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PGC D met in Marlow, UK, in October 2007 (ABOVE) and paid a technical visit to Heatric whose products include these gas coolers for the deepwater Boomvang spar platform in the Gulf of Mexico (BELOW).

After a general introduction on IGU activities by the Chairman, Seiichi Uchino, the Vice Chairman, Alaa Abujbara, gave a brief on progress on the Committee's report "The Worldwide LNG Industry at the end of 2008".

Following the presentation, there was a productive discussion among all members on the way forward and how best to meet the deadline while maintaining data as up-to-date as possible. Further, the sources of the data to be used for the report were discussed.

Alaa Abujbara then presented the outline of the *2030 Natural Gas Industry Outlook* study using the guidance pack prepared for this purpose. Action items included Study Group leaders developing draft replies to the questions presented to each of their groups by the 2030 Outlook Study Team. The Vice Chairman is coordinating the drafting of responses to the general PGC D questions. Draft responses were due to be circulated to the broader Committee for review in February.

SG D.1 LNG quality and interchangeability

The Study Group has continued work on its report for Triennium 2006-2009, which will be delivered at WGC 2009. Separate topic groups have been formed for each of the sections of the report, as follows:

1. Quality adjustment at LNG import terminals (led by A. Knoll of Shell);
2. Impurity specifications (led by B. Ho of BP America);
3. Analysis and measurement (led by L. Sabbe of Fluxys);
4. LNG specifications (heating value – led by Ted Williams of the American Gas Association);
5. LNG rollover (led by S. Kunitomi of Tokyo Gas);
6. Impact of LNG on gas turbine performance (led by S. Hull of BP); and
7. Appliance testing (led by Terry Williams of Advantica).

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It was agreed that the first drafts of the report sections would be presented by each of the topic leaders at the next meeting, and that an article would be contributed to this issue of the magazine ("Why Does LNG Quality Matter?" pages 128-136).

SG D.2 LNG contract clauses for more flexible global LNG market

In the third meeting of the Study Group, members took part in an exchange of views between LNG buyers and sellers, focusing on flexible LNG trading in the futures market.

Members from Petronas presented an in-depth diagnosis of emerging markets including China and India, where the share of natural gas is forecast to grow continuously.

Another report emphasised the emergence of Middle Eastern players as swing producers. The region is set to grow further in importance as one of the key supplying hubs of LNG spot trading.

In total six presentations were given in the meeting as follows:

1 Seller's viewpoints on LNG market report
- China, India, Iran, Russia (Petronas)
- Europe and Atlantic Basin (Stream)
- Global LNG markets and flexibility (Total Trading International)

2 LNG buyers' viewpoints
- Flexibilities in LNG contracts (GdF)
- TG's standpoint (Tokyo Gas)
- LNG contract (Kogas)

From the buyers' group, most are signalling the uncertainty as regards LNG production capacity in the Asia-Pacific region around 2010, but the potential for a substantial increase in demand for natural gas if volumes and prices prove to be adequate and competitive.

Discussion of a more flexible LNG market will be continued in future meetings, where more active participation from the LNG sellers' group is expected.

SG D.3 Creative solutions for new LNG facilities

The Study Group's third meeting carried on from the work of the first and second meetings (in November 2006 and March 2007 respectively). Creative solutions throughout the value chain were presented, analysed and discussed. The structure of the report agreed upon in the first meeting was applied as follows:

1 Short description of the creative technology, status of what is known in the public domain or within the organisation.
2 How does the technology connect to the issues?
3 Gap analysis.
4 How can we close the gap?

The intention was to gauge the need for further creative solutions throughout the value chain in order to focus on the appropriate areas, and to continue as much as possible in clusters for more concrete in-depth results.

Besides discussing the reason why only two LNG liquefaction projects received the final investment go-ahead in 2007, presentations were given on:
- Floating storage and regasification units (FSRU);
- Shuttle regas vessels, floating LNG storage;
- LNG offshore transfer systems;
- Regasfication technologies, on/offshore;
- Integrated facilities;
- Onshore liquefaction;
- Small scale LNG;
- LNG storage onshore;
- Shipping;
- Arctic LNG;
- LNG pipelines;
- Gravity-based structure (GBS) and platform-based LNG plants; and
- Modularisation.

After these presentations each creative solution was ranked against conventional LNG technologies.

Future plans

At presstime the next PGC D meeting was due to be hosted by Fluxys in Zeebrugge, Belgium, March 18-20.

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Progress Reports from the Task Forces

This chapter contains news and information from IGU's two Task Forces.

Task Force Research and Development

The third meeting of TF R&D was held September 27-28, 2007, in Moscow, Russia, and was attended by 15 members.

An informal meeting with representatives of WOCs 4 and 5 was held the day before (September 26) to discuss the approach to establishing IGU "best practices, new ideas and innovations". Questions had been raised about the audience, the difference between case studies and best practices, the approach to the added value of best practices, and examples. The idea was to refine the definition of a best practice and to set out the main issues as regards the new IGU approach.

The results of the main meeting are detailed by Working Group.

WG1: Prove the strategic values of R&D to companies and their stakeholders
Leader: H. Watanabe
The action plan was discussed. Gazprom gave a detailed presentation of its R&D priorities, organisation and funds to supplement the R&D management best practices comparison. Particular attention was paid in discussions to the innovative technologies venture fund approach.

Seven groups were identified for the Focus study beyond the traditional gas industry:

- Industry internal – IGU Technical Committees;
- Industry external – other energy industries;
- Manufacturers;
- Academia/research organisations;
- Regulators;
- Governments; and
- Customers.

It was agreed that a new questionnaire be sent to IGU members based on the Task Force's previous questionnaire, but widened to include America and Asia. The review of the results will take place at the fifth TF R&D meeting in September.

Both Task Forces held their third meetings of the 2006-2009 Triennium in Moscow.

WG 2: Significantly increase gas R&D investment
Leader: Marc Florette
The objective is to engage directly with the CEOs of gas companies as regards R&D, and to make R&D a positive expenditure in the eyes of financial analysts, regulators and investors. A questionnaire has been prepared to address strategic questions directly to CEOs and four have already been interviewed. Moreover, under the aegis of GERG, the European Gas Research Group, an R&D presentation was given to the Eurogas General Assembly in June 2007.

Delegates to the third TF R&D meeting were invited to give brief presentations on R&D success stories or promising projects, as such examples are clearly a good way to address R&D. It was agreed that a draft generic R&D presentation be prepared for the next meeting.

The fact that sustainability is high on the agenda represents a good opportunity to get external support from financial analysts and regulators. However, R&D still has to demonstrate that it can reduce final costs, which is the case when R&D offers new services or new opportunities. Regulators should have another approach: they could value more aspects like smart meters which offer several possibilities, payment in advance, reduced costs, more conversation conscience, more services (maintenance contracts…) and increased open market.

WG 3: Support and contribute to the success of the next IGU Gas Research Conference (IGRC 2008)
Leader: Christian Beckervordersandforth
Prior to the meeting a list of 504 contacts from the academic world had been collated from within the Task Force and other sources, and the call for papers for IGRC 2008 had been issued with a deadline of February 1. At the meeting it was noted that some countries were under-represented and that more contacts were needed.

The Working Group recognised that if CEOs attend IGRC 2008, then the TF R&D will have partially fulfilled its objective to convince them to invest in R&D, technologies and innovations. Consequently several proposals were made to the IGRC Policy Committee to redefine the strategy of IGRC based on the example of a US conference which had attracted more than 600 delegates and 50 exhibitors. "Energy for the Future: Solving Industry Challenges through Technology and Innovation" was sponsored by KeySpan, the Long Island Power Authority and National Grid, and was held in Melville, New York, in August 2007.

Next meeting
At presstime TF R&D's fourth meeting was due to take place in Buenos Aires, Argentina, March 13-14.

● Task Force Gas Market Integration

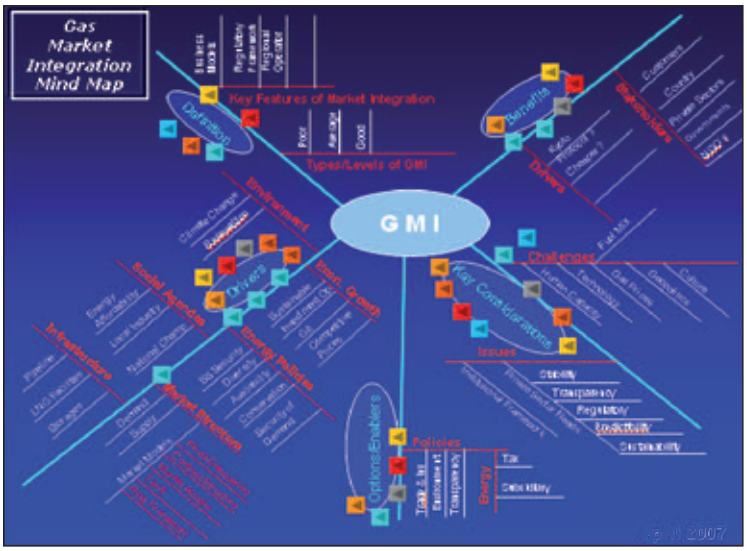
The third meeting of TF GMI was hosted by Gazprom in Moscow, Russia, October 18, 2007, and was attended by a total of nine delegates.

Chairman Jorge Doumanian and member Maxim Potapov (meeting host) welcomed members to Moscow, and Maxim Potapov gave an introductory presentation on Gazprom's main activities.

Jorge Doumanian reviewed the work done in the first two meetings and the objective of the Moscow meeting, noting that the Task Force was achieving the schedule established by the Coordination Committee in Lima in October 2006. He made the following announcements:

- Two new members would join the Task Force for the next meeting;
- TF GMI would contribute to the International Energy Forum/IGU Ministerial Meeting, which at presstime was due to take place in Vienna on March 11;
- TF GMI will participate in the 19th World Petroleum Congress in June with a roundtable; and
- TF GMI will have sessions for a roundtable and presentation of the final report during WGC 2009.

Members then discussed the links for gas market integration based on the mind map (see



ABOVE
Figure 1.

Figure 1) and primary policy, platform and players (stakeholders). New factors being considered in terms of links for gas market integration are:

- Flexibility;
- Predictability;
- Security of supply;
- Affordability;
- Sustainability;
- Accessibility; and
- Availability.

Members went on to review the papers being prepared by the Task Force.

