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● Working Committee 2 Storage

Chairman: Sergei Khan, Gazprom, Russia
Vice-Chair: Vladimir Onderka, Transgas A.S. Czech Republic
Secretary: Elena Sushilina, Gazprom, Russia

During the 2003-2006 Triennium 30 representatives from Algeria, Argentina, Austria, Croatia, the Czech Republic, Denmark, France, Germany, Iran, Italy, Japan, Kazakhstan, Korea, The Netherlands, Romania, Russia, Slovakia, Spain, Sweden, Ukraine and the USA participated in WOC 2's activities. Three Study Groups were created.

SG 2.1 Basic activities

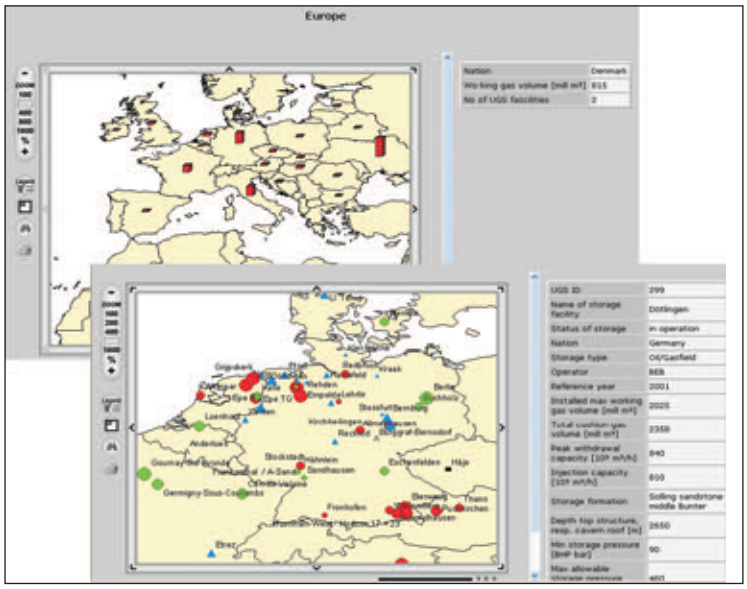
Leader: Joachim Wallbrecht, BEB, Germany

SG 2.1 aimed at updating the worldwide underground storage (UGS) database as well as describing and analysing UGS development trends in separate countries.

SG 2.2 Achievements and trends in the field of technical efficiency and safety

Leader: Alexander Grigoriev, Gazprom, Russia.

SG 2.2 aimed at analysing the achievements and present trends in gas storage technologies.



Sample pages from the UGS database.

SG 2.3 Environmental protection issues

Leader: Gretta Akopova, Gazprom, Russia

SG 2.3 aimed at analysing the achievements and present trends in state-of-the-art UGS environmental protection technologies.

WOC 2 held two sessions and two expert fora during WGC2006.

Committee session June 6

The first session dealt with "Security of gas supply, the role of UGS" and was chaired by Sergei Khan and Joachim Wallbrecht, with the latter also presenting the results of SG 2.1's work. He said that the UGS database covers 610 UGS facilities worldwide with a total capacity of 333 bcm, and that a glossary of relevant UGS terminology is available in different languages (Czech, French, German, Italian, Japanese, Russian and Spanish). He also presented trends in UGS development by country (Austria, Canada, France, Germany, Italy, The Netherlands, Poland, Russia, Slovakia, Spain, Ukraine and the USA). This paper won one of the four awards for the best work presented at WGC2006.

Individual reports from Austria, Germany, Lithuania, The Netherlands and Russia were presented during the meeting. The discussion proved that UGS is a major element of supply security in the gas chain. Many countries possess strategic UGS reserves guaranteeing gas supply security, while several countries with surplus UGS capacities provide gas storage services to neighbours. The UK is an example of a country that has recently become a net gas importer and consequently needs to develop more UGS capacity to ensure higher supply security. The discussion also pointed to the significance of having UGS capacity at gas pipeline crossings, which helps achieve gas flow manoeuvrability and thus enhances supply security. The geological UGS development opportunities in the vicinity of the Baumgarten gas hub in Austria were highlighted in this context.

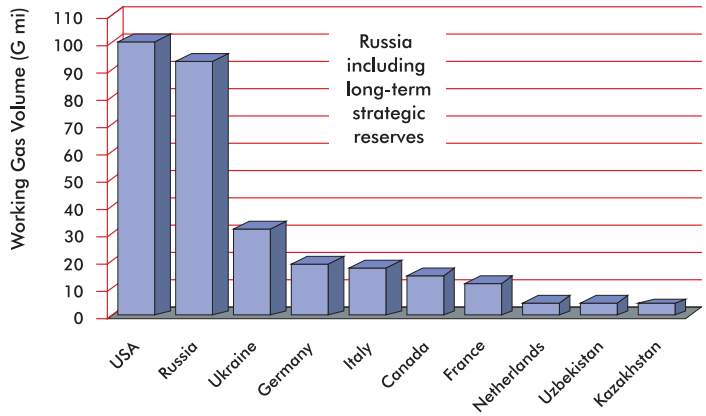
Committee session June 7

The second WOC 2 Session "UGS today and tomorrow" was chaired by Sergei Khan and Vladimir Onderka. Sergei Khan kicked off by presenting the highlights of SG 2.2's report on the development of new UGS technologies which include: utilisation of lined rock caverns for gas storage purposes; CO_2 sequestration; helium and hydrogen storage; and the storage of gas as gas hydrates. Then, speakers from Argentina, the Czech Republic, France, India and Russia looked at existing UGS facilities constructed in oil fields as well as in lined and non-lined rock caverns. Additionally, they highlighted issues relating to geological surveys of operating UGS facilities in depleted fields, and scrutinised other gas storage alternatives including underwater and gas hydrates storage. The delegates stressed that the development of CO_2 sequestration in geological structures was similar to conventional gas storage, and therefore made it possible to use UGS technologies.

Expert forum June 7

Sergei Khan also chaired the first expert forum, which covered "UGS safety and the environment". SG 2.3 leader Gretta Akopova presented the results of the work of SG 2.3, which had investigated issues related to the environmentally-friendly operation of UGS facilities. She explained that the investigation method employed was to search for and analyse information in order to create a database on the technologies, methods and means of enhancement of UGS environmental stability. A comprehensive analysis of legislation, normative materials and technical decisions was carried out. Akopova said that the results obtained could be considered representative both on account of the number of respondents taking part in the study (15 + nine other sources), and in terms of its geographical coverage. (The study covered Argentina, Croatia, the Czech Republic, Denmark, France, Germany, Hungary, Italy, Japan, The Netherlands, Norway, Poland, Romania, Russia, Spain, Sweden, Turkey, Ukraine and the USA).

UGS WORKING GAS VOLUME BY SELECTED NATION



ABOVE
Figure 2.

The analyses showed the similarity of approach to environmental protection in different states. Gas companies were found to follow the specified technical and environmental protection norms during the whole UGS life cycle. The technologies used were found to be reliable and applicable to further UGS prospects.

A further report on concrete UGS facilities outlined the results of the implementation of environmentally-friendly technology.

