing plant.

The paper underlined the features essential for achieving good results from this rotating equipment.

Successful Journey in Flaring Reduction

Following the final coffee break of the conference, sponsored by Tranter, Asyad Al Saleh of Ju'aymah NGL Fractionation Plant, Saudi Aramco, described how the plant, which is the primary source of NGL feed to petrochemical industries in the Eastern part of Saudi Arabia, has successfully achieved more than 70% reduction in its flared gas volume. This major reduction was experienced after 18 months from commencing its journey of a focused Flare Minimisation Plan (FMP) while maintaining the plant's position as a 1.1 million



Asyad Al Saleh - Saudi Aramco

barrel per day capacity of NGL, with no capital investment for Flare Gas Recovery installation. Asyad described how the key success behind the JNGLF story was investing its resources around four main dimensions for reducing flaring: control valves leakage; flow meters



Our friendly colleagues from GPA GCC

reliability; flare monitoring and control; and purge gas optimization.

The presentation also addressed the identified challenges in JNGLF with the path forward to sustain the plant performance and further reduce environmental emissions. These ongoing efforts have materialized into a cultural transformation on flaring reduction, and have significantly enhanced the interaction with the operations workforce.

Design challenges for a zero flaring concept

Last but by no means least, Stéphanie Druesne of Technip described the possible design options to reduce or eliminate flaring. Flares play a critical role as a safety device in oil and gas processing facilities during plant emergencies, upsets, as well as normal operations and start-up. However, to meet



Stephanie Druesne - Technip

increased environmental concerns and tightening regulations, there is an increasing need to design in such a way that environmental pollution is reduced as far as possible.

Stéphanie described how TECHNIP has experienced many engineering challenges to limit any atmospheric discharge from any source in a "zero-flaring" concept. Her paper outlined various options and evaluated the benefits and drawbacks of each process scheme. The discussion covered the main design features of a closed flare system such as the technology of the flare gas recovery unit, the type of device to isolate the flare system, and the flare gas ignition method.

At the end of a fascinating and enjoyable conference, packed with high quality technical papers, Paul Openshaw, Chairman of GPA Europe Ltd, then drew the conference to a close, thanking all colleagues from the GPA GCC for their participation, which all delegates had greatly appreciated.



A very successful exhibition

GPA EUROPE TECHNICAL CONFERENCE LONDON, 24 NOVEMBER 2016

KNOWLEDGE SESSION

Moderated by Simon Crawley -
Boevey, GE Oil and Gas

Produced Water Treatment

The Annual Technical Conference and GPA Europe Annual General Meeting commenced with a knowledge session on Produced Water Treatment, presented by Jonathan Wright who is a Senior Product Engineer with Cameron, a Schlumberger company. The subject is one that is not usually covered at GPA Europe conferences but which is an important part of any offshore and onshore gas processing facility. Particularly in mature fields, produced water can present a significant challenge especially where water injection is used to maintain reservoir pressure and boost hydrocarbon production. The knowledge session introduced the general principles of produced water treatment from understanding the nature and behaviour of reservoir fluids, through to

THE KNOWLEDGE SESSION INTRODUCED THE GENERAL PRINCIPLES OF PRODUCED WATER TREATMENT FROM UNDERSTANDING THE NATURE AND BEHAVIOUR OF RESERVOIR FLUIDS, THROUGH TO PRODUCTION, AND THE INFLUENCE OF CHEMICALS ON RECOVERY AND TREATMENT OVER THE LIFE OF THE FIELD

production, and the influence of chemicals on recovery and treatment over the life of the field. The session went on to cover in detail the commonly used Produced Water



Jonathan Wright - Cameron



AGM in full progress

Treatment processes which are divided into:

- Primary treatment for bulk oil removal which includes gravity separators, media coalescers, hydrocyclones, and centrifuges.
- Secondary treatment for dispersed free oil removal which includes Induced Gas Flotation (IGF) and Compact Flotation Units (CFU).
- Tertiary treatment for polishing which includes cartridge filters and deep bed media filters.

The presentation also covered adsorbent technologies that have been developed to remove dissolved oil. These include:

- Non regenerative adsorbents such as activated carbon.
- Regenerative adsorbents such as Macro Porous Polymer Extraction (MPPE) and Optipore.

In addition the presenter shared data from field tests to show that Compact Flotation

Units can be an effective means of stripping BTEX components from produced water.