A Russia and Germany: Paper approved and submitted for publication in the IGU magazine (see pages 138-142).

B ExxonMobil and Qatar: Ridza Shariff presented the proposed structure. His ideas were approved by the group, which requested that the paper be written in time for the next meeting in March, during which it was due to be approved for publication in the IGU magazine.

C Asian LNG: Ryo Fukushima presented the structure of a future document about the integration of the Asian market via LNG as the common link.

D US, Canada and Mexico: Bob Howard took on the project of writing this paper with the help of Javier Fernández. The main structure of the paper was due to be presented at the next meeting in March.

In terms of working documents, subsequent discussion revolved around:

- Mind map links;
- System governance (consumers, governance and investors); and
- Initial approach in the definition of the step-by-step process to identify different degrees of integration taking into consideration the scenario analysis tools.

As regards the *2030 Natural Gas Industry Outlook* study, there was an initial brainstorming about the questionnaire sent out by the Coordination Committee. There was an open discussion on how GMI will evolve to 2030 and the key points were:

- Market structure and price structure;
- Carbon emission limitations;
- Evolution of alternatives (coal, nuclear, etc.);
- Energy policies and consensus; and
- Existence and mission of the Gas Producing and Exporting Countries (GPEC) organisation.

The agenda for the next meeting, which at presstime was due to be held in San Francisco in March, was proposed as follows:

- Review and approval of the Moscow minutes;
- Review and approval of papers B (ExxonMobil and Qatar integration relationship) and C (Asian integration based on LNG) to be sent to the IGU magazine;
- Analyse structure document on North America integration (Canada, US and Mexico);
- Discussion of the step-by-step process to identify different degrees of integration taking into consideration the scenario analysis tools:
  - Definition of different integration phases (consensus before the meeting); and
  - Run the model with different countries in different regions of the world (using the IGU regions split).

Finally, as regards the principal guidelines for the GMI process, the content and structure of the document were defined.

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Annex – Addresses

IGU Presidency

President
Mr Ernesto López Anadón
Repsol YPF S. A.
Roque Sáenz Peña 777 –
Of. 1202
C1035AAC – Buenos Aires
Argentina
Tel: +54 11 5071 5771
Fax: +54 11 4323 1774
E-mail: elopeza@repsolypf.com

Vice President
Mr Datuk Abdul Rahim Hj Hashim
Petronas
Tower 1, Petronas Twin Towers
KLCC, 50088 Kuala Lumpur
Malaysia
Tel: +60 3 2051 5100
Fax: +60 3 2051 5004
E-mail: rahimhs@petronas.com.my

Coordination Committee

Chairman
Mr Roberto D. Brandt
MetroGAS S. A.
G. Aráoz de Lamadrid 1360, 3°
(1267 AAB) Buenos Aires
Argentina
Tel: +54 11 4309 1400
Fax: +54 11 4309 1447
E-mail: rbrandt@metrogas.com.ar

Vice Chairman
Mr Ho Sook Wah
Petronas Permata
Jalan Institusi, Kawasan Institusi
Bangi
43000 Kajang
Selangor Darul Ehsan
Malaysia
Tel: + 60 3 8732 7700
Fax: +60 3 8925 8757
E-mail: hosw@petronas.com.my

Secretary
Mr Andrés E. Kidd
IAPG
Maipú 645, 2°
(C1006ACG) Buenos Aires
Argentina
Tel: +54 11 4717 0035
Fax: +54 11 4717 6445
E-mail: andrew@ifisa.com

Working Committee 1

Chairman
Mr Vladimir Yakushev
VNIIGAZ, Gazprom
142717, Moscow Region
p.Razvilka, VNIIGAZ
Russia
Tel.: +7 495 3559886
Fax: +7 495 3991677
E-mail: V_Yakushev@vniigaz.gazprom.ru

Vice Chair
Mr Kamel Eddine Chikhi
Sonatrach Exploration Division
BP 68 M Boumerdes 35000
Algeria
Tel: +213 24 81 63 97
Fax: +213 24 81 63 98
E-mail: kamel.chikhi@ep.sonatrach.dz

Secretary
Mr Sergey A. Leonov
VNIIGAZ, Gazprom.
142717, Moscow Region
p.Razvilka, VNIIGAZ
Russia
Tel.: +7 495 3559667
Fax: +7 495 3993263
E-mail: s_Leonov@vniigaz.gazprom.ru

Working Committee 2

Chairman
Mr Vladimír Onderka
RWE Transgas Net, s.r.o.
Pražská 158
642 00 Brno
Czech Republic
Tel: +420 547 123 198
Fax: +420 547 123 173
E-mail: vladimir.onderka@rwe.cz

Vice Chair
Mrs Hélène Giouse
Gaz de France
14-16, rue Touzet-Gaillard
TSA 9.000.6
93 486 Saint-Ouen Cedex
France
Tel: +33 1 7186 1610
Fax: +33 1 7186 1616
E-mail: helene.giouse@gazdefrance.com

Secretary
Ms Petra Grigelová
RWE Transgas Net, s.r.o.
V Olšinách 75/2300
P O Box 166
100 00 Praha 10 – Strašnice
Czech Republic
Tel: +420 267 97 44 77
Fax: +420 267 97 6949
E-mail: petra.grigelova@rwe.cz

Working Committee 3

Chairman
Mr Helge Wolf
E.ON Ruhrgas AG
Huttropstraße 60
45138 Essen
Germany
Tel: +49 201 1845010
Fax: +49 201 1845197
E-mail: helge.wolf@eon-ruhrgas.com

Vice Chair
Mr Eric Dam
N.V. Nederlandse Gasunie
Postbus 19
9700 MA Groningen
Concourslaan 17
9727 KC Groningen
The Netherlands
Tel: +31 50 521 2800
Fax: +31 50 521 1962
E-mail: e.dam@gasunie.nl

Secretary
Mr Uwe Klaas
DVGW Deutsche Vereinigung des Gas- und Wasserfaches e.V.
Bereich Gasverwendung
Josef-Wirmer-Str. 1 – 3
53123 Bonn
Germany
Tel.: +49 228 9188821
Fax: +49 228 9188996
E-mail: klaas@dvgw.de

Working Committee 4

Chairman
Mr Jeremy Bending
Network Strategy Gas Distribution/ National Grid
Gallows Hill
Warwick CV34 6DA
England
Tel: +44 1926 653309
Fax: +44 1926 656553
E-mail: jeremy.bending@uk.ngrid.com

Vice Chair
Mr Alessandro Soresina
AEM S.p.A
Via Balduccio da Pisa, 15
20139 Milano
Italy
Tel: +39 02 77205057
Fax: +39 02 77206575
E-mail: alessandro.soresina@aem.it

Secretary
Mr Robert Thomas
Network Strategy Gas Distribution /National Grid
Gallows Hill
Warwick CV34 6DA
England
Tel: +44 1926 655801
Fax: +44 7973 809914
E-mail: robert.m.thomas@uk.ngrid.com

Working Committee 5

Chairman
Mr Jean Schweitzer
Danish Gas Technology Centre
Dr. Neergaards Vej 5B
DK-2970 Hørsholm
Denmark
Tel: +45 4516 9600
Fax: +45 4516 9601
E-mail: jsc@dgc.dk

Vice Chair
Mr Tatsuo Kume
Osaka Gas Co.
11-61Torishima 5 chome
Konohana-ku Osaka – 554-0051
Japan
Tel: +81 6 6465 2008
Fax: +81 6 6465 2021
E-mail: tatuo-kume@osakagas.co.jp

Secretary
Mr Aksel Hauge Pedersen
DONG Energy, Renewable
A.C. Meyers Vænge 9
2450 København SV
Denmark
Tel: +45 4031 0022
Fax: + 45 4480 6665
E-mail: akhpe@dongenergy.dk

Programme Committee A

Chairman
Mr Knut Barland
Statoil ASA
PB 308
5501 Haugesund
Norway
Tel: +47 91 11 30 48
Fax: +47 52 77 22 10
E-mail: kub@statoilhydro.com

Vice Chair
Mr Juan Puertas
Gas Natural SDG, S. A.
Plaça del Gas, 1
08003 Barcelona
Spain
Tel: +34 93 402 5327
Fax: +34 93 402 9300
E-mail: jpuertas@gasnatural.com

Secretary
Mrs Kari Lindøe Hunsbedt
Statoil ASA
PB 308
5501 Haugesund
Norway
Tel: +47 48 08 02 94
Fax: +47 52 77 25 67
E-mail: kalin@statoilhydro.com

Programme Committee B

Chairman
Mr Pedro Moraleda
Gas Natural SDG, S. A.
Avda de América, 38
28046 Madrid
Spain
Tel: +34 91 589 3170
Fax: +34 91 589 3476
E-mail: pmoraleda@gasnatural.com

Vice Chair
Dr Colin D. Lyle
Gas Market Insights Ltd
30 Grove Crescent
Kingston upon Thames
Surrey KT1 2DG
England
Tel: +44 77 3856 3856
Fax +44 20 8546 4700
E-mail: cl@gmi.eu.com

Secretary
Mr Francisco Sichar
SEDIGAS
Edificio ENAGAS – Paseo de los Olmos, 19
28005 Madrid
Spain
Tel: +34 91 709 9581
Fax: +34 91 709 9583
E-mail: fjsichar@sedigas.es

Programme Committee C

Chairman
Mr Mohd. Farid Mohd Amin
Petronas
Level 75, Tower 1, Petronas Twin Towers
KLCC, 50088 Kuala Lumpur
Malaysia
Tel: +60 3 2331 4613
Fax: +60 3 2331 2950

E-mail: faridm@petronas.com.my

Vice Chair
Mr Antonio Luiz Fernandes dos Santos
Petrobras
Av. Almirante Barroso, 81
32nd Floor
20031-004 Rio de Janeiro – RJ
Brazil
Tel: +55 21 3229 4589
Fax: +55 21 3229 4590
E-mail: aluizfsantos@petrobras.com.br

Secretary
Mr Rashdan M. Radzi
Petronas
Level 75, Tower 1, Petronas Twin Towers
KLCC, 50088 Kuala Lumpur
Malaysia
Tel: +60 3 2331 4655
Fax: +60 3 2331 2950
E-mail: mrashdan_mradzi@petronas.com.my

