

Fuelling the Future



A new dawn is casting its light on the Sultanate of Oman.

At Oman LNG, the power to realise aspirations and build lives is our prime objective. From Oman, we have embarked on providing the world with a new source of energy, a cleaner alternative to fuel, a brighter future.

Established by a Royal Decree in February 1994, Oman LNG is the fastest LNG project ever developed. With one of the most technologically advanced LNG plants in the world, it is the largest investment project undertaken in the Sultanate of Oman. Most importantly, it heralds a new chapter in Oman's development and diversification of the national economy.

Oman LNG. Giving people, communities and nations the energy to move forward, to grow and progress.

Oman LNG's Competitive Advantages: Strong global shareholding formation • Geographical advantage coupled with political, economic and financial stability • Safe harbour • Substantial gas reserves • Reliable state-of-the-art technology • Over 300 cargoes delivered, giving Oman LNG a track record of reliability • ISO certified • Unprecedented international credit ratings of A3/A-

A Decade of Excellence

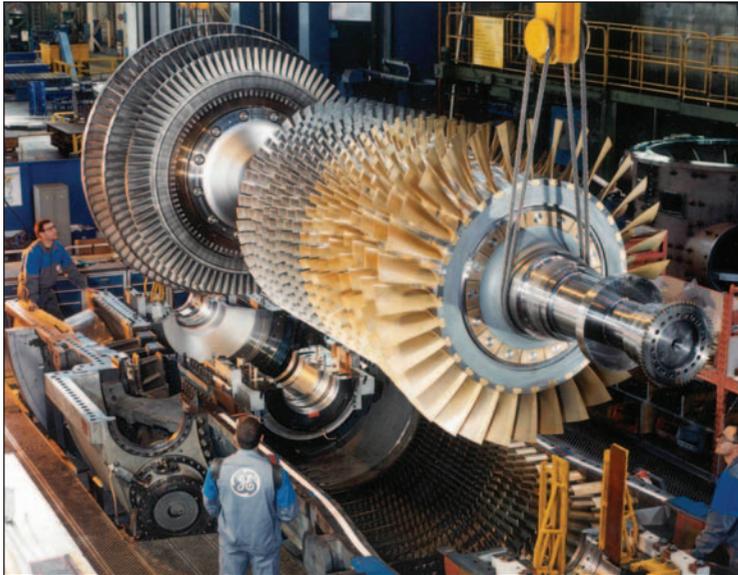
P.O. Box 560, Mina Al-Fahal, P.C. 116, Sultanate of Oman. Head Office - Tel.: (+968) 609999, Fax: (+968) 609900.
Qalhat Site Office - Tel.: (+968) 447777, Fax.: (+968) 447700. Website: www.omanlng.com



الشركة العمانية للغاز الطبيعي المسال ش.م.ع.

Oman LNG L.L.C.

DOB OMAN



A GE Frame 9E gas turbine.

Parallel Mixed Refrigerant Process, for an 8 mtpa train design; the main liquefaction cycle is split into two parallel streams and three Frame 7 gas turbine drivers are used.

● The Skikda explosion

As a late addition to the programme, Bachir Achour of Sonatrach gave a presentation about the major explosion at the Skikda LNG plant in Algeria. On January 19 this year an accidental release of either LNG or cold refrigerant (e.g. propane) vapour occurred in the 0.85 mtpa capacity train, unit 40. Flammable vapour was drawn into the air intake of a steam boiler, giving rise to a boiler explosion followed immediately by a massive vapour cloud explosion and fireball. A large fire covered three trains – units 40, 30 and 20, which were destroyed, along with the adjoining maintenance and security buildings. There were 27 fatalities on site and 56 people were injured, mainly due to blast and collapsing buildings.

Liquefaction train unit 10 suffered some damage and will be brought back into operation by October 2004. The LNG storage tanks and loading facilities were undamaged, as were trains

5 and 6 (800 metres away), which were scheduled for start up again at press time. Sonatrach has decided to replace the destroyed trains with one new 3.8 mtpa train by 2007.

This accident occurred despite Sonatrach's major programme of plant revamping and upgrading of safety in the 1990s. Mr Achour praised the site's emergency plans and the disaster plan of the Skikda industrial area, which had been shown to be effective. He promised that the results of the investigation in progress and the lessons learnt would be fully shared with the LNG industry.

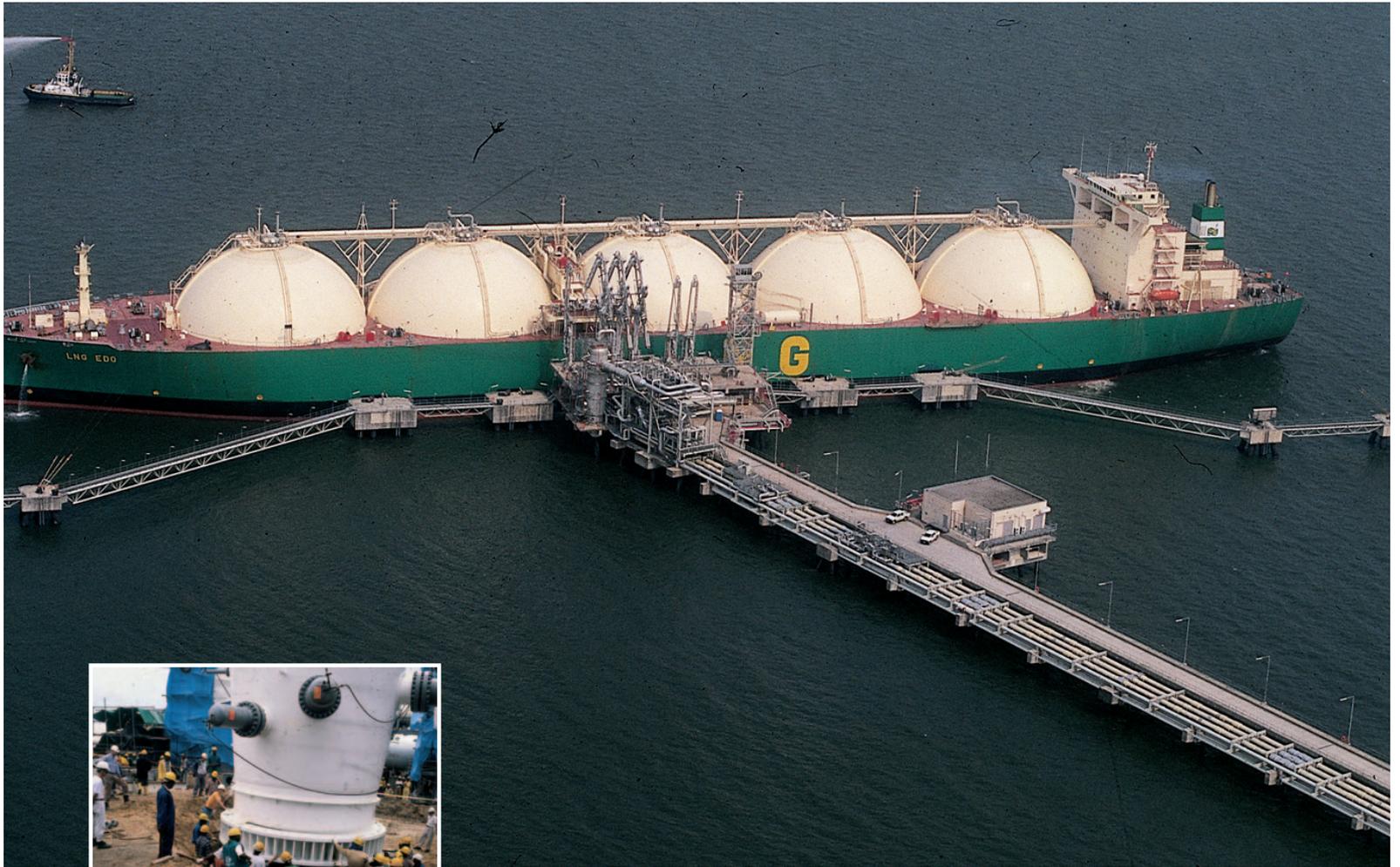
Unfortunately, the report on this major accident overshadowed some good papers at LNG-14 dealing with LNG safety. The disaster raises issues for the LNG industry of the adequacy of the measures taken in design, layout and operation to prevent such explosions. It also makes it more difficult for the proposers of new LNG facilities elsewhere in the world to continue to use general supporting statements about the LNG industry's excellent safety record.