The presenter shared with the audience a couple of new technologies being introduced to the oil and gas industry for the purpose of water treatment. The first was MYCELX which uses a media coalescer in series with a deep bed filter, and a polishing filter. The novel technology resides in the surface modified media used in each of the stages. The second was silicon carbide ceramic membranes which can provide primary, secondary and tertiary treatment stages in one technology.

The knowledge session concluded with an overview of produced solids treatment and management methods.

The audience appreciated Jonathan's comprehensive overview of produced water treatment.



Stefanie Druesne proudly receives her Best Paper Award at the AGM



London Speakers and Moderators

GPA EUROPE TECHNICAL CONFERENCE LONDON, 24 NOVEMBER 2016

TECHNICAL MEETING – AFTERNOON SESSION

Moderated by Bryan Bussell,
Cameron

Choosing 3Å or 4Å Molecular Sieve for Natural Gas Dehydration

The first paper of the afternoon was presented by Howard Secker from Grace GmbH (co-authored by V.Zafirakis, also of Grace GmbH). Plants that have very low operating temperatures as part of their process, typically the liquefaction stage of the cryogenic section, will require the removal of water from the gas down to <1 ppmv. This is to ensure the gas temperature remains above its dew-point to prevent water condensation and the associated problems with hydrates, corrosion and freezing. Molecular sieves are



Howard Secker Grace GmbH

particularly adept at achieving such low dew-points in the gas phase, but which is the best? This paper aimed to unravel the differences between the two main contenders: 3Å and 4Å sieves.

Howard presented a gas train for the upstream treatment of an LNG cryogenic process and discussed how various factors including: the feed composition; operating conditions; regeneration limitations; product specifications; and presence of certain contaminants, can all have a bearing on the best molecular sieve for the application. A review of the crystalline structure of both zeolites showed how one sieve may have a greater propensity to adsorb certain gas molecules compared to the other and this effect can have significant impact on the plant design.

A number of operating cases were presented by Howard to demonstrate how changing parameters can impact: bed size; utility requirements; processing conditions; and product specification. In addition the impact of various contaminants (methanol, glycols,

amines, hydrogen sulphide, mercaptans, carbon dioxide and oxygen) on sieve selection was discussed.

The message from the presentation was that the selection of the right type of molecular sieve for a given natural gas drying application is not always a straight forward one. A full review of the process conditions, constraints and product requirements should be undertaken in order to determine the right grade of molecular sieve for the job.

Optimising Water System Design for Unconventional Gas Fields

The second paper was presented by Philip Burris of Advisian and reviewed the water management techniques employed on a remote, large (300+ well) onshore field development. The focus was on unconventional gas projects, shale or tight gas production, where water demands can be much higher than for conventional gas fields. Environmental regulations and utility requirements for water reuse or disposal mean water treatment costs are a significant proportion of the CAPEX and OPEX for any field development. An efficient water management policy can be the difference in making a project viable.

For this complex project Advisian developed a matrix of water users and returns to establish the water demand over the field life. This work indicated water demand and water availability from produced water were out of phase especially at the front end of the project. In the remote location local water sources were scarce and of varying quality with differing treatment needs.

Utilising techniques outlined by IPIECA, Advisian was able to undertake a detailed risk assessment over the life-of-field to identify the most efficient policy for water usage taking in to account energy, waste and



Philip Burris - Advisian

environmental concerns. This optimisation process led to the development of better water conservation policies, identification of wastewater handling costs, reduced water injectors and reduction in utilities leading to both CAPEX and OPEX savings together with a 15% reduction in water usage.

Novel Measurement System for monitoring of Water Production and Hydrate Inhibitor Injection

After a coffee break, the next presentation was delivered by Harald Solheim of OneSubsea. Monitoring of both the quantity and quality of the water being produced on a well-by-well basis is a key building block for the implementation of an efficient production strategy for gas field developments as the capability of inhibiting and handling produced water is typically a limiting factor. This paper presented a novel measurement system for subsea applications based on microwave reflection measurements. The shallow sensitivity depth of the sensor makes it ideal for detection of minuscule amounts of liquid



Harald Solheim - OneSubsea

water, as well as estimation of its salinity. Furthermore, the measurement system can be employed to directly measure the ratio of hydrate inhibitor to water, enabling substantial cost savings by optimizing chemical injection.

The paper focused on OneSubsea's AquaWatcher conductivity probe technology. The system employs a microwave measurement based on an open-ended coaxial probe mounted flush to the pipe wall. The primary objective of this device is to provide an accurate measurement of the salinity of the water flowing in the process as well as a robust detection of water and formation water, at any flow regime, i.e. from wet gas flow to multiphase flow, low to high water-liquid ratio (WLR), and low to high salinity.