Programme Committee D

Chairman
Mr Seiichi Uchino
Tokyo Gas Co. Ltd
1-5-20, Kaigan, Minato-ku
Tokyo 105-8527
Japan
Tel: +81 3 5400 7622
Fax: +81 3 3578 8365
E-mail: s-uchino@tokyo-gas.co.jp

Vice Chair
Mr Alaa Abu Jbara
Qatargas Operating Company Ltd
P O Box 22666
Doha
Qatar
Tel: +974 485 7556
Fax: +974 473 6122
E-mail: aabujbara@qatargas.com.qa

Secretary
Mr Yutaka Shirakawa
Tokyo Gas Co. Ltd
1-5-20, Kaigan, Minato-ku
Tokyo 1058527
Japan
Tel: +81 3 5400 7580
Fax: +81 3 3578 8365
e-mail: yutaka-s@tokyo-gas.co.jp

Task Force Research and Development

Chairman
Mr Marc Florette
Gaz de France
361, avenue du Président Wilson
BP 33 93211 Saint-Denis La Plaine
France
Tel: +33 1 49 22 50 59
Fax: +33 1 49 22 49 49
E-mail: marc.florette@gazdefrance.com

Vice Chair
Mr Mel Ydreos
Union Gas Ltd
777 Bay Street, Suite 2801
P. O. Box 153
Toronto, ON M5G 2C8
Canada
Tel: +1 519 436 4597
Fax: +1 519 436 5392
E-mail: mydreos@uniongas.com

Secretary
Mrs Marie-José Fourniguet
Gaz de France
361, avenue du Président Wilson
BP 33 93211 Saint-Denis La Plaine
France
Tel: +33 1 49 22 59 75
Fax: +33 1 49 22 51 03
E-mail: marie-jose.fourniguet@gazdefrance.com

Task Force Gas Market Integration

Chairman
Mr Jorge Doumanian
Grupo Gas Natural-Gas Natural BAN (Argentina)
Jaime Balmes N° 8 –704
Colonia Los Morales Polanco
11510 México D. F.
Mexico
Tel: +52 55 52792401/52792402
Fax: +52 55 52792400 Ext:2401
E-mail :jdoumanian@gnm.com.mx

Vice Chair
Mr Dietmar Spohn
Stadtwerke Bochum GmbH
Postfach 10 22 50
D-44722 Bochum
Germany
Tel: +49 234 960 2000
Fax: +49 234 960 2009
E-mail: dietmar.spohn@stadtwerke-bochum.de

Secretary
Mr Javier Fernandez Gonzalez
Grupo Gas Natural-Gas Natural SDG, S. A. (Spain)
Jaime Balmes N° 8 – 704
Colonia Los Morales Polanco
11510 México D. F.
Mexico
Tel: +52 55 52792478 / 790446
Fax: +52 55 52792400 Ext:2401
E-mail: jfernandez@gnm.com.mx

National Organising Committee

Chairman
Mr Eduardo Ojea Quintana
Alicia Moreau de Justo 846
2° Piso – Of. 18
(1107) – Buenos Aires
Argentina
Tel: +54 11 4343 6932
Fax: +54 11 4342 5082
E-mail: eduardo_ojea@hotmail.com

The Leading Natural Gas Company of Turkey

İGDAŞ, which was founded in 1986, is the biggest natural gas distribution company of Turkey, the distribution area of which lies within the boundaries of Istanbul. It gives all kinds of infrastructure, feasibility, operation and consultancy services concerning natural gas. With the International Gas Training Technology and Research Centre it built, it gives natural gas training courses at home and abroad. Offering fast, constant and comfortable service through employment of the latest technologies with the professional staff forms the basis of our concept of natural gas management.

With its 21 years of experience, İGDAŞ has 3.6 million customers today on a distribution network of 13,000 kilometres. This figure actually makes 54% of all the customers in Turkey.

The whole knowledge and experience we possess have enabled us to be the leading natural company in Turkey today. In 2007 İGDAŞ has become the 30th among the first biggest 500 companies in Turkey and the 7th biggest company in the field of energy.

With a new application ever since 2005, İGDAŞ has expanded the boundaries of its services having participated in several projects in the Balkans and the Middle East, among which can be mentioned the feasibility, infrastructure and network management in Syria and Macedonia, the Gas Training of the South Romania Distrigaz Sud S.A, and the still undergoing studies for establishing a Natural Gas School at the Jeddah University in Saudi Arabia.

By connecting natural gas to the islands in the Sea of Marmara with the Offshore Project in 2006, it pioneered another first in Turkey.

As İGDAŞ, we say that what we have accomplished so far is clear evidence to what we are going to do and target with these realised achievements to become stronger in the world.

FEATURES

This issue's feature section starts with "A New Dimension to Trinidad and Tobago's Gas Sector" to mark the country's hosting of the first Executive Committee meeting of 2008. Reports follow on aspects of the work of PGC B and PGC D, followed by a case study that the Task Force on Gas Market Integration has prepared. Then we have articles looking at project finance in the gas industry, the latest developments on the methane hydrates front, IT and Iran's plans to expand its gas industry. There is also a profile of one of IGU's new Associate Members, the Interstate Natural Gas Association of America (INGAA), and a message from the World LP Gas Association. As usual, we round up with a description of the publications and documents available from IGU and the events calendar.

Shell LNG & Gas Technology

With gas playing an ever increasing role in meeting the energy demand of the future it is essential that the technology is available that can handle gases with high Sulphur and CO_2 content.

Shell has the technical know how and experience that allows the resource holders to monetize these so called difficult gases and bring the products to market through the production of LNG.

Gas Treating

Reliable gas and sulphur treating solutions are critical to the success of gas ventures with the destination of the gas determining the required specifications. Because the liquefaction process operates at cryogenic temperatures (-160°C) far lower than the freezing point of CO_2 (-60°C), natural gas that is to be used for LNG production requires far deeper CO_2 removal than pipeline gas. If it is not removed to less than 50 ppmv then the CO_2 will freeze in the system rendering the liquefaction process inoperable. Sulphur species have to be removed to meet the end user specification requirements and local legislation.

Consequently, capabilities in gas treating processes ensure product specifications are met in an effective and cost-efficient way whilst demonstrating the commitment to sustainable development and a safe, clean environment. Hence, they are key to obtaining a licence to operate.

Portfolio of Technologies

Shell holds an extensive portfolio of gas-treating and sulphur technologies for the treatment of natural gas and syn gas. All of the processes are built on our extensive experience in gas/liquid treating and sulphur processes gained in more than 800 treating licenses in operation worldwide.

Shell's Sulfinol process for deep CO_2 removal is applied in many LNG trains and has historically been the process of choice for CO_2 removal. In addition to this process Shell also offers the ADIP-X process which utilises an amine with an accelerator for enhanced CO_2 removal with a lower solvent flow rate than Sulfinol. The ADIP-X process has been applied successfully in LNG plants including Brunei LNG and Oman LNG.

Many of the gas fields that are now being developed also contain gas with high levels of sulphur species (H_2S, mercaptans etc) that need to be removed. Shell's Sulfinol-X process, which has the deep CO_2 removal capabilities of the Sulfinol and the ADIP-X processes, combined with enhanced sulphur removal properties, can be used to ensure that contaminated gases can still be brought to market.

If sulphur species have been removed from the natural gas then it will be necessary to ensure that they are not vented to atmosphere as SO_x. Shell's design and operational experience in the Claus sulphur recovery process combined with the Shell Claus Off-gas Treating (SCOT) Process ensures that more than 99% of the sulphur can be recovered. The final step in the sulphur recovery process is ensuring that the sulphur is safe for handling and transportation; this is achieved using the Shell Sulphur Degassing Process.

After the acid gases have been removed it is necessary to dry the gas using molecular sieves so that water does not freeze in the cryogenic section. Any mercury in the gas also has to be removed because the cryogenic section contains heat exchangers made of aluminium that the mercury will attack. Shell's molecular sieve and mercury removal designs are based on operational experience and detailed catalyst research ensuring that the operator has the benefit of an informed choice when deciding which catalyst vendor to use.

LPG Extraction

Natural gas contains a wide range of hydrocarbons, some of which can be left in the LNG (ethane), some of which can be extracted for LPG products (propane, butane) and some that need to be removed to prevent them from impacting the process (Benzene).

The heavier hydrocarbons can be removed by washing the gas in a scrub column or by utilizing a series of distillation columns in the form of an NGL (Natural Gas Liquids) extraction unit (de-methaniser, de-ethaniser, de-propaniser etc).

Figure 1. Sakhalin II LNG Plant with Shell DMR Process *(Courtesy of Sakhalin Energy)*

Shell offers both moderate LPG extraction (less than 0.1 t LPG/t LNG) and deep LPG extraction process. For deep removal of LPGs and extraction of ethane the proprietary Shell Deep LPG extraction process, which utilizes a turbo expander to reduce the pressure and improve the separation, yields high LPG recoveries for a large variety of feed gas compositions. The power generated by the turbo expander is used to drive the natural gas compressors prior to liquefaction.

In addition to the processes Shell proprietary high capacity trays can be applied for smaller column sizes in the NGL extraction unit in new designs or increasing the capacity of existing columns.

Natural Gas Liquefaction

As a general rule about one trillion cubic feet of gas is required for producing one million ton per annum of LNG over twenty years. What this translates into is a requirement for LNG plants with varying capacities to cater for all the different volumes of gas fields. Shell's LNG technology includes different processes that have an LNG production capacity from 1 mtpa up to 11 mtpa utilizing more and larger compressor drivers as the capacity increases. Shell has provided the design for LNG trains that produce ~40% of the current total world LNG production.

The Shell Single Mixed Refrigerant (SMR) process, with a range of 1-3 mtpa, is a single cycle process (one driver) with low equipment count and hence a reduced plot space requirement. It takes advantage of the different levels of cold obtainable based on different pressure levels of a single MR cycle.

The Shell C3/MR process is a process Shell has many years experience in operation and design. There are two compressor cycles in series, one for the propane (C3) pre-cool and one for the liquefying mixed refrigerant (MR). Similar to the C3/MR process is the Shell DMR (Double Mixed Refrigerant) process. Instead of C3 in the pre cooling cycle a mixed refrigerant is used providing a more flexible design with the same configuration as the C3/MR process. As a result of the flexibility the Shell DMR liquefaction technology is suitable for use in climates with extreme conditions such as arctic, or large seasonal climatic variations.