The Chairman presented the highlights of SG 2.2's report in relation to UGS industrial safety, which found that companies engaged in UGS operation broadly maintained the following approaches: safety studies and audits; preventive technical installations; subsurface safety valves; diagnosis of critical operations; enhanced monitoring; best knowledge of the geological situation; periodical gas inventory and control of cap rock tightness; preventive maintenance; and accident analyses.

Further reports by German, Russian and Slovak speakers explored the methods, approaches and instrumental support for technical inspection of

UGS wells, lines and upstream equipment safety. Special attention was paid to crustal deformation and subsidence during gas field development and possible further implementation for UGS operation.

Expert forum June 8

The second expert forum dealing with the "Improvement of UGS performance" was chaired by Fred W. Metzger (USA) and Joost Ketting (The Netherlands). While the session "UGS today and tomorrow" laid more emphasis on technologies of the future, this expert forum was dedicated to the improvement of operation and parameter optimisation for existing UGS facilities.

SG 2.2 leader Alexander Grigoriev summed up operating results over 2003-2006 and reported on the major provisions of the investigation entitled "Achievements and modern trends in the field of UGS technical efficiency", which set the tone and direction for subsequent discussions, highlighting technical approaches applied within the investigation.

Further presentations by speakers from the Czech Republic, France, Germany, Russia and the USA touched upon aspects surrounding the operation of horizontal wells, instrumental support for the inspection of horizontal sections, utilisation of stressed screens, innovative gas treatment technologies, computerised methods of reservoir and UGS operation simulation and management including artificial intelligence.

● Working Committee 3 Transmission

Chairman: Juan Andrés Díez de Ulzurrun, Iberdrola, Spain
Vice-Chair: Helge Wolf, E.ON Ruhrgas, Germany
Secretary: Gonzalo Castañeda Fernández, Naturgas Energia, Spain

At the beginning of the 2003-2006 Triennium WOC 3 set itself one clear aim: to study and provide information on the status of technology, legislation and economics relating to pipeline transmission systems. Both technical and non-technical aspects were identified. The former concerned issues such as increasing the service life of pipelines, how transmission companies manage old networks and how new technical challenges are tackled, while the latter covered third party access, the increasing administrative requirements for building pipelines and how to prove the reliability and safety of gas transmission. Taking into account this starting point, the work was divided among four Study Groups.

WOC 3 was formed by 63 members from 33 countries and five continents. During the Triennium the Committee met on six occasions to monitor and develop the work done by the Study Groups, while extensive use was made of the IGU Collaboration Portal to exchange information. Thanks to the efforts of its members, WOC 3's objectives were accomplished as detailed below.

SG 3.1 Global review of third party access (TPA)

Leader: Francesco Caria, ENI Gas & Power Division, Italy

Continuing the work done by another Study Group during the 2000-2003 Triennium, SG 3.1 sent out three questionnaires concerning TPA and security of supply. The answers were used to calculate a TPA index that measured the degree of liberalisation in each country. With the perspective of six years' work, the survey results confirm constant growth in terms of the opening of gas markets and the evolution of the liberalisation process.

SG 3.2 Increased service life in the design, construction, operation and maintenance of a gas pipeline

Leader: Jorge Bonnetto, Transportadora de Gas del Sur, Argentina.

SG 3.2 carried out an in-depth study on the causes, detection and mitigation of high pH stress corrosion cracking (SCC). The vast experience of the participant members was put together, resulting in a complete assessment of all the existing

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methods used to detect high pH SCC. Much was learnt and shared in the Study Group about SCC phenomena. The conclusion is that despite the big advances seen in recent years the ideal methodology does not exist yet.

SG 3.3 Addressing increasing difficulties to create infrastructure

Leader: Sigurd Hamre, Statoil, Norway

SG 3.3 prepared two reports. The first was based on a survey sent to WOC 3 members asking them about the administrative difficulties faced when creating onshore infrastructure. Questions covered the different procedures that are required in each country and their respective duration. The results (*see Figure 3*) show that the real duration of the procedures is greater than the hypothetical one. These delays are a serious drawback for infrastructure creation. The second report was a state-of-the-art evaluation of the latest technological solutions for the new challenges faced in offshore pipeline construction. There were some difficulties in achieving a good level of participation from contractors and others, but the result is a complete and useful report.

SG 3.4 Using or creating incident databases for natural gas transmission pipelines

Leader: Rein Bolt, N.V. Nederlandse Gasunie, The Netherlands

SG 3.4 was formed by a group of experts that had helped compile the main databases used in their different countries. They worked to produce a guideline to using or creating incident databases for natural gas transmission pipelines, and their main conclusion is that it is possible to perform a harmonisation of the main databases without loss of historical data. The harmonisation will be performed during the next Triennium.

The work done by the Study Groups was presented at WGC2006 in two committee sessions and two expert fora. All the meetings were well attended with up to 140 participants.

Committee session June 6

The first meeting was chaired by WOC 3's Chairman, Juan Andrés Díez de Ulzurrun, who started proceedings by presenting the results of the survey of administrative difficulties faced when creating onshore infrastructure. Then Jorge Bonnetto presented the work done by SG 3.2 on stress corrosion cracking and Sigurd Hamre presented SG 3.3's report. They were followed by three other presentations.

Kaj Christiansen described Gasum's experience in testing pipeline coatings. The main conclusion was that a 3mm coating of high-density polyethylene (HDPE) is sufficient for most applications.

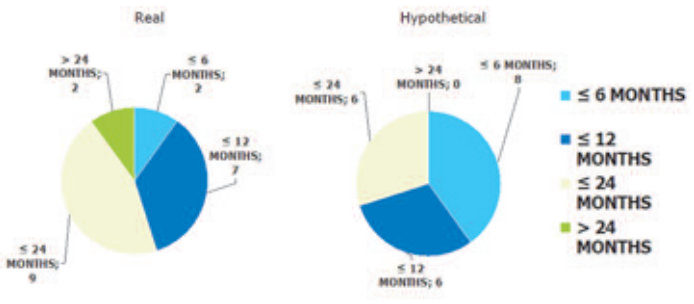
Jay Chaudhury, Project Manager of the Medgaz pipeline planned to connect Algeria with the Spanish market, presented the project's integrity management system.

Bogdan Budzulyak gave an outline of new engineering and laying technologies for the Russia-Turkey gas pipeline (Blue Stream Project), which will ensure its reliable operation and long life span.

Three questions on offshore pipelines were posed to Mr Hamre. These concerned the frequency of inspections, the cost of operation and the possibility of increasing diameters from 44 to 56 inches (111.8 to 142.2 cm). Mr Hamre explained that one inspection is done every year, while intelligent pigging is performed every eight or 10 years. He said that the cost of operation is roughly 2% of total cost and that the next challenge

BELOW
Figure 3.

HYPOTHETICAL VS REAL DURATION OF AUTHORISATION



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as regards diameters would be 30 inches (76.2 cm) at a depth of 2000 metres.

Mr Bonnetto was asked about SCC propagation. He confirmed that decreasing the temperature of the pipeline by 10° decreases the crack growth velocity approximately 10%.

A final question was posed to Mr Ulzurrun concerning parallel pipelines and corridor creation. He replied that many cases of parallel pipelines running without problems are known, and that distances between pipelines or different services are frequently limited by the requirements of the companies involved.