● Shipping

LNG carriers being built are up to 153,000 cubic metres (m³) in capacity. At a Workshop session it was noted that the super-large ships (200,000 m³ capacity or greater) that are being studied are only more economical for very long voyage lengths (e.g the Middle East to USA). Some terminals can be converted to accept them, but most ships of 200,000 m³ will need new dedicated port facilities.

Lorentz Claes of Chantiers de l'Atlantique described why Gaz de France had recently chosen for its new LNG carriers a diesel gas electric propulsion system with dual fuel engines instead of the widely-used steam turbine propulsion system. It was deemed more suitable for flexible LNG trading, and also had lower greenhouse gas emissions. A paper by Keiji Miyashita of Kawasaki Shipbuilding illustrated graphically the extent of

The Secret of Our Success



- Good geographical location
- Abundant gas reserves
- World's fastest growing LNG project
- Owner of world's fastest growing LNG fleet
- A reliable LNG supplier in the Atlantic basin
- Reputable shareholders - NNPC, Shell, Total & ENI
- Top indicative credit ratings from renowned credit agencies
- Excellent due diligence reports on community relations, gas reserves, etc from reputable organisations
- World class health, safety and environmental records

A comforting thought for Nigeria



Nigeria LNG Limited

C & C Towers, Plot 1684, Sanusi Fafunwa Street, Victoria Island, PMB 12774, (Marina), Lagos. Nigeria.

...Helping to put out gas flares in Nigeria



H. E. Abdullah Bin Hamad Al-Attiyah hands over the conference banner to Juan Pons, Chairman of the National Organising Committee for LNG-15.

innovation that went into the design of a 145,000 m³ vessel, confirming that much can be done to reduce costs and increase efficiency without adopting novel propulsion systems and super-large LNG carriers.

● Offshore LNG technologies

There is increasing interest in offshore LNG reception terminals. At a Workshop Session it was said that a problem with many offshore LNG concepts was that they needed unique designs of LNG carriers with mooring aids, as well as unique LNG transfer systems. Also, they were difficult to expand economically. Several papers dealt with new equipment for offshore LNG transfer. Chen-Hwa Chiu of Chevron Texaco stated that FMC Corporation's side-by-side loading system is the only technology that can be considered proven for the demanding offshore environment.

Development work was being continued on cryogenic hose systems and transfer systems for use with tandem mooring.

● LNG terminals and storage

Some new reception terminals were described at LNG-14, which, although large, are still on a smaller scale than the very largest in Asia. A paper

by Korea Gas Corporation described the design of the Phase 2 expansion of their Pyeongtaek LNG terminal with a total of 14 x 140,000 m³ capacity storage tanks – equivalent to the combined storage capacity of seven or more typical new terminals. At a Workshop Session it was said that greater communication between ship and terminal designers was required, in order to achieve optimum (lowest cost) designs of LNG schemes, e.g. by dispensing with vapour return lines at reception terminals through onboard vaporisation during unloading.

Several terminals have been in operation for over 30 years, and there is an increasing need to ensure that the ageing of the facilities does not adversely effect their continued safe operation. Two papers were presented, one by Akio Kobayashi of Tokyo Gas and one by Yoshihiro Muro of Osaka Gas, which showed that the main problems have arisen not with LNG systems, but with seawater corrosion of concrete structures at marine berths and open-rack vaporisers, with carbon-steel piping and valve parts, and certain other ambient temperature components. Systematic inspection, diagnosis, assessment, protection and repair techniques are employed.

● LNG-15

In 2007, LNG-15 is to be held in Barcelona, Spain, and at the closing ceremony there was an official handover to Juan Pons, Secretary General of the Spanish Gas Association, Sedigas. As there is a high level of current interest in new LNG import terminals and LNG trade in the Atlantic Basin it is hoped that LNG-15 will be able to place a greater emphasis in the programme on LNG reception terminals and shipping.

David Roe is an independent LNG consultant and Editor of LNG Journal (www.lngjournal.com). For several years in the 1980s he was the UK representative on the then IGU Working Committee H-1 (LNG).

CREATING INFRASTRUCTURE FOR ECONOMIC DEVELOPMENT

THE NATIONAL GAS COMPANY OF TRINIDAD AND TOBAGO LIMITED



Trinidad and Tobago's leading natural gas Company, The National Gas Company of Trinidad and Tobago Limited (NGC) is staying ahead of the competition by undertaking major infrastructure projects that will keep the country competitive in the investment game. At present, NGC is engaged in four major projects to facilitate expansion of its natural gas transmission network, as well as to provide industrial and marine site infrastructure that will provide for the further commercialization of the country's significant reserves of natural gas in a variety of industries that pave the way for a developed Trinidad and Tobago.

■ CROSS-ISLAND PIPELINE PROJECT (CIPP)

NGC has begun construction of a new 76 km, 56-inch diameter pipeline along NGC's Right of Way corridor from Beachfield Valve Station located on the east coast to the town of Point Fortin on the southwest of the island. At present, NGC's pipeline network comprises 624 km of offshore and onshore pipelines, which have an overall maximum transportation capacity of 1,400 MMscf/d. However, the Cross Island Pipeline Project (CIPP), scheduled to be completed by the fourth quarter of 2005, will add a capacity of 2.4 bcf/d without compression, or 3.2 bcf/d with compression, and will increase NGC's capacity to transport natural gas to projects such as Atlantic LNG Train 4 (ALNG 4), as well as future petrochemical plants earmarked for the Union Industrial Estate, power generation and further plans for LNG expansion.