For the larger capacity ranges up to 11 mtpa the Shell PMR (Parallel Mixed Refrigerant) process can be applied. This process can be based on either the C3/MR or DMR process and utilizes a parallel configuration for the liquefaction cycle preceded by a common pre cool cycle. The advantages of this process include high LNG production capacity whilst maintaining proven equipment sizes, high efficiency and high reliability.

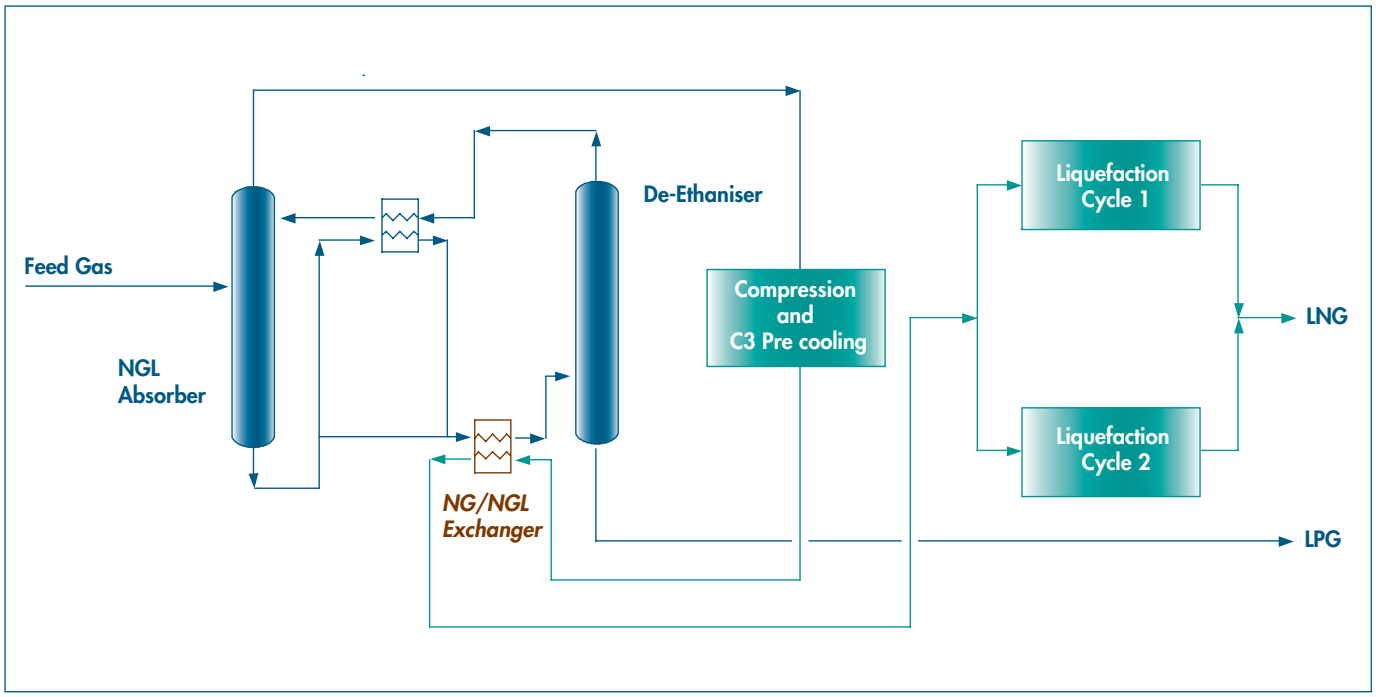

Figure 2. Simplified Scheme Showing the Cold Integration between the LPG Extraction Section and the LNG Section

The Shell PMR process with front-end deep NGL extraction

The latest offering from Shell is the Shell PMR process with front-end deep NGL extraction (Figure 2) resulting in a highly efficient process that is flexible for varying feed gas compositions.

A unique feature about this scheme is the cold integration between the LNG and LPG extraction sections which provides the flexibility to increase the LNG production by removing less NGLs in the de-ethaniser whilst at the same time optimising cold recovery.

Shipping and Marketing

Marketing and shipping challenges include understanding and accessing the many different potential LNG markets around the world, choosing the right project structure, and developing effective shipping solutions.

Shell's LNG shipping expertise includes feasibility studies, benchmarking, port and terminal advice, technical consultancy, fleet operations and vessel procurement. Through our joint ventures and direct ownership, we have equity, management or chartering positions in more than a quarter of the global LNG fleet.

We manage around 30 LNG carriers and employ more than 500 international fleet marine officers with LNG experience and qualifications who work to stringent standards to ensure cargoes are delivered safely and reliably.

In Asia Pacific, Shell is the largest LNG supplier among international companies with a deep knowledge of the Asian market, and 40 years of customer relationships. In addition Shell is also positioned well in emerging markets with LNG imports into China and India. In Europe, Shell is the second largest gas marketer and the largest private LNG importer. In North America Shell has access to three LNG import sites.

Conclusion

All of the above demonstrates Shell's capability in not just the liquefaction process but the complete LNG value chain.


WHAT DOES it TAKE TO DISCOVER SOMETHING NEW EVERY DAY?
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A New Dimension to Trinidad and Tobago's Gas Sector

By Haydn I. Furlonge

Trinidad and Tobago, the host of the first IGU Executive Committee meeting of 2008, has a long history as a petroleum producer. Commercial oil production started in 1908, while the country's use of natural gas as a feedstock in the manufacture of ammonia dates back to 1959. More recent innovative technological and commercial solutions include:

- Upstream technologies – directional drilling and 3D seismic surveys with a relatively high success rate, and the use of enhanced oil recovery methodologies;
- Process technology – commercialisation of the Optimised Phillips Cascade LNG process;
- Plant construction and management – records in project completion time, cost and safety of several downstream plants (methanol and LNG);
- Business models – innovative gas pricing and commercial arrangements; and
- Project financing – multi-million dollar project financing for plant and infrastructure projects.

Now the country is developing the Natural Gas Institute of the Americas (NGIA) as a regional centre for gas R&D and training. Launched in August 2006, NGIA is part of the University of Trinidad and Tobago, whose President, Professor Kenneth S. Julien, has identified research and development as a priority.

R&D accounts for just over 0.1% of Trinidad and Tobago's GDP, a tenth of the level of developed countries. The aim is to boost expenditure and build a cadre of critical thinkers, innovators and entrepreneurs so there is an appreciation of and attraction to R&D work at the highest level.

Industrial R&D typically focuses on applied research. The challenge for academia is in the acquisition of venture capital, management of marketing risk and commercialisation of inventions.

Globalisation presents an avenue for countries such as Trinidad and Tobago to fast-track their initiatives. Opportunities include alliances with R&D centres worldwide, sharing financial, physical and human resources, and outsourcing intellectual labour to developing economies. US energy R&D funding has fallen by about $1 billion over the past decade, and the fastest growth rates, in terms of R&D investment and economic activity, are in developing economies in Asia and the Far East.

The energy sector plays a vital role in Trinidad and Tobago's economy. (ABOVE) The Atlantic LNG plant, (OPPOSITE, ABOVE) the Labidco Fabrication Yard and (OPPOSITE, BELOW) the gas processing plant operated by Phoenix Park Gas Processors Ltd.

The benefits of an expanded tertiary education sector placing strong emphasis on R&D are diversification of the nation's energy skills base with a range of new economic opportunities.

Approach to R&D

These are some of the strategies to be at the forefront of gas-related research and expertise in the Atlantic Basin region:

- Increase the depth of energy-related research at the University of Trinidad and Tobago;
- Partner with industry in identifying research projects;
- Build a reputation for quality research and training by attracting the best researchers;
- Develop ties with local, regional and international R&D institutions;
- Maximise resources by forming multidisciplinary research teams; and
- Grow research capacity by expanding funding, physical, computing and information resources.

Research areas

NGIA has defined four Research Groups. These cover fundamental and applied research to be undertaken (some in collaboration with entities such as the University of Texas in Austin and Methanol Holdings of Trinidad).

1 Upstream Technologies Group

- CO_2 sequestration
- Improving well productivity
- Production of gas from methane hydrate reservoirs

2 Midstream and Downstream Technologies Group

- Methanol to power
- Natural gas hydrates
- Reaction kinetics and catalysis

3 Energy Economics and Policy Group

- Macroeconomics and sustainability
- Gas market dynamics
- LNG value chain optimisation

4 Energy and the Environment Group

- Environmental modelling
- Renewable energy

The NGIA of the University of Trinidad and Tobago seeks to add value to the economy by combining gas and human resources to bring maximum returns on innovativeness, entrepreneurship and sustainability. This comes at a critical juncture in the local economic circumstances and global environment.

Haydn I. Furlonge is Associate Professor at the NGIA, University of Trinidad and Tobago (www.utt.edu.tt). He is also the National Gas Company of Trinidad and Tobago's Assistant Manager, LNG and Investment.

WE'RE IN THE BUSINESS OF

Natural Gas

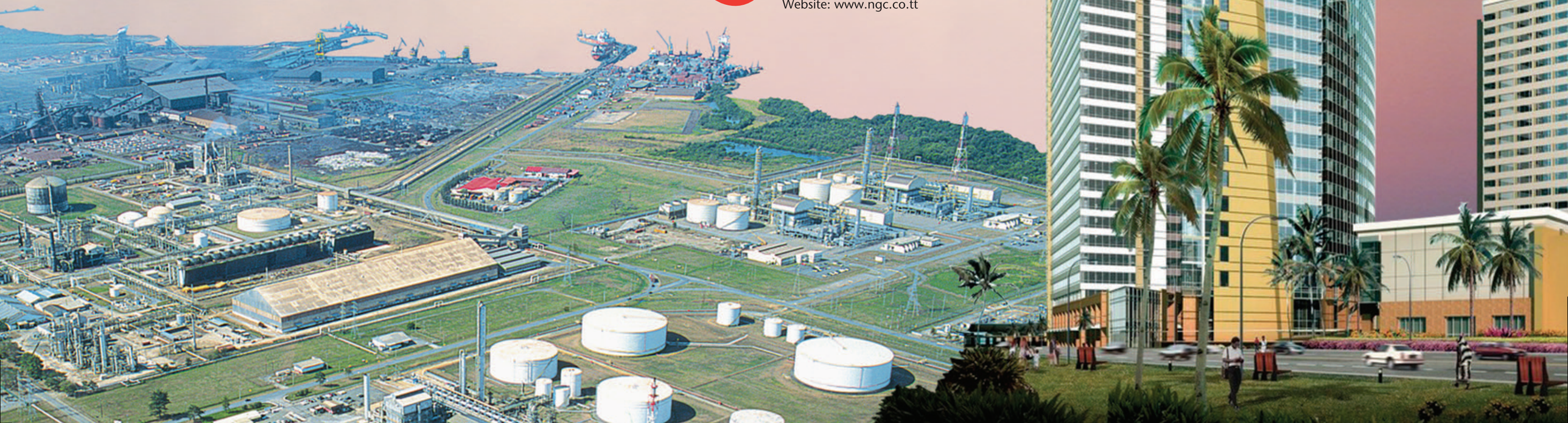
Since August 1975, The National Gas Company of Trinidad and Tobago Limited (NGC) has played a key role in the development of the natural gas industry. NGC's core business is the purchase, transmission, distribution and sale of natural gas. NGC owns and operates the country's 800 km/ 4.4 bcf/d pipeline network which comprises both offshore and onshore segments.