Committee session June 7

The second Committee session was chaired by WOC 3's Vice Chair Helge Wolf. Proceedings commenced with the final reports of SG 3.1 and SG 3.3, which were presented by Francesco Caria and Rein Bolt respectively, and continued with a number of papers.

Milan Sedlacek gave a paper entitled "The issue of transit in liberalised markets. Is it really possible to forget transit and to speak of gas transport only?", which showed the important role of transit in achieving security of supply in the EU. He highlighted the need for specific transit tariffs that avoid cross subsidisation.

Pipeline integrity is a vital issue.

Vyacheslav Salyukov's paper "The diagnostics system of JSC Gazprom's gas mains" declared that Gazprom's gas transmission system reliability was in line with European and US standards, thanks to the development of the pipeline diagnostics system. In-line inspection is the key to the diagnostic system, he explained.

Karine Kutrowski presented the paper "A common approach for assessing the safety of natural gas compressors", which was a collaborative effort of Gaz de France, Gasunie, E.ON Ruhrgas and Snam Rete Gas. The group worked on the development of a common methodology for assessing the safety of natural gas compressor stations and successfully implemented it in a software package called SARONG. Ms Kutrowski said that new applications were being investigated for this tool.

Volker Busack presented "The pipeline integrity management system (PIMS) of VNG-Verdbundnetz Gas AG". VNG uses PIMS as a guarantee of the safety of high pressure gas pipelines. Data are processed though statistics and are used to evaluate the service life of the pipelines and the probability of failure.

Questions were posed to Messrs Sedlacek and Caria. Mr Sedlacek was asked for his opinion on the formulation of transit pricing. He said that it should be balanced and cost based, but not necessarily based on benchmarking. Mr Caria was asked about the questionnaire on who was responsible for ensuring the availability of sufficient gas quantities to meet market demand. He said he was convinced that there should be a single entity ensuring security of supply.

Expert forum June 6

In the expert fora less general issues were covered and more technical presentations were given. In the first, which was chaired by Rein Bolt, six experts gave their views on some aspects of safety.

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Dick van den Brand gave his views based on his experience with EGIG, the European Gas Pipeline Incident Data Group. Daniel Roberto Fallabella proposed an integrity management system exclusively for old pipelines. Werner Zirnig presented a new laser-based aerial inspection method for leakage using helicopters. Hordijk Pijnacker explained the use of the pipeline integrity management system through key performance indicators. Menno van Os presented a direct assessment module for pipeline integrity management developed by Gasunie. Yuji Hosokawa reported that new corrosion protection criteria were established based on DC and AC current densities measured using coupons that can assess AC corrosion risk.

After the presentations Mr Hosokawa was asked whether the effect of AC currents had been studied on coatings other than polyethylene. He said that no such study had been made as it had not been necessary for Tokyo Gas.

Expert forum June 7

At the second expert forum, which was chaired by Alessandro Cappanera, five speakers gave papers on new pipeline related technologies and 10 posters were presented.

Olaf Meyer presented a laser-based methane detection method using helicopters. Anatoly Arabey gave a paper describing advances made in the attempt to construct pipelines resistant to stress corrosion cracking. Yuichi Takeuchi's paper gave his experience in the crack arrestability of high pressure pipelines using X100 or X120. Abdelkrim Ainouche presented the experience of integrity management using a Bayesian system to estimate the growing rate of defects detected in in-line inspection. Peter Schwengler presented a new automated tie-in technology for pipelines.

Mr Ainouche was asked about the reliability of the data used for the estimations used in the Bayesian system. He replied that to date results had proven to be consistent.

Daniel Roberto Fallabella started the poster presentations by describing progress in the development of a predictive model for finding locations of significant high pH SCC in gas pipelines. Ari Suomilammi presented a method of gas compressor unit performance monitoring using fuzzy clustering. Abderrahmane Taberkokt presented the experience of Sonelgaz in predicting corrosion in non-piggable pipelines. Peter Schwengler presented a poster on a new gas detection method called gas camera. Vladimir Kharionovsky's poster was on the extension of service life of gas pipelines through the evaluation of the defects and the cost analysis of repair. Hiroshi Sato presented a poster on a new method of ultrasonic inspection for pipeline welds. Woo-sik Kim presented a poster about a comparative study for various repair methods of in service pipeline using full scale burst. Mykhailo Bekker presented a method for estimating residual pipeline life based on in-line inspection data. Saeid Mansouri Alghalandi's presentation was on welding defect pattern recognition in radiographic images of gas pipelines using an adaptive feature extraction method and a neural network classifier.

Now that the 2003-2006 Triennium has finished, WOC 3 believes that it has succeeded in contributing to the Strategic Guidelines by analysing and improving the reliability and safety of gas transmission through high pressure pipelines and by trying to address the technical and regulatory challenges that the gas transmission industry faces when trying to reach new markets in the most economic way possible, thus promoting gas as the fuel of choice.

Working Committee 4 Distribution

Chairman: Peter Cistaro, Public Service Electric & Gas Co., USA

Vice-Chair: Jeremy Bending, National Grid Transco, UK

Secretary: Larry T. Ingels, AGA, USA

For the 2003-2006 Triennium WOC 4 was organised into three Study Groups to tackle topics



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Launched in 2005, our wholly-owned Purovsky Gas Condensate Processing Plant is an integral part of our hydrocarbons' value chain. The plant has the capacity to produce 1.6 million tons of stable gas condensate and 400 thousand tons of LPG per annum. The commissioning of the plant has proved a vital link in our mid-stream operations allowing us full control over our processing needs, enhancing the quality of our liquid products and providing access to new marketing channels including the delivery of stable gas condensate to US and European markets.

We have ambitious plans to diversify our business by becoming both a leading independent natural gas producer and an active player in the processing, petrochemical and power generation sectors.

Our strategy is to leverage our competitive strengths to increase hydrocarbon production on a sustainable and profitable basis, while operating in a socially and environmentally responsible manner. Specifically, we intend to:

- Substantially increase our production of hydrocarbons, particularly natural gas
- Maintain our low cost structure
- Capture maximum margins on natural gas and liquids sales
- Prove-up our resource base

OPERATING HIGHLIGHTS

2005 Consolidated Production	
Natural gas	25.2 bcm
Crude oil and Gas condensate	2.6 mm tons
Total	186 mm boe
Reserve Base	
Proved	4.6 billion boe
Proved plus Probable	7.4 billion boe
Reserve Replacement Rate	
2005	311%
Three-year average	232%
Reserve-to-production life	25 years



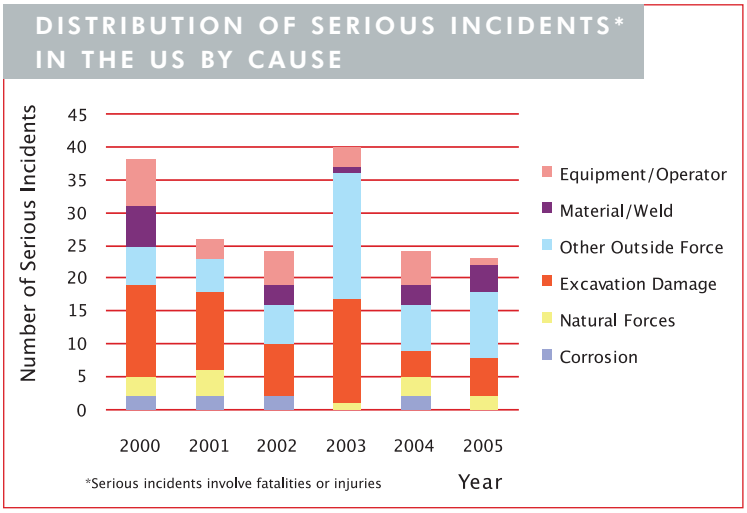

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Figure 4.

of particular interest to the 38 country members. Surveys were conducted, data and other information collected and reports prepared. An overriding concern affecting all topics is the impact of liberalisation and changes in regulations on gas distribution. The integrity and safety of distribution networks is critical for the industry's reputation. Cost control and safety drive the need to implement best practices internationally. Short-sightedness in R&D funding could negatively impact the industry.