■ BEACHFIELD UPSTREAM DEVELOPMENT (BUD) PROJECT

Work has also begun on the Beachfield Upstream Development Project (BUD), which comprises a 66 km-36-inch-diameter marine line from Cassia B offshore platform to Beachfield Valve Station, inclusive of a 4.8 km onshore line and a new accumulator station. The BUD Project will require over 5,000 lengths of 40-foot pipes each weighing approximately 6,800 kg before concrete coating. This line will add 600 MMscf/d to NGC's transmission capacity.

■ FABRICATION YARD AT LA BREA

NGC, through its subsidiary companies National Energy Corporation of Trinidad and Tobago Limited (NEC)/La Brea Industrial Development Company Limited (LABIDCO), has established a Fabrication Yard for the construction of topsides and jackets and other major structures at the La Brea Industrial Estate in south Trinidad. The establishment of the yard significantly boosts the level of local content in oil and natural gas exploration and production activities in Trinidad and Tobago. Essentially, the Fabrication Yard is located on 25 acres of land with a 17-acre Common Yard for short-term leases and two four-acre blocks for long-term lease. The establishment of a Fabrication Yard has also included the development of adjacent yards for long-term rental.

In April 2004, BHP Billiton's 'Kairi 1' platform was built at the estate and loaded out from the adjoining La Brea Dock at the Port of Brighton. At present, bpTT's Cannonball platform is

under construction at the Fabrication Yard.

■ UNION INDUSTRIAL ESTATE, LA BREA

Just 16 km from Trinidad's second city of San Fernando, Union Estate, the newest industrial location under development, is located in the La Brea/Brighton area in southwest Trinidad.

The programme of development works that is currently being undertaken by the National Energy Corporation (NEC), a wholly owned subsidiary of NGC, and the company mandated to develop Union Estate, is scheduled for completion with all utilities and infrastructure installed by December 2005. However, while these developments are at different stages of completion, sites for specific plants can be made available before December 2005.

The Union Industrial Estate is earmarked to be the home of several world-scale petrochemical, ethylene and aluminium complexes and plants. In May 2004, a Memorandum of Understanding (MOU) was signed between three parties, ALCOA, NEC and SURAL, for the construction of a US\$ 1 billion, 250,000-tonne-per-year aluminium smelter and associated power plant at Union Estate. January 2005 is the scheduled time for the completion of a definitive agreement and final investment decision.

■ YOUR NEW LOCATION

Yes, we are developing new pipeline and industrial site infrastructure for the serious investor who will utilize the country's location, pro-investment climate, skilled labour force and

competitively priced natural gas to partner our vision of a developed Trinidad and Tobago. Trinidad and Tobago is your best choice in the Western Hemisphere if your business is metals, ethylene, or petrochemicals particularly if you are interested in downstream processing activities.

For further information you can contact:

Frank Look Kin
President
The National Gas Company of
Trinidad and Tobago Limited (NGC)
Orinoco Drive
Point Lisas Industrial Estate
Couva
Republic of Trinidad and Tobago
West Indies

Tel: (868)636-4662/4680
Fax: (868)679-2384
Email: flk@ngc.co.tt

Or

Prakash Saith
Chief Executive Officer
National Energy Corporation of
Trinidad and Tobago Limited (NEC)
Corner Factory and Rivulet Roads
Brechin Castle
Couva

Tel: (868)679-1156/1061/1138/2453
Fax: (868)636-2905
Email: Prakash@ngc.co.tt



THE NATIONAL GAS COMPANY
OF TRINIDAD AND TOBAGO LIMITED



NATIONAL ENERGY CORPORATION
OF TRINIDAD AND TOBAGO LIMITED



Gas Developments in the Americas

By Terence H. Thorn

In 1991, Arkansas Governor Bill Clinton defeated the incumbent President George Bush by keeping the campaign focus on the economic problems in the US rather than Bush's recent Gulf war victory. A sign on the wall of his campaign headquarters in Arkansas said it all: It's the Economy Stupid!

Today a similar sign hangs in executive offices throughout the Americas: It's the Price Stupid! In North America, despite recent predictions of a potential 32 tcf (896 bcm) natural gas economy, record high gas prices are raising concerns about lost markets and the flattening of demand. Ironically, these same high prices are raising hopes that, if prices stay at these levels, long-term LNG imports will become viable and maybe even the Alaskan gas pipeline can be constructed. For now natural gas prices appear likely to remain high and volatile, and temporary physical shortages cannot be ruled out.

In South America, government intervention to lower prices during a severe economic downturn has created a supply shortage in Argentina and a halt in energy investment just when an economic upswing is beginning in the southern cone countries. Meanwhile, in Brazil the depreciation of the real since being floated has pushed up gas prices lowering demand. Bolivia lost a President last year in the face of massive protests against proposals to export gas to the US, while Chile faces winter power shortages because of a cut of 15% in import volumes from Argentina.

● North America – the demand-supply conundrum

Natural gas demand in the US and Canada has caught up not only with wellhead supply but also with existing storage capacity and transportation

infrastructure. The long-term average price for natural gas in the United States has risen persistently during the past six years and although futures markets project a near-term modest price decline from current highly elevated levels, contracts written for delivery in 2009 are more than double the price levels that had been predicted when much of the new gas-burning facilities were constructed. The perceived tightening of long-term demand-supply balances is beginning to price some industrial demand out of the market and it is not clear whether these losses are temporary, pending a fall in price, or permanent.

Mark Papa, head of EOG Resources, an oil and gas exploration and production company headquartered in Houston, maintains that high prices are going to persist for years due to what he calls



The US is the world's second largest gas producer (after Russia) – part of the Jonah field in Wyoming



“a perfect storm on the supply side”. Canadian gas production is dropping, Mexico is importing American gas and the ageing gas fields off the continental United States are entering a period of dramatic decline.

In the US the current decline rate is averaging 28% per year and new wells are being depleted more quickly all the time. While this is partially due to growing demand, it is also due to the fact that the large plays of natural gas are all declining. Newer natural gas fields tend to be smaller and are produced (and depleted) quickly in the effort to maintain overall production levels.

The most dramatic example of this decline is in the offshore waters of the Gulf of Mexico. Production there accounted for 31% of US gas supplies in 1990 compared to 24% today. Current offshore production is at the lowest levels in 16 years.