As a diversified group of companies NGC's operations span the entire gas value chain with involvement and investments in upstream gas and oil production, industrial site, port and marine infrastructure development and services, NGLs and LNG production and shipping. A key NGC subsidiary, National Energy Corporation of Trinidad and Tobago (NEC), is responsible for natural gas-based investment promotion and facilitation.

After 32 years, in 2007, NGC's group assets are over US$3 billion with operating revenues of over US$1.5 billion. With the projection that natural gas will continue to play a vital role in world energy requirements, Trinidad and Tobago's natural gas sector will remain a key economic sector for development.

THE NATIONAL GAS COMPANY OF TRINIDAD AND TOBAGO LIMITED

Website: www.ngc.co.tt



Adding Value to IGU Membership: PGC B Disembarks in Washington DC

By Pedro Moraleda, Francisco Sichar and Jayesh Parmar

PGC B's annual plenary meeting of 2007 was held in September in Washington DC, the capital of the USA and also the political centre of the North American gas industry. The meeting combined an intensive review and discussion of PGC B activities, an exposure to the North American gas industry, and a chance for delegates to get acquainted with the operation of energy-related institutions there.

The primary objective of the meeting was to review and comment on the work of the Committee, and to plan for the next phase. A progress report on this work is provided in this issue of the magazine.

The meeting also provided PGC B delegates with an invaluable opportunity to exchange information, to develop relationships at the highest level, and develop an insight into one of the most advanced and competitive gas markets in the world. Highlights of some of these meetings included:

- *Federal Energy Regulatory Commission (FERC)* – the role of the Commission, the issues facing the gas industry in the USA and how these are being addressed, and the approach to market monitoring.
- *Market Monitoring Centre (MMC) of the FERC* – a detailed look at the role and operation of this centre, including the broad spectrum of price, capacity and transaction data, and how this is collated and analysed by the MMC. Delegates of Study Group B.2 even had the opportunity to participate in a live session of the MMC and provide input on gas/LNG demand estimations in the Atlantic Basin.
- American Gas Association (AGA) and Interstate

PGC B's annual plenary meeting of 2007 was held in Washington DC, September 26-27.

The group's visit to FERC was hosted by the Commission's Chairman, Joseph T. Kelliher (SECOND FROM LEFT IN THE MIDDLE ROW).

Natural Gas Association of America (INGAA) – understanding the operation of the market, and the different roles and interactions between transmission companies and gas shippers.

- *US Department of Energy (DOE)* – delegates of Study Group B.2 had the opportunity to meet with analysts from the DOE and discuss gas price formation mechanisms and trends in the North American market.
- *Natural Gas Roundtable* – an opportunity to meet with a broad section of the gas industry and a unique chance to hear the enhancing view on the future of gas from Aubrey McClendon, Chairman and CEO of Chesapeake Natural Gas, the third-largest gas producer in the United States.

Despite the tight schedule, there was just enough space in the programme for delegates to spend a little time together catching up. These social events included an evening tour of Washington DC on "Segway" electric scooters (which required some skill and coordination, but thankfully training was provided and everyone returned safely!), and a sampling of the nightlife in Georgetown, one of the most popular suburbs of Washington DC.

Special thanks are due to our North American colleagues for their hospitality and substantial involvement, and particularly to David Sweet, Executive Director of the World Alliance for Decentralised Energy, for arranging and hosting the meeting.

One of the objectives of PGC B is to address the global gas industry, broaden involvement in the Committee, and give an opportunity for the maximum number of people to participate in its meetings and discussions. Therefore, the plenary meetings are scheduled for a different continent each year, and the next meeting is scheduled for September in Japan. It is expected that a large number of delegates from Asia will attend this meeting.

Pedro Moraleda, Francisco Sichar and Jayesh Parmar are respectively the Chairman, Secretary and the member responsible for relations with stakeholders of PGC B.

Social events included a tour of Washington DC by electric scooters for which the group donned helmets.

CLP plans a cleaner, greener future with gas

Hong Kong is famous for its glittering night skyline. Demand for the power needed to keep the bright lights burning is increasing 2-3% a year in a city that imports 100% of its energy. Now, with supplies via pipeline out of China set to dwindle, power utility company CLP urgently needs to secure new sources of natural gas.

CLP supplies three-quarters of Hong Kong's electricity. It started piping natural gas from China's Yacheng gas field to its 2,500MW power station at Black Point in 1996. Its subsidiary, Castle Peak Power Company (CAPCO), a 60-40 joint venture with ExxonMobil, has contracted to buy 2.5 bcm/yr from Yacheng to 2015. Today, natural gas contributes a third of its fuel mix, alongside nuclear power and coal.

CLP wants to source more natural gas to meet government targets to reduce emissions by 2010. However, supplies out of Yacheng are dwindling and CLP wants to build the first liquefied natural gas (LNG) terminal in Hong Kong, securing long-term gas supplies.

The company plans to invest over $1 billion in a state-of-the-art LNG terminal on South Soko island, developed and operated by CAPCO, the first phase up and running by 2012, capable of handling 2.6 million tons of LNG a year.

"We started to look at options in 2002," says CLP's Commercial Director, Richard Lancaster. "Having chosen LNG as the best source for continuing supplies of natural gas and for environmental performance, we have been working in parallel on LNG procurement and technical development of the receiving terminal.

"Natural gas generates a quarter of Hong Kong's electricity needs. We want to increase the proportion of gas in our fuel mix to meet emissions targets. This would see gas accounting for up to 35% of Hong Kong's electricity needs. Chinese gas demand has grown hugely, creating stiff competition for a valuable resource and we need to ensure reliable supply lines into Hong Kong in future."

CLP studied 29 sites, before choosing South Soko. It gained an environmental permit in April 2007, and has recently awarded front-end engineering design contracts. CLP hopes to win full government approval, including financial approval and land grants, in early 2008.

From the outset, CLP aimed to make the consultation process transparent, involving government, customers and environmental groups. Green campaigners worried that the project would threaten South Soko's marine life, including the rare Chinese white dolphin. To allay these fears, CLP plans to build a marine park alongside the terminal.

"Marine conservation and development of the terminal go hand-in-hand," Lancaster says. "Gradually, environmental groups have realised that this project will benefit air quality and at the same time can enhance the marine environment. What makes this project credible is the need to secure future supplies of natural gas to improve air quality. The environmental benefits of using more natural gas in our fuel mix are widely accepted in the community."

Black Point Power Station is one of the largest gas-fired power stations in the world. CLP aims to phase in LNG shipments from 2012, gradually reducing dependence on Yacheng. Phase two of the project begins when Yacheng supplies are phased out.

"The LNG market is tight, due to rising demand for cleaner fuel and constrained supply due to delays to several new projects," says Pat Roberts, Managing Consultant at Gas Strategies Consulting. "CLP has a credible LNG project. Early planning and thorough evaluation create an opportunity to complete ahead of the depletion of the Yacheng gas supply."

CLP is negotiating with LNG-exporting countries and specialist shipping companies. The terminal could expand to handle third-party gas supply, subject to demand.

"No other South China Sea gas fields are available to meet CLP's timeframe," Lancaster concludes. "The only alternative would be to stretch the existing supply out of Yacheng, burning more coal. This would have an unacceptable environmental impact.

"As the government is urging companies to source power from natural gas to meet its emissions targets, this project is completely in line with that policy. Once we have approval, we will build a world-class LNG terminal to serve Hong Kong's growing energy needs."

CLP 中電

Asia's trusted energy partner

Hong Kong is one of the most dynamic and metropolitan cities on earth, relying on electricity to fuel its growth and prosperity.

As the largest electricity supplier in Hong Kong, CLP is also the city's largest consumer of natural gas. With a solid track record and many years of experience in using gas for electricity generation, CLP has developed a reputation as a trusted partner in the Asia Pacific region, powering homes and businesses in Chinese Mainland, Australia, India and Thailand.

By pioneering the use of clean natural gas in Hong Kong, CLP is doing our part to address climate change and improve the environment – while supplying clean, reliable and affordable electricity to Asia's cities.

Why Does LNG Quality Matter?

By Martin Josten

A key issue when arranging the destination of LNG cargoes is the gas specification of the receiving market, with the Asian markets requiring gas with a high calorific value, the US and UK using leaner gas and continental Europe more flexible in terms of the range of calorific values.

A Study Group of Programme Committee D has been looking at LNG quality and interchangeability since the 2003-6 Triennium. A paper was delivered at WGC 2006 in Amsterdam and, because of the continuing level of interest, it was agreed to continue into the current Triennium. This article gives an overview of our work, which will culminate in SG D.1's report to WGC 2009 in Buenos Aires.

Varying LNG specifications

With the evolution of gas as LNG into a globally traded commodity, some of the old certainties have gone. When you could count on all the cargoes from Abu Dhabi, for example, ending up in Japan, all you had to do was make sure that the LNG plant was designed to meet the Japanese gas specifications. Now that some of those cargoes are likely to turn up on the US East Coast instead, you may have a problem if the LNG is too rich (mainly in ethane and propane) for the US market.

As pointed out in the report from the 2003-6 Triennium[1], the actual specifications in each market depend mainly on the history of its gas supply. In general, if the natural gas industry began with pipeline gas supplies it was accustomed to lean gas, and if the first gas came in an LNG carrier the specifications were set up for this richer gas.

The Study Group has carried out a survey of the specifications established in different member countries, which will be published in the 2006-9 report.