SG 4.1 Distribution pipeline integrity

Leader: Mel Ydreos, Union Gas Limited, Canada
Vice coordinator: Jeremy Bending, National Grid, UK

SG 4.1's report says that the distribution sector is learning from experiences with transmission integrity. The industry has been proactive in developing and maintaining codes and standards using risk-based analysis. Third party damage is still the main threat and a collaborative effort by all stakeholders is necessary to develop any rule changes.

SG 4.2 Implementation of leading practices for the construction, maintenance and operation of gas distribution systems

Leader: Jorge Doumanian, Gas Natural, Argentina
Vice Coordinator: Fergal Geoghegan, Bord Gais Eireann, Ireland

According to SG 4.2, liberalisation and changes in regulations drive cost effectiveness. In general, best practices are used to improve safety, service quality and cost effectiveness. Leading companies have similar and proactive strategies.

SG 4.3 The role of R&D and technology in gas distribution

Leader: Juan Puertas, Gas Natural SDG, S.A., Spain
Vice Coordinator: Alessandro Soresina, Italy

SG 4.3 highlights the fact that as liberalisation expands, R&D funding contracts. There is a need to balance short-term and long-term R&D. Funding is needed for R&D into the rate-making process. Despite liberalisation and competition, collaborative R&D is the best approach.

The Study Groups gave oral reports at WGC2006 and the WOC 4 programme also included nine papers presented in two Committee sessions, 23 poster presentations made in the two expert fora and three additional posters given in the general poster session. Session highlights are detailed below.

Establishing a regulatory approach to distribution integrity within the US

In her paper, Lori S. Traweek from the American Gas Association declared that, in general, the integrity of the current US gas system is good, and that third party damage remains the greatest threat. (*See Figure 4* showing historic damage by causes.) She said that a joint approach involving utilities, state and federal regulators is being used to identify any needed enhancements.

Risk-prioritised distribution asset maintenance

Robert Thomas and Jeremy Bending explained that the UK's National Grid has a 30-year programme approved by the regulator to replace all iron gas mains within 30 metres of buildings. They said that National Grid uses a mains risk prioritisation system (MRPS) to quantify risks in its mains system

covering 120,000 kilometres, and that similar risk-based approaches are being developed for other assets.

Re-writing standard operating policy using risk-based methodologies

Leigh Ann Shoji-Lee presented a paper by P. Rietdyk of Union Gas, Canada, in which the author advocated combining quantitative and qualitative risk assessment, as appropriate. Quantitative risk assessment compares inspection frequency and system failure rates to establish probability. Qualitative risk assessment addresses geography, the type of customer and the nature of the system. Inspection schedules are now related to risks, resulting in an overall cost reduction. Maintenance practices can be improved with the addition of critical maintenance timelines.

Field test of hydrogen in the natural gas grid

H. Iskov and Jan Jensen of the Danish Gas Technology Centre gave a presentation on the development of a miniature gas grid using existing standards. Leaks were detected upon initialisation after hydrogen filling and at intervals, while valves and filters were investigated in detail after a test period. The introduction of hydrogen is possible using a 19 bar steel system and a 4 bar plastic system. Continued study of the plastic system is needed as some material changes were noted. All joints, components and fixtures should be checked at regular intervals. Some components should be modified. A three-year test programme is now underway.

Development and implementation of a knowledge management system to drive best practices

Paul Pirro of PSE&G, USA, presented his company's approach to implementing best practices and addressing areas for improvement. He said that the knowledge management system approach has brought several benefits and results, and that its adoption as a strategic tool will also facilitate future process improvements, as well as the implementation of best practices.

Geographic information technology (GIT), the primary success factor in restructuring gas emergency maintenance operations

In their presentation, Saeka Arai, Y. Zaitsu and H. Adachi of Tokyo Gas Co. Ltd, Japan, explained that the company successfully restructured gas emergency maintenance in August 2005 using GPS. Tokyo Gas has a network of 50,000 kilometres of gas lines and 9.6 million customers, while around 140,000 leak-related calls are received each year. Six separate service areas are now coordinated for faster response using GIT. The closest unit can respond to a leak call regardless of its assigned service area. Reports are made using web services to reduce paper work.

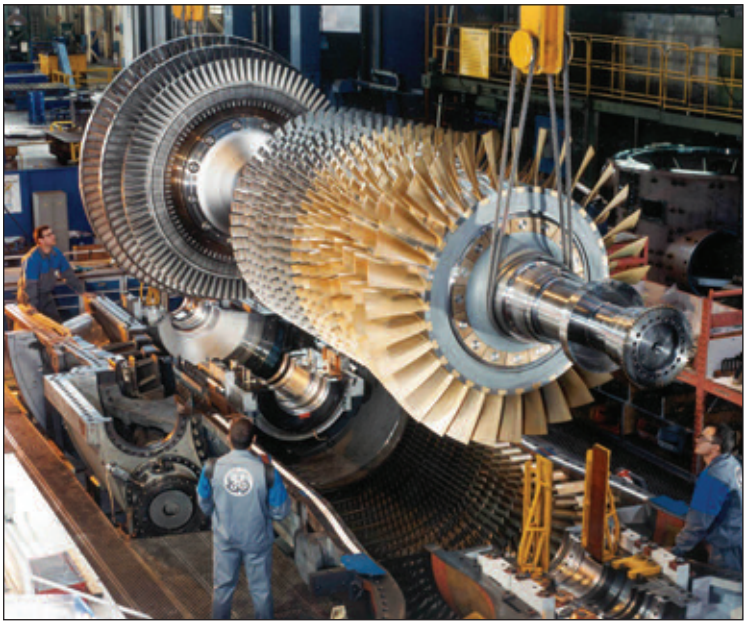
● Working Committee 5 Utilisation

Chairman: Marc Florette, Gaz de France, France
Vice-Chair: Jean Schweitzer, Danish Gas Technology Centre, Denmark
Secretary: Alain Quinqueneau, Gaz de France, France

SG 5.1: Industrial utilisation

Led by Robert van der Geest, Gasunie, The Netherlands, SG 5.1 started out with a broad and ambitious target to study a number of challenges and new developments in the industrial utilisation of natural gas. These included new combustion technologies, gas turbines, hydrogen and new devices for gas quality measurements. However, due to time and manpower constraints, work was focused on identifying the underlying challenges for the industry in a liberalised market for natural gas. Even though the Study Group has not achieved the original target, the results obtained and presented at WGC2006 are satisfactory.