Demand in North America had been expected to grow about 2% a year with the US and Canada breaking through the 30 tcf (840 bcm) demand barrier in 2009. But with high gas prices, demand in the US was 22.2 tcf (630 bcm) in 2003 and may be entering a flat period.

Increasingly tight natural gas supplies and the doubling of prices have not escaped the attention of the electric power industry. Since the early 1990s, 90% of new generation has been natural gas-fired and the amount of electricity now generated by natural gas is 18%, up 33% since 1990. Many had predicted that this figure would rise to almost 30% by 2025. Power generators currently use 5 tcf (140 bcm) a year.

The current US Clean Air Act's complex requirements for electricity generators limited the use of coal in new power plants. However, the new Clear Skies Act would create a national “cap and trade” system in which utilities could buy and sell pollution allowances and choose their own technology for reducing pollution. This should make it easier to burn coal and expand older coal-fired plants, and at least 94 coal-fired electric power plants are now planned across 36 states. However, it is unlikely

that all but a small number of these will be built. It can take seven to 10 years for a coal power plant to go from planning to construction, while legal action and public protests often halt them.

With existing fields declining, exploration companies are scrambling to opening up new areas of the US to drilling. President Bush's energy bill, which is bogged down in the Congress, would open more federal land where most of the new oil and gas reserves may be found, including in the Arctic National Wildlife Reserve (ANWR) and in the Rocky Mountain basins.

Even if drilling were approved, pipelines from the existing Alaska North Slope reserves, the Canadian Arctic or ANWR, aside from their multi-billion dollar costs, each face a huge number of political, environmental and hurdles and under the most optimistic construction forecasts are 10 years away.

● **Canada: no longer a “reserve” player**

For years Canadian gas supplies have eased shortages and kept prices stable in US natural gas markets. Currently Canadian exports account for 16% of total US natural gas supplies. But the days when Canada can make up for falling US production may be over as natural gas production in the province of Alberta peaked three years ago and is expected to decline at an annual rate of 2.5%.

Alberta accounts for just over 80% of the natural gas produced in Canada. Of the annual production of 5 tcf (140 bcm) about half is exported to the United States and around one-quarter flows to other points in Canada.

The Alberta Energy and Utilities Board has said in its annual reserves report that while a total of 12,000 gas wells were drilled in the province in 2003 – a 46% increase over 2002 drilling – production declined 2%. And while the expected record number of wells drilled this year should keep production flat, conventional gas will begin declining in 2005 by about 2.5% a year. As conventional gas supplies decline, Alberta is looking to



Canadian gas production is concentrated in Alberta – minimising environmental and agricultural impact at an EnCana wellhead near Ponoka.

new sources such as coal bed methane as well as from drilling in the foothills of the Canadian Rockies where a single well can cost from \$2-7 million.

● **The LNG solution**

LNG remains one of the fastest growing sectors of the energy business and may present an important solution to North America’s supply problem. Initially the Atlantic Basin market was dominated by sales from Algeria in the 1980s and 1990s, but by 2000 it had received supplies from all the world’s LNG plants, with the exception of those in Brunei and Alaska. In 1999, developments in Trinidad and Tobago provided a new source of LNG. The United States imported 7.82 million tonnes (378 bcf or 10.71 bcm) from Trinidad and Tobago in 2003 and the country currently serves as the source for a full 75% of US LNG imports.

New suppliers from Angola, Egypt, Norway and possibly Venezuela are looking at the basin markets and terminal capacity will have to be

expanded. Each additional 1 tcf (28 bcm or 21 million tonnes) of import capacity is expected to cost at least \$1 billion, including both new terminals and shipping capacity.

In 2003, the four US LNG import terminals took in 203 cargoes and a little over 10 million tonnes (487 bcf or 13.8 bcm). This compares to their estimated combined peak capacity of about 26 million tonnes (1.27 tcf or 35.9 bcm) per year and an estimated base load capacity of 18.5 million tonnes (900 bcf or 25.5 bcm) per year. All four terminals either have recently completed an expansion or plan to expand their regasification capacity by 2006.

In addition, the US Energy Information Administration’s (EIA) Annual Energy Outlook 2004 projects that four new LNG regasification terminals will be constructed from 2007 through 2010 to meet the predicted increase in LNG imports for that timeframe. The first new US LNG terminal in more than 20 years is projected to open on the Gulf Coast in 2007. Additional terminals are

Enbridge

Enbridge began life as Interprovincial Pipe Line in 1949, shortly after Canada's first major oil discovery at Leduc, Alberta. The company now delivers more than 2 million barrels of crude oil and liquids per day to customers in Canada and the US. Enbridge has since evolved into an energy delivery success story, acquiring and operating Enbridge Gas Distribution, which distributes natural gas to 1.7 million customers in parts of Ontario, Quebec and New York State. Enbridge has also begun to develop additional natural gas distribution networks.

Today, Enbridge is a Calgary, Alberta-based energy delivery company with assets throughout North America and in several other countries, including natural gas transmission, crude oil feeder pipelines; midstream natural gas business, and crude oil pipelines and related terminal and storage facilities that will help producers realise the promise of Alberta's oil sands as a pillar of sustainable and secure energy reliability.

Pat Daniel, Enbridge's President and CEO, says the company's vision is to be the leading energy delivery company in North America. Enbridge also intends to be at the forefront of development and planning for an Alaska gas pipeline. In addition to its extensive

experience operating the world's longest crude oil and petroleum liquids pipeline system, Enbridge has broad experience in natural gas. It owns and operates Canada's largest natural gas distribution company, and has significant interest in the Alliance and Vector Pipelines. Enbridge is also a partner in Inuvik Gas in Canada's Northwest Territories.

Enbridge has some significant and unique advantages for northern development. Enbridge is the only pipeline company with regulatory, design, construction and operating experience in the North. The Norman Wells crude oil line, constructed in the early 1980s and operated by Enbridge, has resulted in solid working relationships with northern communities and other stakeholders.

With the acquisition of more than 10,000 miles of natural gas transmission and gathering pipelines in the mid-continent and Gulf Coast area, Enbridge has a growing interest in natural gas transportation and processing. Collectively, these pipeline and distribution interests handle more than 10 billion cubic feet per day, positioning Enbridge as one of the leading players in the North American natural gas industry.

It takes more than a pipeline to connect energy with people.

It takes a continental commitment. As operators of the world's longest crude oil pipeline, and Canada's largest natural gas distribution company, we're expanding our reach throughout North America. Initiatives like the Alaska Natural Gas Pipeline connect new sources of clean burning natural gas to growing markets. This focus on continental natural gas transmission and gathering systems make us a leader in energy delivery. And our tireless commitment to corporate social responsibility will keep us there.