To further complicate matters, the LNG that arrives at an import terminal is not necessarily the same as the LNG that left the liquefaction plant several days before. It will have "weathered" or "aged" by the preferential vaporisation of light ends, and unless the ship has onboard liquefaction facilities (only fitted on a few of the most recently delivered carriers) these light ends will be burned in the ship's propulsion system, leaving a higher heating value gas to be delivered. A number of modelling tools are available on the market to predict this effect.

Convergence of specifications has reached the political agenda in a number of regions, in an attempt to eliminate barriers to cross-border trade or just to reduce the cost impact on the consumer of quality adjustment. In the UK, for example, the gas network regulator is examining the implications of a wider heating value range, more like that of continental Europe, and in the Far East some countries are looking at acceptance of leaner gas to reduce the amount of costly propane injection. It is clear that this process will take a long time, for the reasons mentioned below, and the eventual outcome is far from certain.

The gas that is delivered to a national or local transmission network will not only be used for heat or power generation. It will often be chemically converted into other products such as fertiliser. These end-uses tend to be more sensitive to the presence of impurities than to density or heating value.

In consequence, market requirements are expressed in terms of more than just heating value; there will be limits on impurities as well *(see Table 1)*. And the sensitivity of each regional market to specific impurities will depend on the nature of the predominant users.

The Study Group is examining in some depth the nature and reasons for sulphur, nitrogen and oxygen limits, their origins and whether they are still applicable in today's market. Then we shall look into the implications for the LNG industry of

1 Report of Study Group D.1, "LNG Quality", IGU, June 2006.

meeting these limits, and propose a common baseline for the sulphur specifications that in extreme cases can pose challenges for liquefaction plant design.

Effects on power station (gas turbine) performance

The nature of the users has also evolved over the 40 years or so of LNG trade development. Gas is now the fuel of choice for many large power stations, which are driven by gas rather than steam turbines, and it is popular not only for economic reasons and for CO_2 reduction, but also for lower emission of sulphur and nitrogen oxides.

The catch is that in order to deliver NO_x reductions, gas turbine vendors have developed a variety of low-NOx combustion devices that are, in turn, very sensitive to gas quality.

However, the most fundamental parameter to determine gas turbine performance is Wobbe Index (gross heating value divided by the square root of density). This is a better indicator of combustion chamber conditions than heating value alone.

We should not forget that gas turbines are not the only machines that burn gas to generate power.

BELOW
Table 1.

SELECTED WORLDWIDE INDUSTRY STANDARDS ON IMPURITY QUALITY

Gas Property	*Units*	*US ASTM D-3 Committee Draft #1 Pipeline quality natural gas (1977)*	*US ASTM D-3 Committee Draft #4 Pipeline quality natural gas (1981)*	*ISO 13686: 1998 Natural Gas – Quality designation*	*ISO 20765-1: 2005 Worldwide pipeline gas quality for property calculations*	*China Code GB 17820-1999*
Total sulphur compounds	mg/m³ (gr/mscf)	22.9 (1.0)	22.9 (1.0)	120 (5.2)		I < 100 (4.4); II < 200 (8.81); III < 460 (20.1)
Hydrogen sulphide	mg/m³ (gr/mscf)	5.7 (0.25)	5.7 (0.25)	5 (0.22)	<0.02%	I < 6 (0.26); II < 20 (0.87); III < 460 (20.1)
Mercaptan sulphur	mg/m³ (gr/mscf)	11.45 (0.5)	11.45 (0.5)	6 (0.26)		
Water vapour	lb/MMscf	7	7	Ground temperature technically free of water	<0.015%	
Carbon dioxide	mol%	3	3		20	I < 3; II < 3; III < 3
Nitrogen	mol%				20	
Oxygen	mol%	0.001	0.1	<3% in dry network, <0.5% in wet network	0.02	

Source: BP.

Höegh LNG As

Background/History

Höegh LNG represents an organisation that has been pioneers in the international shipping industry since 1927. Leif Höegh found his opportunity in the growing market for oil transportation, and in 1928, M/V "Varg" became the first crude tanker owned by Höegh and it was built at Odense Shipyard, Denmark.

Throughout the years, the size and diversity of the Höegh fleet increased, and in 1973 the company entered the LNG market with the delivery of the LNGC "Norman Lady" – the first Moss type LNG carrier ever built, a vessel still in operation. Since then, one generation of technical and commercial LNG competence has been accumulated within Höegh LNG Ltd. Providing for a centre of experience, competence and innovation in the LNG field.

Höegh LNG today

In June 2006 Höegh LNG Ltd. was established as a separate company, with the primary shareholder being Leif Höegh & Co Ltd. The main purpose of this separation was to allow the management of HLNG the freedom to focus solely on LNG and to give it the flexibility to grow the business.

Höegh LNG continues to operate successfully as an LNG carrier service provider, and it currently owns and operates a fleet of five traditional LNG tankers. However, recent market developments has encouraged the company to leverage its commercial and technical expertise to offer new and existing customers innovative business solutions within the complete LNG chain.

New Business solutions

As a result of a strategy of providing the industry with added value, the company has developed Shuttle- and regasification vessels (SRV) and Floating LNG Terminals, so-called Deep Water Ports (DWP), and is currently building two SRV's jointly with MOL at Samsung for the Neptune project offshore Boston. Further, Höegh LNG has under development two DWP and associated SRV's. One in the US, offshore western Florida, "Port Dolphin", and one offshore western UK, "Port Meridian". Höegh LNG is actively pursuing other floating LNG projects around the world.

Recently Höegh LNG entered into agreements with major contractors and formally started a pree FEED (Front End Engineering and Design) for its first LNG FPSO Unit (Floating Production Storage and Offloading), with the objective to design and construct the worlds' first LNG FPSO.

- *Our strategy is to develop Höegh LNG's business model from pure LNG transportation into offering also solutions for LNG production and floating regasification terminals, says Sveinung Støhle, President and CEO of Höegh LNG AS.*
- *With the LNG FPSO in place, Höegh LNG can offer a complete offshore LNG supply chain, production, marine transportation, storage, regasification and market access.*

Innovation

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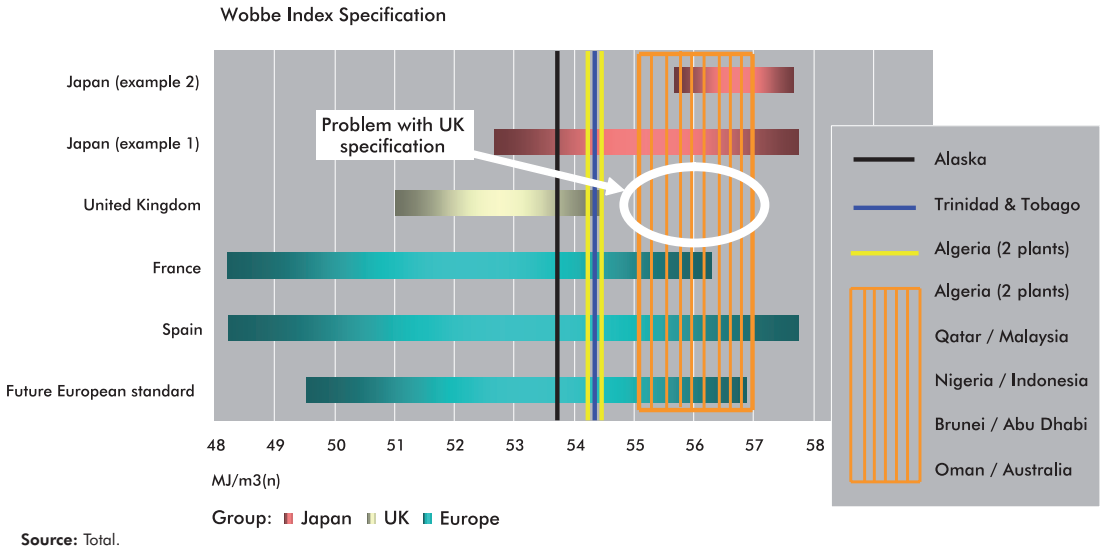
LNG TERMINAL SPECIFICATIONS – WOBBE INDEX



Source: Total.

RIGHT
Figure 1.

The other important users are reciprocating internal combustion engines, for which there are also significant fuel gas parameters.

● Testing of consumer appliances

Attempts to harmonise gas specifications across national borders are nowhere more topical than in the European Union, where the differing energy history of Member States has led, for example, to varying tightness of the limits on heating value. The European Association for Streamlining of Energy Exchange (EASEE-Gas) was set up in 2002 to promote convergence within the EU through the development of Common Business Practices. At the moment, the UK is being asked to consider a broader range, which is very challenging because of a legacy of industrial and domestic appliances that can exhibit inefficient or even dangerous performance when operating outside their specified fuel range. *(See Figure 1: LNG Terminal Specifications.)*

In good faith, the UK has embarked on an extensive programme of appliance testing, to verify if the current limits can be relaxed at all – or whether we shall have to wait until the entire stock is renewed or at least modified – a very long-term outcome. Others are also engaged in this work. Elsewhere in the EU the European Commission is using Marcogaz to carry out appliance testing, while in the US this is being undertaken by the Gas Appliance Manufacturers' Association and by regulatory bodies in various states.

● How do you measure quality?

Quality measurement is a rather specialised art. The hardware is the province of the instrument engineers and technicians, but the limits on accuracy specification need to be understood by commercial as well as technical staff, as the economic consequences of even small errors can be significant over a period.

Most terminals perform a mix of online and offline analysis. Techniques for both approaches will be reviewed in our final report, and their speed and accuracy will be evaluated. Similar principles apply to both quantity and quality measurement, but our focus will be on quality analysis. Online analysers can be used directly in the blending

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INNOVATIVE PROJECTS

LNG FPSO – Floating Production, Storage and Offloading

SRV – Shuttle and Regasification Vessel

DWP – Deep Water Port floating terminals

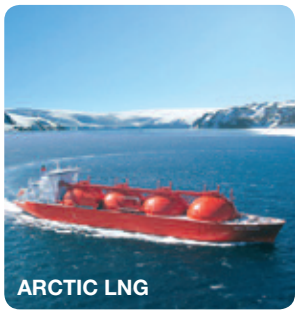
FSRU – Floating Storage and Regasification Unit

Arctic LNG – LNG trades under development in the Arctic


SRV

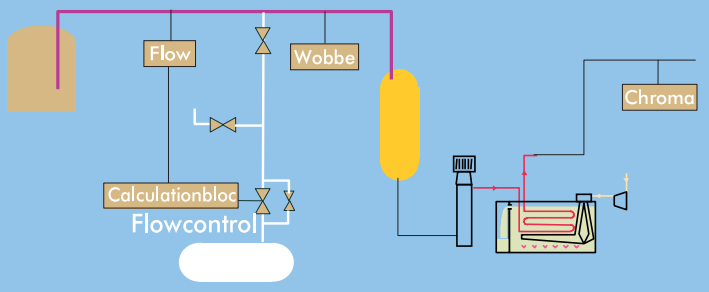

DWP


FSRU


ARCTIC LNG

HÖEGH LNG

METERING IN THE IMPORT TERMINAL



Reaction Time : Injection – Wobbemeter: 12 min.