When positioned downstream of chemical injection, the measurement system can in addition be employed to give a direct measurement of the ratio of hydrate inhibitor to liquid water. Complementing accurate prediction of the amount of vaporized water at the well-head based on gas rate measurements and knowledge of reservoir conditions, as well as measurements of chemical injection rate, this measurement gives superior control of the hydrate inhibitor dosing.

Implementation of Zero Liquid Discharge (ZLD) projects in Qatar

The final paper of the afternoon was presented by Eric Bartolome and Laure Defrance-Ableson of EGIS EAU along with Sanjeev Kumar Sharma from Technip, Qatar. Water is an essential resource for communities and industries. Awareness of soft water scarcity has increased in the past decade. Soft water scarcity can be due to lack of available quantity or degradation of quality. Therefore, National Authorities all around the world have tightened legislation on water intake and effluent discharge impact. In consequence, industries have to develop projects to reduce their water consumption and effluent discharge.



Eric Bartolome and Laure Defrance-Ableson EGIS EAU

In Qatar, zero liquid discharge (ZLD) in the sea is targeted by end of 2016, leading industries to develop water reuse within their plants. This paper outlined some examples of projects developed by Technip, assisted by water treatment specialists EGIS EAU, for the oil & gas industry. These projects show that each case has unique constraints and opportunities, such as composition of effluent and water

reuse options, which require specific design solutions. These studies have also highlighted that adequate effluents segregation according to their characteristics is critical to optimize the treatment schemes and select the destination of treated water and residues. Treated water is recycled within the plant to reduce water consumption. Surplus residues may be reused in irrigation systems, injected in wells or sent to final waste disposal.

Implementing a complete ZLD project can be very costly as evaporation and crystallization technologies are expensive. This can be summarized as "The last drops cost the most". This paper considered alternative options to evaporation such as reuse for irrigation or injection into deep wells of brines. These options are some-times known as "near-ZLD".

In coming years ZLD or at least "near-ZLD" will become common for new industrial projects. Integration of a ZLD system at beginning of new project requires less CAPEX and OPEX cost compared to retrofitting an existing plant.

At the end of a very informative day, delegates were then invited to join the evening networking event in the bar!

OBITUARY: RONALD C (RON) COULTRUP - 1930-2017

Members will be extremely sad to hear of the death of Ron Coultrup on Friday 24th February.

Ron was a long-time supporter and member of GPA Europe. He was Membership Secretary of GPSA Europe (Gas Processors Suppliers Association) from 1990 and was instrumental in the merger of GPSA with GPA European Chapter which was to become GPA Europe as we know it today.

Many of you will remember Ron with affection and it is no understatement to say that Ron and his wife Christine Etherington were together key influences on taking GPA Europe forward in the earliest years of the 21st century. As Membership Secretary, Ron spearheaded a dramatic growth in membership at both individual and corporate levels, many of whom are GPA Europe's members today.

In November 1999 Ron offered GPAE dedicated office services and facilities from his company Forcom International and the administrative organisation we see today was conceived. Forcom were Corporate

Members of GPAE and Ron and his dedicated staff worked tirelessly in promoting and safeguarding the interests of the Association.

You may well know of Ron and Christine as "Bon Viveurs" and "Gourmets Extraordinaire" and over their years of organisation, they always took pride in accepting the "unofficial" job of sourcing the venues used at our major



conferences for food, wine and ambience. As many of the delegates from all over the world can testify they have never failed us in this role. Few other technical conferences have built on this convivial networking opportunity to enhance the value of their conferences

and that tradition was begun by Ron and Christine and is much appreciated by all attendees today.

In 2006 Ron was a very worthy recipient of the GPA - US "Citation for Service" award for outstanding leadership in the Natural Gas Processing Industries and services to GPA Europe and GPA International activities.

Ron was an active member of the Management Committee up until his retirement from the industry in 2005, and in 2007, the Management Committee made their farewells to Ron and Christine as key members of the Committee by making them Honorary Members of GPA Europe.

Away from work, Ron was very active in his local community of Great Hallingbury near Bishop's Stortford, Herts. He served on the parish council, including some time as Vice-Chairman, and was editor and printer of the very informative and entertaining "Highlights" newsletter.