SG 5.1 gave a number of oral presentations at WGC2006 on the latest technological developments in industrial utilisation, which were



LNG liquefaction plants are major users of gas turbines.

followed by a panel discussion on the future of natural gas for industrial utilisation. The panel consisted of a number of representatives along the natural gas value chain: a gas merchant, a natural gas researcher, an equipment manufacturer and an industrial end-user. The main topic of the panel discussion was how to preserve the climate for the industrial utilisation of natural gas, which led to a lively debate on the roles and responsibilities of the various stakeholders in the natural gas value chain. The technical presentations also attracted a sizeable and interested audience.

The Study Group report entitled "Challenges in industrial utilisation" (main author and contact: R.A.B.van.der.Geest@gasunie.nl) has become more of an executive summary than a real technical report. The main finding is that there are considerable challenges ahead for the industrial utilisation of natural gas, in particular the challenge of coping with rising energy prices. At the same time, it is important that the gas business manages to maintain its focus on industrial utilisation and continues to support industry with R&D.

The main conclusion of the panel discussion on the future of the industrial utilisation of natural gas is that it is very important that all stakeholders along the natural gas value chain maintain a good dialogue about industry challenges and solutions developed through R&D.

The oral presentations clearly presented the two main technical challenges for the future of industrial utilisation, that is, energy efficiency and gas quality issues.

SG 5.1 made an effort to put the customer at the focus of the natural gas industry and believes that customer focus will be the most important strategic issue for the years to come.

The two main topics for further study that have been identified for the coming Triennium are energy efficiency in the light of rising energy prices, and gas quality issues due to the call for greater interchangeability of gas. It is important that representatives of large countries such as Russia, China and India join the Study Group.

SG 5.2: Domestic and commercial utilisation

Led by Jean Schweitzer, WOC 5's Vice-Chair, SG 5.2 continued studies done in the 2000-2003 Triennium on the impact of new gas technologies on utilisation in the domestic and commercial sector. In that regard the objective was achieved, with both the new technologies and ways of optimising the existing installations and technologies (e.g. low installation costs, the potential of air-conditioning, combined heat and power generation) being treated in detail. However, a lack of expertise meant that an extended programme (covering e.g. the combination of gas with renewable energies and indoor air quality) could not be conducted.

The oral presentations and Committee session were organised under the same motto ("Will there be natural gas in the house of tomorrow?") and there was therefore a good consistency in the overall input of SG 5.2. Moreover, having a combined session with SG 5.4 (Distributed energy generation) achieved a good synergy.

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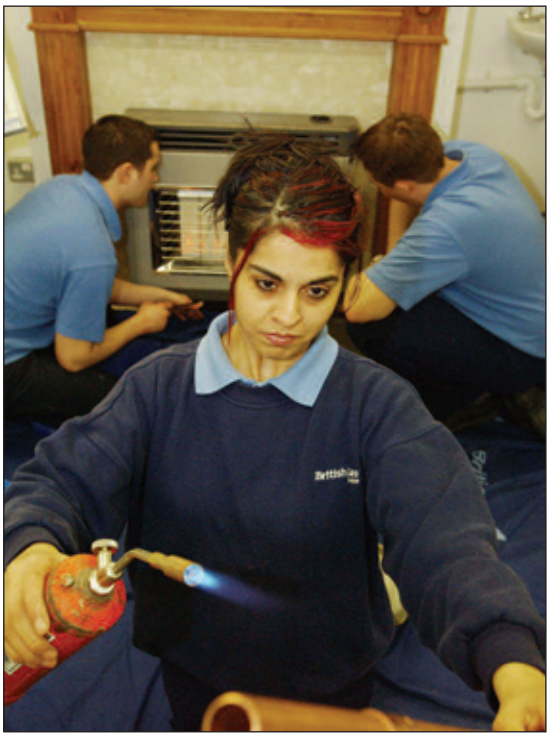

SG 5.2's report says there is risk of a decrease in domestic gas utilisation.

The round table was a success with five speakers from different continents and backgrounds, but there was a lack of time for audience discussion. Moreover, the attendance was disappointing (there were only about 40 to 50 people at each session). The merging of Study Groups 5.2 and 5.4 for the next Triennium should help address the problem.

SG 5.2's report surveys technology and markets and its major finding is a warning to the gas industry about the risk of a decrease in domestic gas utilisation. Suggestions for tackling this include reducing costs and introducing new and environmentally-friendly technologies. This means that it is important for the gas industry to have a strong commitment to R&D and the promotion of new technologies in order to maintain the competitiveness of gas and its contribution to sustainable development.

For the next Triennium it is important to get more members involved in the new Study Group.

SG 5.3: Natural gas for vehicles (NGV)

Led by Davor Matic, of the Energy Institute Hrvoje Pozar in Croatia, SG 5.3 fully met its objectives and intended results. A detailed study on present and future fuels and technologies was prepared, together with detailed country cases giving overviews of the existing technologies used in each country, and recommendations made. The report is called "Natural gas as a transportation fuel for today and tomorrow" and the contact person is Davor Matic (dmatic@eihp.hr).

The work included the preparation of trend analysis charts and a strength, weakness, opportunity, challenge (SWOC) analysis. Information was collected using direct input through questionnaires (with a remarkable reply rate of more than 80%, or 23 replies in total). Where there was no direct contact available, in-depth desk-research analysis was carried out (for 25 countries). In total, 48 countries were analysed. Finally, Study Group experts provided descriptive scenarios of the future use of methane in transport worldwide (for CNG, LNG, bio-methane and hydrogen produced from natural gas). These covered road and off-road applications, markets, technological developments including fuelling infrastructure and the expected development of legislation.

The major findings are that the principal market drivers in NGV business development are price, which dominates, cooperation between stakeholders, which strongly influences, and government involvement which is a common requirement.

Long-term recommendations include the support of global harmonisation efforts for regulations, codes and standards covering NGVs (retrofit and OEM). The path and speed of adoption should be based on local conditions (the transition from other earlier-established local standards must follow a realistic timetable avoiding unnecessary expen-ditures). A strategic approach to the regionalisation (and internationalisation) of fuelling infrastructure

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Brazil was one of the country cases presented by SG 5.3 at WGC2006. The picture shows a CNG filling station in Rio de Janeiro.

should also be supported with a particular focus on the "Blue Corridor" concept. This can be achieved by strategic alliances and joint action by national NGV associations through regional NGV bodies, and in turn through IANGV to achieve critical mass and worldwide standardisation. In every process it is important to involve all relevant stakeholders and establish a synergy between them.

Short-term recommendations are to lobby, especially for consistency in long-term policies (i.e. consistent fiscal and policy instruments, consistent financing schemes, consistent non-technical measures (such as exemptions from congestion charging, mandates etc.) and international standards.

SG 5.3 presented the final report during the first WOC 5 Committee session at WGC2006 and also gave country presentations on Brazil, Russia and Sweden (in the last case with the emphasis on bio-methane). Representatives of IANGV and the regional NGV associations (ALGNV, ENGVA and ANGVA) then took part in a round table discussion about the development of efficient "natural gas for transport" markets in their regions. They agreed that harmonisation is desirable in the NGV industry, but pointed out that it is not easy for countries with 1.5 million vehicles in the market to adjust to certain new standards.