Crude oil & petroleum product pipelines • Natural gas distribution & transmission • International energy ventures • Frontier pipelines • Alternative energy technologies | enbridge.com



The Atlantic LNG plant in Trinidad and Tobago supplied three-quarters of US LNG imports in 2003 and will bring a fourth train into service in 2006.

expected to serve markets in Florida, the southern Atlantic states and the western Gulf Coast. EIA also forecasts that a terminal targeting the Florida market will be constructed in the Bahamas with the gas piped to Florida.

Two of the most aggressive companies pursuing US LNG projects are ExxonMobil and Sempra Energy. The oil giant has purchased an option to buy about 90 hectares for a terminal near Sabine Pass, 145 kilometres east of Houston. ExxonMobil is also considering sites in Corpus Christi, off the coast of Louisiana and in Mobile Bay, Alabama, but the latter has run into opposition from local residents who have filed suit to block the project. In October 2003, ExxonMobil announced a \$12 billion-agreement to ship an annual 15.6 million tonnes of LNG (760 bcf/21.5 mcm) from Qatar to the US for 25 years starting in 2008/9.

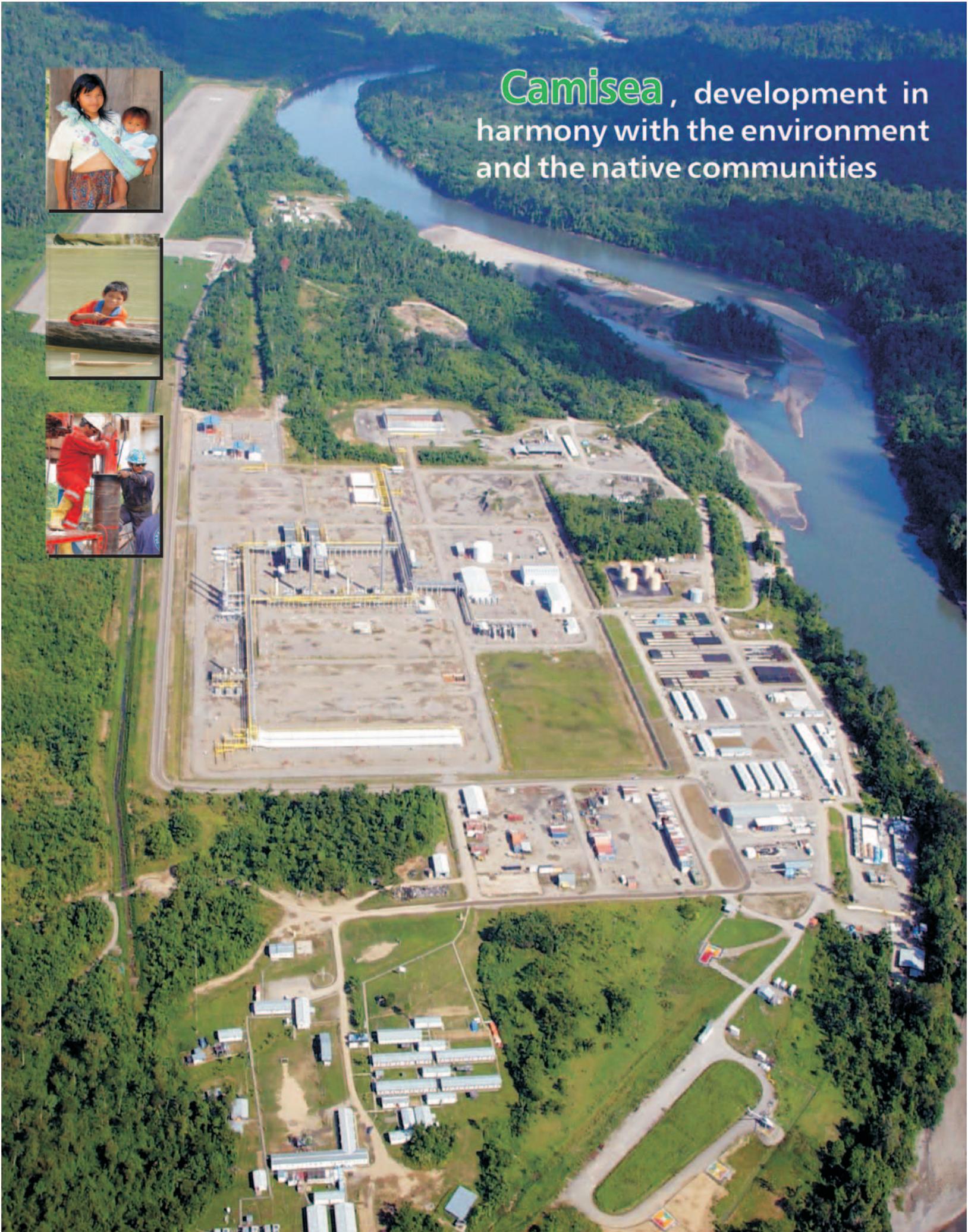
Sempra Energy is moving ahead rapidly on three major LNG regasification facilities. A joint venture with Shell International Gas is planned on

the coast of Baja California, Mexico, which would be supplied from Indonesia and handle 1 bcf (28 mcm) per day. Larger plants (1.5 bcf/42 mcm per day) are proposed at Cameron, south of Lake Charles in Louisiana, and at Port Arthur, 137 kilometres east of Houston in Texas.

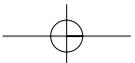
Meanwhile, ConocoPhillips is seeking to build an offshore facility 24 kilometres off the coast of Alabama, El Paso has plans for a marine terminal 187 kilometres offshore Louisiana and Chevron-Texaco is also seeking to build a terminal off the Louisiana coast.

To date, environmental and safety concerns, cost considerations and the unwillingness of regulators to support long-term contracts have limited the number of terminals available for importing LNG, and it is a real question as to whether or not import terminals can be permitted fast enough to meet the forecast demand.

If environmental, regulatory and normal safety concerns were not enough, many coastal towns are



Camisea, development in harmony with the environment and the native communities





The Tucuruí Dam in Brazil – hydropower accounted for 38% of Brazil’s energy consumption in 2003.

rejecting plans for receiving terminals out of fear that the LNG tankers could become the targets of terrorist attacks. Alabama Governor Bob Riley sent letters to the Federal Energy Regulatory Commission and the Alabama Port Authority saying he would block sale of state-owned land to Exxon Mobil for use as an LNG terminal “until an independent safety study has been completed and evaluated”.

In the face of such opposition several other high profile projects have been killed recently. Calpine Corporation has withdrawn plans for a receiving terminal in Eureka, California, and ConocoPhillips cancelled a terminal project in Harpswell, Maine. It is looking more likely that only a handful of the proposed terminals, mostly on the Texas and Louisiana coasts will be built.

● **Welcome recovery in South America**

South America is experiencing a welcome recovery from some very difficult economic years. The regional economy is set to grow by around 4% this

year, the best performance since 1997 and inflation remains in check in most places. Prices for Latin America’s raw materials have soared thanks to voracious demand for them in China and foreign capital has been slowly trickling back into the continent.