He will be remembered with respect and affection and our sympathies go to his wife Christine and his daughters Kerry and Tracy and their families at this extremely sad time.

GPAE CHAIRMAN'S ANNUAL REPORT - 2016

Ladies and Gentlemen, friends and colleagues. Thank you for taking the time to join us for our Annual General Meeting.

It is customary for the Chairman to take the AGM as an opportunity to thank the Administrator for his hard work and support throughout the year. This is normally done at the end of the report. Well this year, I would like to move Sandy to the top of my speech. In 2016 Sandy has worked tirelessly on a total of ten conferences – which I think is a record. Let me count you through them.

We began, in February with our Young Professional's Training day, at the University of Manchester. Following up on the success and feedback we received from our inaugural YP event in 2015, we set ourselves two targets: to shift the mix of attendees from a majority of students to a majority of Young Practising Engineers; and to shift the mix of papers towards the practical presentations, based on industrial experience. I am pleased to report we met both targets. So how do we make further improvements for next year? Well, you will see that we are now venturing outside the UK. Like Manchester, Paris is still a train ride away from London but unlike Manchester, Paris is also train ride away from many other European cities so we can make this free conference available for many of our young engineers across the continent.

Paris has a strong track record as a popular venue for GPA Europe events, which brings me to our Spring Conference. At a time when company travel restrictions have made it more difficult than ever for our members to get approval to attend, it was particularly pleasing to see another successful Conference with some excellent papers and some lively participation. Furthermore, the finances ended up slightly ahead of budget. Next Spring we will be meeting in Milan.

For this year's annual conference, we thought we would try a completely new and different location – Istanbul, which seemed to



Steve O'Donnell thanks Paul Openshaw for his service to GPA Europe as he takes up the Chairman's reins

be the perfect place to hold our first ever joint meeting with our sister chapter in the Middle East, the GCC. Unfortunately, events outside our control took over. Following the attempted military coup at the end of July we took the difficult decision to cancel Istanbul and go to Athens. We were two months away from a major event which had been more than two years in the planning. I would like to thank both Committees for their rapid response and unanimous support and of course Sandy and Anne who did a remarkable job to pull away from one set of commitments and set up a new Conference in record time.

The positive feedback we have received from delegates, sponsors and distinguished guests from the Middle East has convinced us we join forces for a second event. Having already set up our 2017 GPAE Annual meeting in Budapest we are now considering a GCC / GPAE Joint Conference in 2018.

Then of course there was the preparation for today and for the 2017 AGM bringing us to a total of ten events on which Sandy has beavered away. I think that deserves a round of applause.

2016 has been a year of tremendous change within GPA Europe. It would be nice to claim

the changes came about through visionary leadership, but in reality there have been a large number of enforced changes that have been thrown at us. 2016 has been an evolution rather than a revolution. Nonetheless I have been pleased with the way the Management Committee and Programme Committee, together with Sandy have adapted and administered the changes.

We have a new auditor, a new Company Registered address, a new publisher for In Brief (thanks Claire) a new sub-group of Young Professional representatives and very shortly you will have a new Chairman and a new Deputy Chairman.

Which brings me to my successor – Mr. O'Donnell. I am delighted to be handing over the reins to Steve. He has shared with me some of the ideas he has and I have to say I am excited by the direction he is looking to take the organization over the next couple of years.

And I am keen to be part of the next phase. I would like to stay on the Management Committee so today is not so much as good bye from me as au revoir or auf wiedersehen.

To all members of GPA Europe, thank you for your support in 2016 and all the best for 2017.

FORTHCOMING EVENTS

2017 SPRING TECHNICAL MEETING

17-19 May, 2017

Hilton Garden Inn, Milan North

- Panel Discussion
- Knowledge Session
- Trace Impurity Removal
- More Efficient Design and Measurement

2017 ANNUAL CONFERENCE

13-15 September 2017

Sofitel Chain Bridge, Budapest

- Technical Papers
- Conference Dinner
- Companions Tour

AGM & TECHNICAL MEETING

23 November, 2017

Hilton London Paddington Hotel

2018 SPRING MEETING

9-11 May 2018

UK - Site under consideration

- Technical Papers
- Site Visit

2018 ANNUAL CONFERENCE

19-21 September 2018

Rome, Italy

- Technical Papers
- Conference Dinner
- Companions Tour

2018 AGM & TECHNICAL MEETING

22 November, 2018

Hilton London Paddington Hotel

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This listing of current Corporate Members represents the status as at 13 March 2017.

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