Reaction Time : Wobbemeter – Chroma: 20 min.

Source: Fluxys.

ABOVE
Figure 2.

2 "Tools & Methods to Tackle the Diversification of LNG Supply Sources", D. Uznanski of Gaz de France, LNG Tech Summit, Rotterdam, September 2007.

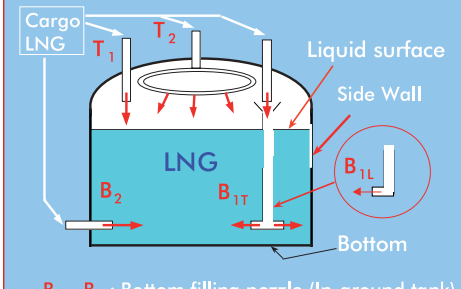
BELOW
Figure 3.

equipment to control the process and provide quality assurance. (*See Figure 2: Metering in the Import Terminal.*)

● Mixing of different LNG cargoes in a tank

Loading of different quality cargoes into the same tank may be done intentionally, with controlled mixing, in order to achieve a market specification, in which case it is normally referred to as "blending". It may also sometimes occur because of limited storage availability. In either case, the possibility of rollover needs to be considered.

LNG STORAGE TANK FACILITIES (FOR ROLLOVER PREVENTION)



Stratification factor
- Tank shape/structure
- ? Filling operation
- ? Initial difference of density
- Initial liquid level
- Filling flow rate
- Heat input
- etc.

B_{1L}, B_{1T}: Bottom filling nozzle (In-ground tank)
B_2: Bottom filling nozzle (Above-ground tank)
T_1: Top filling nozzle
T_2: Top filling nozzle(Ring type)

Source: Tokyo Gas.

Rollover is a phenomenon that was energetically investigated in the earlier stages of the LNG trade, back in the 1970s. But because it nearly always relates to the mixing of different quality cargoes, something that was rare until the late 1990s, it did not seem to be a big issue in practice. Now of course the likelihood of such mixing at most import terminals is relatively high, and it is back on the agenda, albeit with improved modelling tools available[2].

Briefly, the problem occurs when a lighter cargo sits on top of a heavier cargo, maintaining distinct layers ("stratification") whose properties can evolve over time until their relative densities are reversed. Thus you have an unstable situation, which can resolve itself suddenly by a rapid interchange of the layers ("rollover"), accompanied by evolution of large amounts of vapour from the superheated lower liquid layer as it reaches the surface. If this evaporation rate exceeds the relief capacity of the tank, a failure of containment can occur.

Preventing rollover depends on a number of design and operational principles: guidelines for filling arrangements when cargoes of different density are loaded into the same tank, design of the filling nozzles themselves, and instrumentation to provide early warning of stratification potential. The critical parameters to measure at a range of levels in the tank are temperature and density. (*See Figure 3: LNG Storage Tank Facilities.*)

It should not be forgotten that LNG quality adjustment measures such as nitrogen ballasting can affect downstream users. This applies particularly to peak-shaving plants, where the gas may be re-liquefied and stored for much longer periods – several months if the peak-shaving is of a seasonal nature. Rollover may become an issue in the peak-shaving tanks.

● How do you adjust the quality?

If the LNG does not meet the market requirements, is adjusting the product quality at the liquefaction plant the best solution? In general, this will not be

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economic unless very large quantities of product are destined for the same market, and it will always be expensive and operationally inconvenient to have to segregate your storage for different product grades. Accordingly, the focus has so far been on import terminals, where a variety of solutions have been adopted for quality adjustment – either richer or leaner – where necessary.

The simplest method of reducing the heating value is to inject nitrogen, commonly known as ballasting. It is not cheap, as, surprisingly, nitrogen is generally more expensive per tonne than LNG.

The other principal method is to extract the heavier components such as ethane and propane, condensing them into a liquid phase. This may be economic if there is a local market for the liquids. The technical issues and economic/market drivers for liquid extraction will also be examined in the report.

When the gas needs to be enriched, the usual method is to inject propane. This may even be imported from the places where it was extracted from the LNG in the first place.

All of these methods will be covered in the report. In the meantime, it should be noted that a comprehensive overview of quality adjustment methods is already available to GIIGNL members[3].

3 Quality Adjustment of LNG for Transmission, GIIGNL Technical Study Group, May 2007.

Report for WGC 2009

The report of Study Group D.1 of the PGC D will cover topics outlined above, according to the following provisional table of contents:

1. Quality adjustment at LNG import terminals and liquefaction plants;
2. LNG heating value specifications;
3. Impurity specifications;
4. Analysis and measurement;
5. LNG rollover;
6. Impact of LNG on gas turbine performance; and
7. Appliance testing.

Martin Josten of BP is the leader of PGC D's Study Group D.1.

Liquid nitrogen ballasting is simple but not cheap – the Zeebrgge LNG terminal in Belgium.

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Russia and Germany: A Solid Regional Energy Partnership

During the next World Gas Conference in 2009, gas market integration on a global and regional scale will be a priority topic for debate and consideration.

The approach for market integration could be a theoretical one, developing frameworks and primary research, but it is our expectation that it could also engender a more significant practical approach: learning lessons from cases around the world, which could be applicable to other regions.

Much of the present-day dynamics of the energy world revolve around politics and we will find that specific cases often denote a strong political undercurrent. This paper, however, will use real world examples where politics and energy policy can comfortably be set on the sidelines, while commercial interactions take the centre stage. Hence, a more business-oriented perspective will be appropriate here to highlight the circumstances and arrangements involved in the hitherto resilient energy relationship between Russia and Germany.

By the mid-1970s, this relationship gained substance as the so-called Orenburg pipeline deal was established, connecting the Russian upstream sector to the West German downstream market by means of midstream long-distance transmission lines through Russia, Ukraine and Eastern Europe.

Given the tensions prevailing during the Cold War and the strict division between West and East at the time, this can be seen as a remarkable achievement, and could be considered as the foundation of the Soviet integration with European energy markets. As of today, it is clear that Russian energy supply is essential for Europe and, moreover, energy payments are instrumental to fuelling the Russian economy (25% of European natural gas is supplied by Russia, while income from natural gas exports provides 50% of the Russian state budget). It is obvious that both Germany (and Europe) and Russia are mutually dependent on the other, and have engaged in a win-win situation, ensuring balance between both parties.

With the days of the building of the Orenburg "energy bridge" long gone, we are entering a new phase of cooperation, an even more integrated one, stabilising and giving shape to a more sophisticated business model based on mutual interest. Currently, one can witness an entirely new form of interaction between privately-owned companies on the one hand, and a state-controlled National Oil Company (NOC) on the other, while on the sidelines government positions provide their respective support to this interaction. This development is entirely new in the sense that state-controlled forces interplay with market-oriented ones, and is driven by a desire on both sides to secure their long-term strategic positions (security of demand / security of supply) through business-to-business cooperation.

To provide solid examples of the characteristics of this relationship, we will make use of two distinct cases.

Wintershall – Gazprom

Wintershall (a subsidiary of BASF) is a minor but important stakeholder in a joint venture with Gazprom, centred on the Siberian Yuzhno Russkoye gas field: Gazprom owns 51%, while Winterhsall owns 24% in Serverneftegazprom[1] as well as 10% worth of no-voting right preferred shares. By agreement, Wintershall receives natural gas produced at the wellhead in Russia and delivered through the joint venture by Gazprom, based on prices composed by an average value of domestic Russian sales and Russian export sales. This type of arrangement is remarkably similar to the Dutch approach in the Netherlands, which motivates producers to develop the smaller fields first[2], and provides an upfront economic value and incentive for its stakeholders, supporting the development of greenfield operations (even upstream).

Further downstream, Wintershall is the main wholesale seller of Russian natural gas on the

1 Servern eftgazprom is the Russian licence holder for the exploration of the Yuzhno Russkoye gas field.

2 C. van der Linde, G. Greving, R. van Dorssen, *Public-Private Partnership and the Dutch Small Field Policy*, Groningen: Energy Delta Institute: 2007, p3.

German domestic market, and in exchange for its minority stake in Yuzhno Russkoye, Gazprom has agreed to a minority stake (49%) of the wholesale operation, where Wintershall remains the main stakeholder. The two partners will also take up a 50-50 share in Wingas Europe, a venture designed to market Russian gas in Europe at large, outside Germany.

E.ON – Gazprom

In another business-to-business venture, German energy firm E.ON is considering the same type of upstream cooperation with Gazprom by also acquiring a stake of 24% in Yuzhno Russkoye[3]. The corresponding gas volumes and those from existing gas fields in the North Sea amount to roughly 15% of the gas supplies of E.ON.

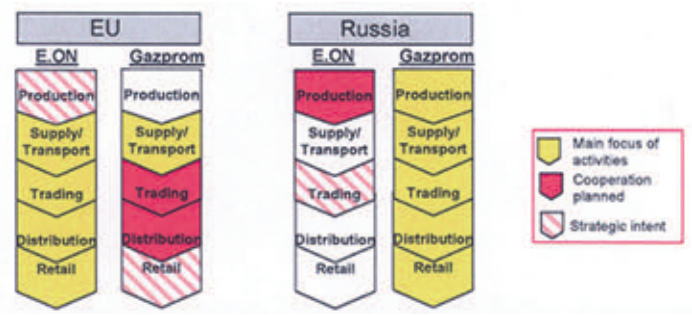
Furthermore, the company is involved in the Russian power market through another joint venture with Gazprom, which consists of buying Russian natural gas at domestically regulated prices from Gazprom, and using it to generate power in the Russian market, where Gazprom remains as the major stakeholder. In exchange, Gazprom will be E.ON's major partner in the Hungarian natural gas sector, i.e., a downstream European gas market. In return for the stake in the field, Gazprom is receiving minority interests of 49% in the Hungarian gas companies E.ON Földgaz Storage and E.ON Földgaz Trade, a stake of 26% in the regional power and gas supplier E.ON Hungaria and a compensation still to be quantified.