However, in terms of the energy sector, the lack of fully functional markets and government interventions since 2000 have led to temporary supply shortages and stagnant investment in South America’s energy infrastructure. This follows a decade that saw electricity and gas market reforms, the doubling of production capacity and the completion of several cross-border pipelines setting the basis for a regional natural gas network. Natural gas-fired power plants represented approximately 60% of the total new investments in power capacity in the Southern Cone during the 1990s. Yet today, currency devaluations and depreciations, selective gas price increases and decreases, reduced electricity consumption and political unrest and intervention have hit the industry hard.



● **Brazil**

With a population of 175 million people, Brazil remains the economic engine of South America. It is the third largest energy consumer in the Americas and the 11th largest in the world. The recent Central Bank interest rate cuts and a looser monetary policy promise to rekindle growth in the domestic economy and strengthen the currency. Although the latest opinion polls show a decline in President Lula's popularity and unemployment remains high, the government so far shows few signs of yielding to pressure and abandoning its economic reforms.

Brazil became the largest consumer of hydro-electric power in the world in 2003 (overtaking Canada). However, a heavy dependence on hydro-power can lead to brownouts (voltage reductions) and blackouts during times of drought, and Brazil is constructing a natural gas infrastructure to expand the use of domestic and imported gas and to fuel new gas-fired capacity. The state-owned oil and gas company, Petrobras, has been actively pursuing projects to promote the use of natural gas, especially through the implementation of thermoelectric power plants and is working with gas distribution companies and large industrial consumers to increase natural gas utilisation.

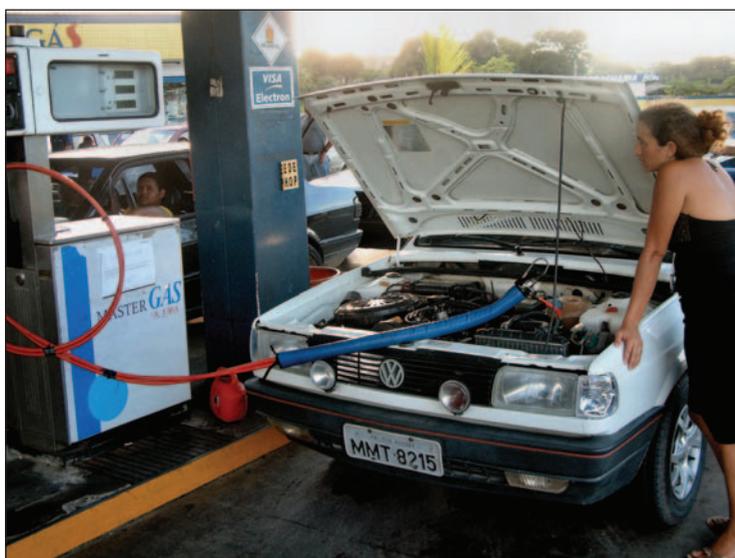
However, Brazil could do more to improve the investment climate for natural gas. As the company that made the original investments to develop the market, Petrobras still has significant market power. Fully competitive regional and gas markets with broad participation and ample liquidity do not yet exist, gas prices are set rather than freely negotiated and there is a lack of third party access to the transmission infrastructure. Furthermore, the floating of the Brazilian real in 1999 and its subsequent depreciation against the US dollar made gas imports from Bolivia (denominated in US\$) more expensive and less competitive against domestic fuel and hydro alternatives. The wellhead gas price of Bolivia to Brazil, which is adjusted in line with international fuel-oil prices, has almost doubled

since the start-up of deliveries in 1999. As a consequence the take or pay expected volumes have not been fulfilled since 2001.

● **Argentina**

Economic activity in Argentina is recovering at a robust pace across all sectors of the economy as the country rebounds from the turmoil brought on by the collapse of the fixed peso-dollar exchange rate in 2001-2002. However, consumption remains subdued, as high unemployment, tight credit and the deterioration in real incomes dampen consumer spending. Also the recovery has brought with it a new set of problems. With economic growth topping 8% in 2003, the IMF and foreign creditors are demanding that more tax revenues be diverted to paying down debt. Meanwhile, popular policies, such as the hard line President Kirchner has taken with foreign creditors, utility companies and the IMF, are beginning to produce unpopular results such as power shortages.

The economic collapse also had a severe impact on the energy industry. The government of Eduardo Duhalde, President Kirchner's predecessor, converted energy prices to pesos and froze



There are around 600,000 NGVs in Brazil (ABOVE a CNG filling station in Natal) and more than twice that number in Argentina.



them. Wellhead gas prices today are approximately \$0.50 per million btu versus approximately \$1.2 per million btu before the devaluation. At the time, he said he planned to renegotiate the contracts of the utilities. (Utility prices had been fixed in pesos.) What was initially an emergency measure – taken out of fear of the social impact of tariff rises on a newly impoverished country – has become energy policy. For most of the utilities the frozen tariffs cover only their operating costs, so investment has stalled.

The results of the tariff freeze have been predictable. Most Argentines now pay only a third as much as they used to pay for gas and electricity and demand has soared producing shortages. Each month, some 25,000 Argentines have been converting their cars to run on compressed natural gas, which costs 45 centavos (\$0.18) a litre, compared with 2 pesos (\$0.71) for high quality petrol. Meanwhile, since energy prices are at around one-third of the level required for a reasonable return on investment – and many of the electricity companies are in default on their dollar debts – supply has stagnated and exports have been cut.

Daniel Cameron, Argentina's energy secretary recently admitted that the energy shortages posed a serious threat to the country's economic recovery and President Kirchner has quietly moved to increase some tariffs, by 35% or so for industrial users of electricity and gas. He has promised gas producers that prices will be "normalised" by 2006 and has also launched a plan for a new state exploration and production company.

The investments required to revitalise the energy industry could exceed \$500 million a year for electricity generation, with a similar sum for electric transmission and distribution, and ramping up gas exploration and easing pipeline bottlenecks. Such a level of investment will require a better regulatory framework since the current one gives insufficient incentives for investment in the transport of both gas and electricity. On one point, there is surprisingly broad agreement: Argentina needs a single energy regulator, staffed by engineers as well as

economists. And Argentina's politicians need to let them get on with their job.

● Chile

Chile is the most open economy in Latin America and with only small deposits of coal, oil and gas, it has come to rely heavily on Argentina's cheap and abundant natural gas for two-fifths of its electricity. Since the mid-1990s, around \$5 billion has been invested in cross-border pipelines, gas-fired power plants and the conversion of industries and homes. However, in March and without consultation with the Chilean government, President Kirchner ordered a cut of up to a quarter in exports of Argentine gas to Chile, which normally amount to 706 mcf (20 mcm) per day.