Regarding transition to the NGV-1 standard, it is going to take between five and 10 years to carry out in countries with large fleets like Argentina or Brazil. In the meantime, an adaptor can be used to make a Blue Corridor (such as the 4000-kilometre Blue Corridor from Santiago de Chile to Rio de Janeiro) a reality.

Regarding the image of NGVs, the challenge is to change the paradigm. People see it as risky to have compressed gas in their cars so it takes time to explain that NGVs are safe.

The key messages from the round table are that the economics must be right, stakeholders must be active and the government has to be involved as regards the regulatory environment and fiscal incentives. This is the time for NGVs and the expansion of the NGV idea should be with a win-win strategy for the users, for the government in terms of energy security and for the general public concerned about the environment.

SG 5.3's work should assist decision makers and is in line with the IGU Strategic Guideline for 2003-2006 to promote gas as the fuel of choice preceding a sustainable energy system. Going forward to the next Triennium, it is recommended that there be more steering committee meetings than plenary sessions, and that the latter should only set rules and give a short overview of the work in hand. It would also be useful to have technical tours and to integrate external expertise from different stakeholders. Moreover, in addition to the detailed report, the outcome should include short and simple presentations suitable for the general public.

SG 5.4: Distributed energy generation – from CHP to micro generation

Led by Samuel Bernstein, Bernstein Enterprises LLC, USA, the target of SG 5.4 was to study distributed generation (DG) technologies, barriers and application models. The intended objectives were to share experiences, visit sites and report on issues both internally (IGU reporting mechanism) and

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to asia

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SG 5.4's message is that DG is a good growth opportunity.

outside the group by presenting papers in technical meetings. All in all the targets were met and or exceeded.

The meetings were, in general, well attended and the members came out feeling that they had advanced their professional knowledge. However, it would have been good to have more members from The Netherlands, UK, US and South America.

The oral presentations and Committee session were organised under the same motto ("Can the gas industry afford not to use DG?") and there was therefore a good consistency in the overall SG 5.4 message that DG is a good growth opportunity. Options for the DG business to be undertaken by some gas and electricity companies include international combustion engines, turbines, Stirling engines, fuel cells (solid oxide and polymer electrolyte) and tri-generation of micro-CHP with heat pumps. Barriers to this potential new business for the gas industry include legal frameworks.

There was a noticeable drop in attendance towards the latter part of WGC2006 and future organisers should do whatever possible to entice delegates to stay for the entire meeting (one possibility would be to have the high-level speakers participate on the last day). On the other hand there should also be some fair way to give all Committees an equal chance for a slot during the early days of the conference. Moreover, speakers should have more recognition for the effort (usually volunteered) involved in preparing papers and travelling to the meeting to present them.

The round table was a success with four speakers from different backgrounds. However, more time should be given for discussion even at the cost of reducing the number of the sessions. The poster sessions were not as well organised and should not be done at the same time as the oral presentation. In general it is very important that all sessions stick strictly to the timetable so that delegates can plan their attendance accordingly and respect each speaker for his/her preparation. SG 5.4 achieved this goal but it required forceful management at times.

As regards the next Triennium, it is important that the business managers of companies be involved in the decision to send their colleagues to the Committees.

● Programme Committee A Sustainable Development

Chairman: Daniel Arias, Pan American Energy LLC, Argentina
Vice-Chair: Knut Barland, Statoil, Norway
Secretary: Patricia Yurgel, Pan American Energy LLC, Argentina

PGC A's work for the 2003-2006 Triennium was divided between two Study Groups:

SG A.1 Life cycle analysis

Leader: Knut Barland
Co-leader: Tjerk Veenstra, N.V. Nederlandse Gasunie, The Netherlands

SG A.2 Sustainable aspects of the natural gas industry

Leader: Daniel Arias
Co-leader: Bertus Postmus, Gastransport Services, The Netherlands

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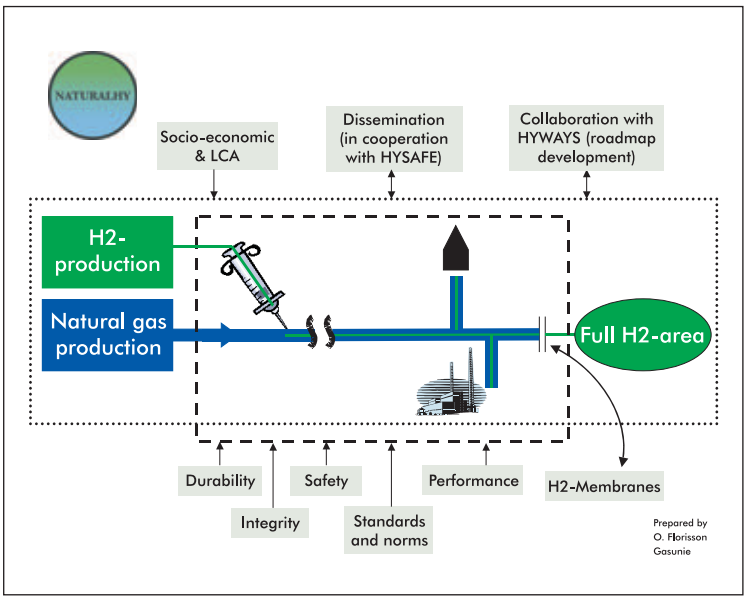
For WGC2006, PGC A organised four meetings during which a total of 18 authors presented their papers and posters. A Committee session and an expert forum on Tuesday, June 6, covered "Hydrogen and renewable energy sources", while "Climate change and air quality" was the theme for both the committee session and expert forum on Thursday, June 8. The major findings are detailed below.

Committee session June 6

Life cycle analysis was the subject of in-depth presentations by Tjerk Veenstra from Gasunie and Maartje Sevenster, an independent environmental consultant in The Netherlands. They highlighted the importance of identifying opportunities for improvement in chain control and efficiency, and concluded that life cycle analysis is a good method for assessing environmental impact. Their recommendation was to continue building a database using a systematic approach. During the ensuing discussion, the audience stressed the importance of another aspect that requires attention: the availability of reliable data.



During the second PGC A Committee session, Onno Florisson and I. Alliat submitted a paper on the NaturalHy Project.

Professor Igor Tutnov said that micro-combined heat and power (CHP) systems are a good option when there is a need to combine different energy sources, since micro-CHP increases energy efficiency and reduces related risks. He concluded that micro-CHP is a realistic option to reduce emissions as it has a good potential for sustainable development.

Most of the presentations and discussions referred to the use of alternative fuels and/or carriers in combination with natural gas, such as the Biomass and Gas-integrated CHP Technology (BAGIT) Project, which was presented by Advantica. Issues related to integrity management, safety and health uncertainties are still to be clarified.

Committee session June 8

PGC A Chairman, Daniel Arias, spoke about sustainability, stressing the importance of Natural Gas for Vehicles as one of the major applications of natural gas with relation to sustainable development. NGV use, he said, complies with the three Ps of sustainability: people, planet and profit.

Other important aspects presented were the improvement of existing appliances related to energy efficiency. Micro-CHP was seen as an interesting subject since this technology represents a stabilising factor in electrical supply, both in case of blackouts or brownouts, and when renewable energy sources become part of the ordinary energy supply. As to the chain of supply, non-conventional sources of methane such as coal-bed methane and methane hydrates can provide this fuel in the order of 100 times the existing reserves.