All these separate deals are stand-alone commercial deals, and not supported by some form of political concession. Thus through these types of value chain "vertical swaps" up-, mid- and downstream, Gazprom enhances security of supply for

3 "E.ON and Gazprom reach understanding on participation in gas field", E.ON press release, July 13, 2006.

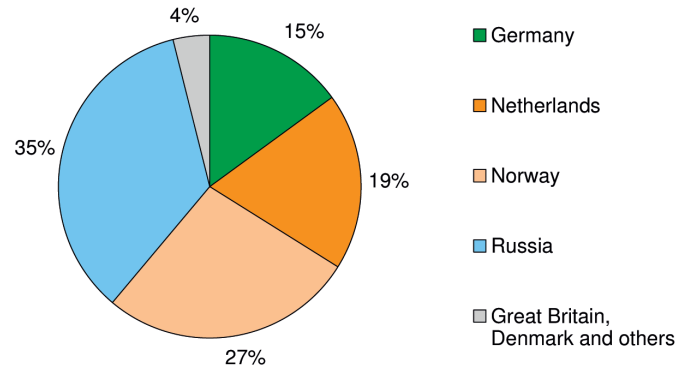
The German-Russian energy relationship has entered a new phase. Pictured are the Chairmen of Gazprom (Alexei Miller, centre) BASF (Jürgen Hambrecht, left) and E.ON (Wulf Bernotat, right) following their agreement to build the Nord Stream pipeline.

ASSET SWAP STRUCTURE ALONG THE VALUE CHAIN



Source: E.ON, Cooperation between gas producers and importers as a vehicle for enhancing security of supply, presentation held for the "Energy Dialogue Russia-EU", Berlin, May 26, 2006.

GERMANY'S NATURAL GAS SUPPLIES BY ORIGIN, 2006



Source: German Association of Gas and Water, www.bgw.de, 2007.

TOP
Figure 1.

ABOVE
Figure 2.

E.ON and BASF while the latter, in all commercial fairness, provide Gazprom with corresponding security of demand. Despite the fact that the contracts in place are short-term, they provide the necessary incentives for extensive cooperation and therefore also imply long-run partnership. The same type of arrangements are deemed necessary to help initiate greenfield investments and projects upstream in Russia, ones that, given the extreme climactic circumstances in areas such as Siberia, require more than token business agreements and short-run deals. Asset swaps in this regard represent reciprocity and mutual benefit, as has often been discussed in many debates over Russian-EU energy relations.

The German-Russian energy partnership, flowing forth from a business-to-business partnership, exemplifies how concrete action on both sides has led to the realisation of upstream interests for Germany. Changing legal frameworks and the lack of predictability regarding tax regimes can be overcome in both Russia and Germany as mutually-beneficial relationships create inter-dependence and strengthen bilateral commitments. The asset exchanges along the value chain provide partners on both sides of the chain with a firm basis upon which to fall back in terms of bankable assets, even in circumstances where long-term commitments might become unfeasible in legal frameworks.

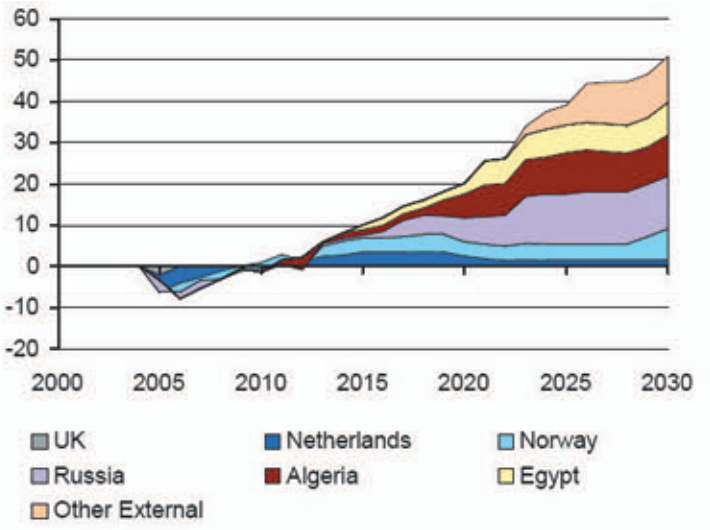
Even though there is a strong contrast between two types of governance, in the sense that the German stakeholders have their roots in a Western, market-driven economy while the Russian stakeholder operates from a centrally-led Russian economy (with albeit monopolistic characteristics), the regional East-West market integration fully rests on commercial business-to-business activities. *Figure 1* illustrates the nature of the asset swap deal in place between E.ON and Gazprom along the natural gas value chain.

Considering the German natural gas import portfolio in *Figure 2*, one can see that gas resources come from state-owned or semi state-owned suppliers: The Netherlands, Russia and Norway. This dependency is due to increase sharply after 2010.

For Germany, enlarging and securing its natural gas import portfolio will be crucial in the years to come (*see Figure 3*).

The drive to secure supplies to meet this rising natural gas demand mirrors Gazprom's ambition to become a leading global player while it maintains its market share in Europe. To this end, Gazprom is not only expanding interconnection capacities inside Russia geared for exports to

GERMANY'S NATURAL GAS IMPORT PORTFOLIO, 2005-2030



Source: Global Insight 2006.

ABOVE
Figure 3.

Europe, but it is also about to embark on an LNG strategy, developing LNG production locations step-by-step. Moreover, it is clear that Dutch and Norwegian relations with Germany are based more on market-based principles, while the Russian-German relationship – as presented above – is guided by government-to-government rather than market-based principles; whilst not loosing sight of the fact that these principles are ultimately put into practice business-to-business with the use of long-term asset swap deals.

The business-to-business deals discussed above can lead to a potentially stable, predictable and above all sustainable commercial environment. Does such a situation expose the German end-consumer to political vulnerability or Russian political influence, as is so often heard in the wider media? Given and considering Germany's import portfolio and the ongoing liberalisation process, the answer is no. In Bochum, the end-consumer is able to choose between different "suppliers" or retailers, switching effortlessly and quickly from one brand name to another, basing decisions on price and quality. These daily decisions have a major impact on the dynamics of the downstream elements of the value chain, but they cannot be made without a guaranteed supply volume, the lack of which precludes any choice being made in the first place. It is in the end-consumer's best interest, therefore, that not only short-term considerations be taken into account, but long-run ones as well. In a liberalised environment, it would seem that although the end-consumer makes decisions based on the short-run, the necessary security of supply remains a long-run issue.

The current evolution of the international gas market points to a trend in which gas is traded at greater distances in a world where market forces play a marginal, regional role. In such a dynamic and sometimes chaotic environment, the only security for both consumers and producers lies in stable, long-run relationships based on commercial logic and mutual trust. This means consumers as well as producers must be on equal footing, i.e., security of demand from a producer's perspective must be as central to any debate as security of supply from consumer's perspective. Integrating the European wish to gain access to the upstream parts of the value chain with Russia's wish to move downstream in Europe is essential to creating a situation in which long-lasting cooperation can thrive.

The German-Russian example presented here is an exponent of cooperation, a role model for other European consumer countries. It is a perfect example of how partnership can be achieved, even under adverse circumstances, with transit and technical issues, in a sector known to be notoriously fraught with political interference, but where cross-border partnerships can have a truly and genuinely commercial nature, benefiting both parties.

This position paper was prepared by Stadtwerke Bochum (www.stadtwerke-bochum.de) in cooperation with the Energy Delta Institute (www.energydelta.org) for IGU's Gas Market Integration Task Force.

eustream
SLOVAK GAS TSO

The largest carrier of natural gas in the European Union has changed its business name. On 1st January 2008 the company 'SPP – preprava, a. s.' was renamed to 'eustream, a. s.'

eustream
"The name 'eustream' reflects the core business of our company, which is the transmission of natural gas to secure supplies to the European markets," explains Andreas Rau, Chairman of the Board of Directors. "The new name should indicate that we are a 'highway' for Russian gas, a major player in European gas transmission and as such hopefully also a good 'ambassador' for Slovakia." Since legal unbundling was carried out in SPP, a. s. in 2006, the environment in which the Slovak natural gas carrier does business has changed dramatically. International competition in the gas transmission business is gradually increasing. What's more, the regulatory framework is changing significantly. The new name 'eustream' also complies with the regulation policy of the European Union as it means the complete separation of branding strategies for transmission activities and trading activities of the former vertically integrated gas company SPP, a. s.

90 billion m³
The transmission system operated by 'eustream' has a capacity of more than 90 bcm/a and it is 2,270 km in length. Last year the company transported roughly 20 % of total gas consumption in the EU.

eustream
'eustream, a. s.' grants access to the Slovak transmission network on a transparent and non-discriminatory basis and provides a full service concerning the transmission of natural gas. The company is also in charge of operating and maintaining the pipeline sections and compressor stations of the transmission system. Thanks to the continuous modernization of infrastructure, 'eustream' also contributes to the security and reliability of gas supplies to Central and Western Europe while reducing the environmental impact of gas transmission as much as possible. The main business partners of the company are from Russia, the Czech Republic, Croatia, France, Germany, Austria, Italy and Slovenia.

tradition
'eustream, a. s.' represents the future of natural gas transmission via Slovakia while having a wealth of experience in gas transmission. Since 1972 the company has transmitted a total of 1.9 trillion m³ of natural gas. The largest carrier of natural gas in the European Union thus follows on in the tradition of the gas industry in Slovakia, which started more than 150 years ago.

eustream
The company SPP – preprava, a. s. began its independent life after the legal separation of transmission activities from the parent company SPP, a. s. on 1 July 2006. By establishing this company, the legislative requirements for the creation of an independent transmission system operator were met. The priority of 'eustream, a. s.' is still to offer reliable transmission services on a transparent and non-discriminatory basis and to be flexible in meeting market needs.

SPP – preprava is changing to eustream.
The business environment for natural gas transmission is changing.
So are we... Progressing and drawing on experience.

eustream
SLOVAK GAS TSO