The agreement signed by the two countries in 1995 says that Argentina can cut supplies in an emergency, but that Chilean customers should not be discriminated against compared to domestic customers. So far, the gas cuts have mainly affected several big copper mines in the north and Chile's government hopes to get through the winter without blackouts. Old coal-fired plants there have been brought back into service and most of the gas-fired plants have switched to diesel.

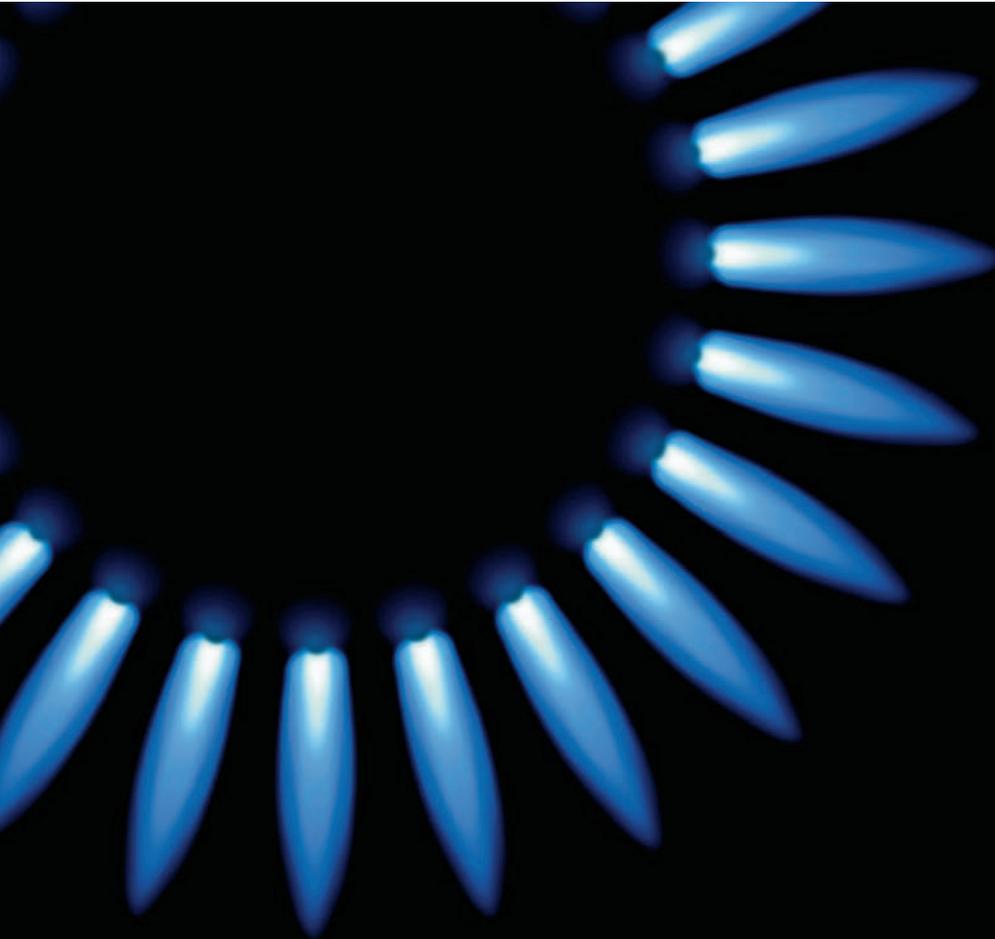
Cuts in gas supplies to central Chile, home to 90% of the population and most (non-mining) industry, would be far more damaging. The central grid has little spare capacity and avoiding power cuts there may depend on whether winter rains are sufficient to fill hydroelectric dams. In an effort to reduce reliance on Argentine gas supplies, the government is looking at building an LNG terminal perhaps to import gas from Peru. Bolivia is the logical alternative supplier, but a bitterly remembered 19th century war in which Bolivia lost its coastline to Chile makes exports almost impossible from the political perspective.

● Bolivia

Indeed, Bolivian President Gonzalo Sánchez de Lozada was driven from office in October 2003

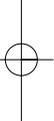
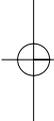


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**WHEREVER THERE IS A SOURCE OF
NATURAL AND CLEAN ENERGY, PETROBRAS WILL INVEST IN IT.**

You can't see natural gas, but you can see its effects on the economy and the environment. Natural gas is clean, efficient and economic energy that Petrobras sells and transports through the biggest network of gas pipelines in Brazil – over 8,000 kilometers long. It's no wonder that Petrobras is Brazil's biggest natural gas company, producing over 45 million m³ of gas per day. And that's not all: by 2010, the company plans to increase production to 84 million m³, taking the benefits of natural gas to thousands of Brazilians.





because of his support for a plan to let multi-nationals export natural gas to the United States through Chile. Although the issue is now moot – the US company involved has since signed a contract to import gas from Indonesia instead of Bolivia – the country remains in turmoil over gas policy. Since former Vice President Carlos Mesa Gisbert became head of state, there have been five different energy ministers.

In an effort to win over critics, President Mesa has offered free gas connections for 200,000 families, and wants to increase taxes on foreign gas companies while reviving the state oil and gas firm, which was privatised by Mr Sánchez. He hopes these proposals will be enough for the government to win a promised referendum on energy policy and the future of the LNG project. Bolivia has 28.7 tcf (804 bcm) of reserves and little local demand.

● Peru

One of the positive natural gas stories in South America is in Peru where at presstime gas from the Camisea field in the Amazon was scheduled to reach the capital Lima. Camisea has proven reserves of 9 tcf (252 bcm) of natural gas and 600 million barrels of condensates – more than enough to supply Lima for decades. Royal Dutch/Shell started exploring the huge Camisea gas field in the mid-1980s, but finally walked away from it in 1998 after years of wrangling with Peru's governments over the contract for the country's biggest energy project.

In 2000, the government awarded a licence to develop the field to an upstream consortium headed by Pluspetrol of Argentina. A second downstream consortium led by Tecgas of Argentina is responsible for two pipelines (one for natural gas and one for natural gas liquids) and a plant to process condensates for export. In a second stage a liquefaction plant is planned at Pampa Melchorita on the Pacific coast, 169 kilometres south of Lima, to export LNG from late 2007 or

early 2008 to Mexico and possibly California. This stage is led by Hunt Oil, a US company that is also a partner in the upstream and downstream consortia.

● Venezuela

Finally, for over a decade Venezuela has been striving to attract investors to a Paria LNG project. The North Paria area covers an estimated 10 tcf (280 bcm) of offshore reserves and connects to additional reserves in the Plataforma Deltana. Shell and its partners appear increasingly confident that a commercial agreement underpinning a \$2.7 billion-project to export an annual 4.7 million tonnes of LNG (229 bcf/6.5 bcm) will be signed by the end of this year. The lack of stability in the country with national strikes, aborted coups and Presidential recall efforts have paralysed efforts to finalise export agreements so far.