There was discussion of the role of governments in terms of subsidies, taxation and education, which will be a key element in enhancing the responsible use of natural gas.

Finally, it was pointed out that industrial demand for hydrogen is and will continue to be satisfied through natural gas until another option can comply with demand.

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Bert Wikkerink submitted a paper on the "Improvement in the determination of methane emissions from gas distribution in The Netherlands".

Friedhelm Wannagat submitted a paper on the "Importance of connecting small to medium-sized cities in the Russian Federation to the natural gas grid for speeding up the process for energy efficiency".

Onno Florisson and I. Alliat submitted a paper on the NaturalHy Project, which looks at the value of the existing natural gas system for hydrogen, the sustainable future energy carrier. The project has 39 partners to assess the change in risk when adding hydrogen to the grid.

Expert fora June 6 & 8

William Leighty from the USA presented two posters on "From a natural-gas-based to a hydrogen-based society: Proposal for a north-east Asian hydrogen highway". It was a creative and innovative project highlighting concern about pipeline integrity and safety, since hydrogen can adversely affect gas pipeline material, causing certain deterioration.

Insaf Sayfullin from Russia presented a poster on the "Control and monitoring of greenhouse gas emissions", which was particularly interesting as this technology is fundamental for effective monitoring of emissions.

Other aspects related to CO_2 sequestration and storage projects were presented by Gaz de France.

Recommendations related to the 2003-2006 Strategic Guideline: "Gas as the fuel of choice preceding a sustainable energy system"

More about people: Since many countries have initiatives related to the reduction of risks in public health, it will be extremely valuable to include this issue in some activities organised by IGU. Professionals in medicine and biology can add competent opinions in this regard, and liaison is needed with governmental authorities responsible for public health. PGC A and sustainable urban design have to be linked in a proper way during the new Triennium.

More about the planet: In spite of the comprehensive coverage of life cycle analysis, E&P upstream operations were out of the scope of these presentations, which could very well be a subject of analysis for the coming Triennium.

There are enormous opportunities for improvement in energy efficiency, not only in terms of appliances, but also as regards better home insulation. While micro-CHP is a well-known technology in European countries, there are opportunities to extend this good practice in the rest of the world through initiatives like those of IGU.

More about profits: Initiatives related to monitoring systems for greenhouse gas emissions must continue if carbon credit trading is to be further developed as part of the Kyoto Protocol's Clean Development Mechanism.

● Programme Committee B Strategy, Economics and Regulation

Chairman: Klaus-Robert Kabelitz, E.ON Ruhrgas, Germany
Vice-Chair: Pedro Moraleda, Gas Natural SDG, S.A., Spain
Secretary: Uwe Klaas, DVGW, Germany

SG B.1 Regulatory framework of the gas industry

Leader: René Snijder, N.V. Nederlandse Gasunie, The Netherlands

SG B.2 Main streams and challenges on the supply side

Leader: Runar Tjersland, Statoil, Norway

SG B.3 Major trends in demand

Leader: Flavia Di Cino, Tecpetrol S.A., Argentina

PGC B held three plenary meetings in the 2003-2006 Triennium. Although this seems a low figure compared to other Committees, much of the

The Middle East will play an ever more important role as a supplier of natural gas. The picture shows the Haradh gas plant in Saudi Arabia.

workload and almost all of the coordination necessary was carried out during eight meetings involving the Chairman, Vice-Chair, Secretary and the leaders of the Study Groups. In addition to the normal final report, PGC B tabled a strategic paper at WGC2006.

Throughout the Triennium, PGC B witnessed striking developments in its field of work. Globally, the steep increase of crude oil prices triggered a similar development for gas prices. In Europe, temporary problems with the supply of pipeline gas from Russia put security of supply at the top of the agenda and increased the attractiveness of LNG. In the US, changes to the regulatory regime also increased the attractiveness of LNG, and marketing specialists now distinguish between the Pacific Basin LNG market (which has existed since the late 1960s) and a true Atlantic Basin LNG market (the previous Atlantic LNG trade having been limited). Meanwhile, political developments in South America have impacted on the regional gas sector.

These developments were reflected in PGC B's technical programme for WGC2006, which consisted of two Committee sessions, with 65 and 50 participants respectively, two expert fora, with 85-90 participants each, and one poster forum with 35 participants.

Conference programme for June 6

The first event was the poster forum, which began with some interesting posters covering the domestic gas markets in Russia and Ukraine. Then, a poster looked at the decline in investment in natural gas power plants in Brazil; due, it was explained, to extremely low hydropower prices. This means that the existing gas-fired power plants are only regarded as back-up plants and some have been out of use for many years. Another poster covered the use of natural gas hydrate pellets to transport fuel as an alternative to LNG. There were also posters about third party access and regulation in European pipeline grids and LNG terminals.

The poster forum was followed in the afternoon by an expert forum on regulation and supply development. The impact of regulation and unbundling on the gas network in the EU was the subject of a number of contributions presenting the viewpoints of both the gas transport companies

and the regulating authorities. It became obvious that the regulators seek maximum transparency of the operating companies and third party access at regulated prices to every cubic centimetre of a given grid or storage, because otherwise "the system will not work". On the other hand, the network operators expressed their need for guaranteed revenue from certain parts of the system such as storages, because otherwise the resulting lack of investment could endanger the security of supply. A presentation about options to liberalise the Russian gas industry appeared interesting, although for the time being rather theoretical. Finally, a presentation clarified the key role of Qatar in the emerging global LNG market. Of all the LNG suppliers, it is Qatar who is exporting to both the Atlantic and the Pacific markets.

Conference programme for June 7

The second expert forum covered global market developments and was opened with an outstanding presentation given by Ben Hollins of Wood Mackenzie, who highlighted the hotspots and challenges of the global gas market. The next presentation was on a region currently little known as a gas supplier, but with a huge potential: Eastern Siberia and the Russian Far East. This was followed by two presentations dealing with LNG. One gave a simulation of the possible interaction of LNG and gas market integration, while the other looked at possible price developments in the classic LNG market of the Far East. The expert forum concluded with a paper prepared by a World Bank team on the advances and mistakes of a selection of developing countries with regard to their natural gas sectors. Its main point was that, given a limited supply of natural gas, artificially low gas prices are not the cure.

In the afternoon the first Committee session was held. Entitled "The industry's response", this commenced with the presentation of SG B.1's report on the effects of regulation by René Snijder. The report observed that regulatory regimes differ from country to country, with substantial differences concerning their efficiency and their ability to foster investment in the industry. In fact, some of these regulatory regimes proved to be investment killers. One positive development noted was that, in a number of countries, attention has moved from maximum market liberalisation to security of supply. However, the report concluded that there is still a lot to learn and that, in most cases, the gas industry and the regulating authorities need a greater understanding of each other's positions.

Then, Angelo Ferrari of GIIGNL reported on the effects of regulation in Europe, with Italy chosen as example. Finally, Simon Blakey of Cambridge Energy Research Associates reported on the shift in market power and encouraged the European gas industry to take a look at itself from outside.