● Looking forward

Changes to market dynamics and regulatory climates have left the natural gas industry in the Americas between a "rock and a hard place". North American executives are experiencing their own dotcom boom and bust as the rush to gas has stretched supplies and catapulted prices, encouraging the expansion of supply sources such as LNG while threatening to flatten demand. In South America, changes of government and intervention have temporarily hobbled an industry that was on its way to completing an integrated natural gas market stretching from the tip of Argentina to north-east Brazil. In the end, new supply sources and the inevitable realisation that market interventions always do more damage than good will herald the next natural gas boom.

Terence H. Thorn was the Chairman of IGU Working Committee 9 in the 2000-2003 Triennium and is President of JKM Consulting in Houston, Texas. He may be contacted at tthorn@txthorns.net.

VENEZUELA



Opportunities in the Gas Business

Venezuela has 147 trillion cubic feet of proven gas reserves with further resources of between 40 and 60 million cubic feet subject to confirmation.

PDVSA Gas is a new subsidiary of Petróleos de Venezuela, which operates in sectors across the gas chain from the exploration and production of natural gas and the production of LNG, to the transportation, distribution and marketing of natural gas products. It has more than 2,300 highly qualified workers and more than 5,000 kilometres of pipelines.

The new PDVSA Gas is in the vanguard of the energy future.



Retama celebrates gas works

While developing the Camisea gas pipeline project, **TgP** -the gas transportation company- has gone beyond environmental and social standards.

Working with care and sensibility, the land over the pipe is now more fertile than before the works started.

And local communities, like these folks at Retama, now enjoy the benefits of such care.

Considering all the resources it demanded from us, we feel deeply proud for this project's success.

Hidden among the Andes, in a place where time seems to go incredibly slow, Retama is now alive with celebration.

What moves this usually calmed people this much? They're dancing and singing because of the first crops obtained from a previously sterile land. A very special one indeed.

The Camisea gas pipeline runs beneath this harvest party.

To know more about Retama and other environmental activities from TgP please visit

www.camisea.com.pe/retama





WOC 1 Takes a New Approach

By Marie-Françoise Chabrelie, Dominique Copin and Rebecca Hyde

IGU Working Committee 1 has a wide remit covering the exploration, production and processing of gas. In order to address this topic in sufficient detail, the Committee has been divided into two Study Groups. While building on the best traditions of IGU, WOC 1 is taking a new approach both in the organisation of activities and the way in which the information is gathered and presented.

We aim to hold meetings that are productive and informative for all those who attend. For example, at the autumn 2003 meeting hosted by Centrica in Windsor, UK, a trip was arranged by Mark Howard of BP to one of the company's HIVE (Highly Immersive Visualisation Environment) installations. A HIVE is a workroom with a series of three-dimensional digital projectors around which large teams of people can gather to manipulate data and pictures, giving them a common mental picture of the structure on which they are working.

Then in Paris at the meeting this spring, Yves Tournié of Total gave a presentation on the Taweelah A1 power and desalination plant in the UAE, which provided an insight into this fascinating area.

WOC 1's next meeting in Hørsholm, Denmark, this September is being organised by the IGU Secretariat as a joint session with other IGU Committees and Task Forces. At the joint meeting, which will be attended by WOCs 1 and 2 (Storage), PGC A on Sustainable Development and the ICT Task Force, WOC 1 will lead discussions on the following subject areas, which we hope will be of interest and relevance to all groups attending:

- GTL and sustainable development – Mark Howard, BP, UK;
- New technologies for storage and exploration and production, including smart wells – Lucian Stancu, Romgaz, Romania; and
- CO₂ sequestration – Torstein Hole, Statoil, Norway.

Following Hørsholm, there will be WOC 1 meetings in spring and autumn 2005 and spring 2006. Details are yet to be finalised, but the probable venues for the latter two are Je-Ju Island, hosted by the Korea Gas Union and Vienna, hosted by ÖMV.



WOC 1's autumn 2003 meeting included a visit to one of BP's HIVEs. The company has more than 30 of these in operation around the world, which have produced \$150 million in bottom-line savings by improving the efficiency of operations and lessening their impact.



The real technical and commercial analysis is carried out by the Committee's Study Groups, whose current areas of work, their results so far and long-term goals are described below.

● **Study Group 1.1**

Be it for the size of their reserves, their geological structure, their location or the technical advances or challenges their development has or will incur, a number of gas fields emerge as the world's most significant. Some will be well known, others may well surprise you.

Led by Djaouid Bencherif (Leader) and Torstein Hole (Deputy Leader) and supported by Marie-Françoise Chabrelie as Technical Advisor, Study Group 1.1 aims to put together a unique selection of these fields by applying a number of specific criteria gauging significance. Through their specific characteristics, these selected reservoirs will provide a panorama of the world's most significant developments in exploration and production over time, each providing its own set of prominent features or lessons on field development. We think this should suggest future trends that will affect the global gas business.

During WOC 1's Windsor meeting in November 2003, we identified criteria for choosing significant fields and posted a questionnaire on the IGU WOC 1 portal. All WOC 1 participants were asked to select the most exciting fields worth studying from their point of view and to comment on the specific statistical data of these reservoirs (the size of reserves, existing and/or potential production, etc) and their characteristics. This survey enabled us to compile a tentative, initial list of reservoirs. Although the feedback was very interesting, undoubtedly providing a useful starting point, the in-depth analysis of the results gave clear evidence that a number of very significant gas fields had not



WOC 1 members attending the spring 2004 meeting pose for a group photograph in front of the La Défense arch in Paris.

been identified. Besides which, some very interesting, although smaller, reservoirs had also been left out. A presentation of the analysis was made during the WOC 1 meeting in Paris in March, emphasising the pros and cons of the selection. (Figure 1 shows the initial selection of identified fields.)

The aim is to finish with accurate case studies, including all types of structures, situations and challenges; to do so, the Study Group has decided to extend and then refine the list. The search has been divided into continents and shared among the 16 participants in the group, including Djaouid Bencherif, Marie-Françoise Chabrelie, Torstein Hole, Mark Howard, Mohamed Johari Dasri, Vadim Kobilev, François Labaune, Peter Reichetseder and Nahum Schneidermann.

Data for each of the listed reservoirs will subsequently be analysed according to the set of criteria already identified by the Study Group.

Technical advances and challenges

This criterion encompasses the technological and economic breakthroughs and challenges associated with the geographical environment of the field, as well as its geological structure. Significant undertakings linked to reservoir modelling,



RIGHT
Figure 1.



South Morecambe is one gas field to be considered as one of the world's most significant. Operated by Centrica Energy, it is the largest wholly-owned gas field in the UK.