Conference programme for June 8

Delegates attending the second Committee session entitled "Gas: Meeting the expectations" were rewarded with excellent presentations and subsequent discussions. First off was Flavia Di Cino, who presented the development of gas demand as part of SG B.3's report, highlighting the fact that some gas demand forecasts from previous Triennia appeared to be too optimistic from today's point of view. She was followed by Runar Tjersland, who presented SG B.2's findings on the global supply situation for natural gas. The conclusion is that there are still ample gas reserves, although their exploitation will require substantial investments, and that the Middle East will play an ever more important role as a supplier of natural gas, particularly as LNG.

Then, Junji Yoshitake of Tokyo Gas presented further results of SG B.3 on the demand situation. He explained that there are a number of new players, although often they are not seen as such, examples including gas transport or even distribution companies buying shares in gas production to secure their supply. He forecast continuing increase in demand, even if the power sector does

not fulfil the high hopes of a few years ago.

Jonathan Stern of the Oxford Institute for Energy Studies wound up with a presentation on the role of LNG in future supply. He pointed out that LNG importing countries not only have to make substantial investments in regasification terminals, but they also have to compete with some of the richest economies in the world for the gas itself. He highlighted the risk of landing capacities growing faster than the liquefaction capacities in the countries of origin. He doubted that LNG under such conditions would be economically competitive to pipeline gas supply.

● Programme Committee C Developing Gas Markets

Chairman: Camillo Gloria, Eni Spa, Italy
Vice-Chair: Mohd. Farid b. Mohd. Amin, Petronas, Malaysia
Secretary: Marco Gianninoto, Eni Spa, Italy

The objectives of PGC C, in accordance with the Strategic Guidelines of the Dutch Triennium, were mainly addressed to the identification of key drivers and elements that can start or support the growth of gas markets, with a particular focus on developing or transitional economies. Accordingly, the subjects for four case studies were identified in order to derive knowledge and to learn lessons from around the world. During the work programme, members reviewed and discussed a large amount of information and documentation to reach wide agreement on the key messages to be delivered by the Committee. This work is summarised below.

Major findings of Committee studies

Each of the case studies carried out was the responsibility of a Study Group as follows:

SG C.1 Developing gas markets in Asia: The case of China

Coordinated by: Mohd. Farid b. Mohd. Amin, General Manager, Corporate Information and Research Unit, Petronas, Malaysia

SG C.2 Developing gas markets in the Mediterranean Basin – Case study: Egypt

Coordinated by: Nasseradine Rarrbo, Secretary General, Agence de Régulation des Hydrocarbures (ARH), Algeria

SG C.3 Developing the gas market in Brazil, within the South American regional context

Coordinated by: Pablo Ray, Manager, Commercial Development, Transportadora de Gas del Sur (TGS), Argentina

SG C.4 Further market development in areas deeply involved in market opening and increased competition pressure

Coordinated by: Albin Romé, Special Advisor to the Chairman, Geoplin, Slovenia

Each of the case studies was completed with an identification of "key lessons learnt" and some "recommendations" or "suggestions" that IGU, as the spokesperson of the gas industry, could disseminate among stakeholders, particularly governments, lawmakers and regulators. The key findings were:

- the acknowledgment that purely "technical" conditions are necessary but not sufficient to develop gas markets;
- the importance of a consistent institutional and legal framework to promote "gas as the fuel of choice" in competition with other fuels;
- that there are no "universally valid rules" of regulation;
- the paramount importance of economic issues, in particular related to investments (particularly sensitive in developing economies where large infrastructure developments are necessary and financing is critical); and
- the setting of gas prices that are both "adequate" to the internal price level of each market and consistent with international market conditions – price distortions may be an obstacle to market development as they give rise to non-consistent behaviour.

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Egypt was the subject of SG C.2's case study.

Conference sessions

During WGC2006, PGC C held two Committee sessions and two expert fora. The latter were dedicated to the presentation of case studies (two presentations per session), which were followed by a discussion panel involving experts invited from outside the IGU membership. A total of nine experts from four continents participated, representing energy research institutes, the gas industry and regulators.

The discussions following the presentations were wide-ranging. Perhaps the key point made was that political issues have come to prevail over technical, or even commercial, aspects in the development of gas markets. Political issues include the proper activities of law making, the design and enforcement of regulation (or, as it has been described, "the art of regulation") and more general attitudes towards the development of natural gas within the overall energy sector.

Looking closer at the specific field of gas market regulation, the discussions addressed very specific topics such as the ultimate goal of regulation (within each country), the consistency of regulatory systems in interconnected markets, and the impact of regulatory systems on the ability to finance the development of infrastructure.

During the two expert fora, a total of 14 papers were presented orally and as posters. The geographical spread of the authors was: Europe (six), South America (five), Asia (two) and North America (one), and all the authors were from the gas industry with one exception.

Concluding remarks

With the aim of providing continuity in Committee activity going forward, some issues arising from the case studies will be the subject of further analysis by the PGC C Study Groups in the next Triennium.

From the more practical perspective of organising the work of PGC C, it is important that members from countries with mature markets as well as from those with developing markets participate in the Study Groups, to provide a wide range of points of view. In addition, every effort should be made at the earliest stages of the work to involve representatives from the countries which are the subject of the case studies.

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Table 1.

PGC D: RESULTS IN MEETING OBJECTIVES OF 2003-2006 TWP

	Description of the objective and the topic	*Results*			*Remarks*
		Large	*Medium*	*Weak*	
1	PGC D to monitor the LNG business by issuing a report.	Yes			To be improved
2	PGC D set itself the task of attracting old and new actors to participate or take an active role in IGU activities.		Yes		To be continued
3	PGC D to monitor and support the activities of WOCs 1-5 as well as those of the other Programme Committees by providing the necessary expertise in the field of LNG.		Yes		To be continued
4	PGC D was assigned a major task in order to rationalise the LNG activities of IGU in cooperation with the other international LNG organisations. PGC D to identify all those who cover the LNG field in some way and to attempt to define with them an understanding of cooperation, coordination and exchange of information on important studies and research.	Yes			To be continued
5	PGC D will establish contact with organisations such as: the two other sponsors (apart from IGU) of the LNG-X Conferences, the Gas Technology Institute (GTI) and the International Institute of Refrigeration (IIR); the International Group of Liquefied Natural Gas Importers (GIIGNL); the Society of International Gas Tanker and Terminal Operators (SIGGTO); the International LNG Alliance (ILNGA); the World Energy Council (WEC); the International Association for Natural Gas Vehicles (IANGV); and any other organisation identified which may be covering an area of the LNG industry.	Yes			To be improved
6	PGC D will attempt to combine meetings, use the same individuals and offer the possibility for these organisations to participate in the LNG activities in the Study Groups or during the World Gas Conference, the goal to be achieved being enhanced coordination of the respective LNG activities and projects and avoidance of work duplication.		Yes		To be continued
7	PGC D to perform studies on LNG topics of interest to IGU Members. After consultation with IGU Members, taking into account the Strategic Guidelines set out for 2003-2006, the following three topics were selected for study:	Yes			To be continued
	7.1. The standardisation of LNG qualities;	Yes			
	7.2. Safety and technology developments in LNG terminals and vessels; and	Yes			
	7.3. The future of the LNG spot market.	Yes			