

Commemorating

15 years of NGC's Cross-Island Pipeline

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In addition to commemorating its 45th anniversary in 2020, The National Gas Company of Trinidad and Tobago Limited (NGC) simultaneously marks the 15th anniversary of the completion of the Cross-Island Pipeline (CIP). This pipeline was constructed over the period 2002 to 2005 and it was the largest and most expensive infrastructure project undertaken by NGC at that time in its history. At 56" in diameter, it represented the largest diameter natural gas pipeline in the Western Hemisphere at the time.

In 1967, Pan American Trinidad Oil Company (then Amoco Trinidad Oil Company, and now known as BP Trinidad Oil Company) drilled its first exploration well OPR2, which discovered substantial oil and natural gas resources in Trinidad's East Coast Marine Area. This success was followed by other discoveries of non-associated natural gas and by 1972, over 10 trillion cubic feet (tcf) of natural gas was identified. The company sought to find markets for this gas. This led the Peoples Gas Company of Chicago to suggest an export project to convert natural gas to LNG for market in the Mid-Continental United States in 1972.

Dr. Eric Williams, the first Prime Minister of Trinidad and Tobago, scuttled that project in favour of an alternate programme to develop gas-based industries using natural gas as a fuel and raw material over the next two decades. With the country having abundant natural gas resources over and above that required by domestic industries, the Government approved the development of the first LNG train in Point Fortin in 1996. This was followed by two other LNG trains by 2002, with gas utilisation at 1,550 mmscfd. The other 45% of gas produced was utilised in power generation, ammonia and methanol production and other domestic industries.

In 2002, with proven gas reserves of 21.3 tcf and 8.2 tcf in the probable and possible category, Atlantic LNG shareholders contemplated a fourth LNG train and possibly, further trains. An 800 mmscfd train would have the advantage of economies of scale in plant construction and be competitive with other LNG exporting countries. Atlantic LNG shareholders initiated development concepts for pipeline infrastructure to transport gas from the East Coast Marine Area to Point Fortin. Negotiations among the members were protracted with consideration of three pipeline sizes - 36", 48" and 56" - as well as related capital costs, pipeline capacities, rate of growth of gas demand and the number of additional LNG trains.

A 56" pipeline was considered the most capital efficient - 50% more efficient with three times the throughput

capacity compared to a 36" line. However, there were limitations. Only five steel mills manufactured this pipe size, few pipeline contractors had the requisite capability and there were concerns about the impact of construction with wide turns, wide trenches and heavy loads on the environment and infrastructure along the pipeline route.

In November 2002, NGC - the smallest of a five-member consortium - presented a proposal to build and operate a 56" pipeline to Point Fortin. This proposal was met with scepticism that NGC could undertake this project with limited experience in pipeline construction of such large scope and managing an estimated US\$189 million project.

Eventually, however, the recommendation was made that NGC as the state company in the consortium should construct, own and operate the 56" pipeline.

This was a momentous and historic decision, for it demonstrated Government's confidence in NGC's

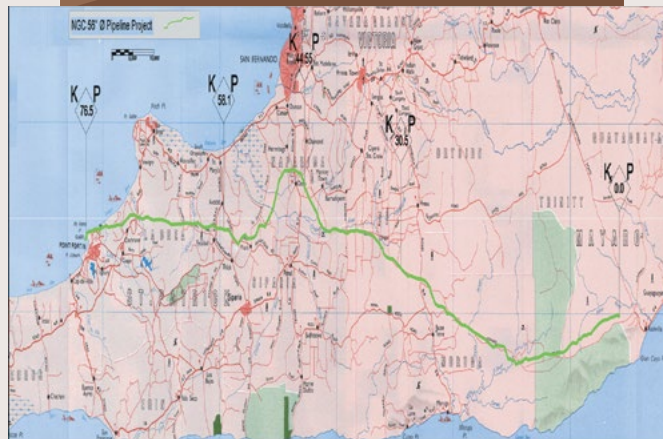
management and technical capability. In 2002, NGC operated three CIPs - the 24" built in 1978, the 30" built in 1982 and the 36" inch built in 2000, with a total of 423 km of large diameter pipelines.

The new project - a 76.5 km long 56" pipeline with a capacity of 2.4 billion cubic feet per day (bcfd) - was a major challenge for NGC. It involved procurement of 56" diameter pipe and fittings, pipeline construction and testing and the borrowing of over US\$200 million within three years. While NGC was delighted by this decision, there was apprehension as this would be the most difficult and challenging project to be undertaken by the Company in its 27-year history. Then Chairman of NGC, Keith Awong accepted the challenge and declared that "failure was not an option". NGC had to complete the pipeline construction ahead of the Train 4 LNG plant completion otherwise it could face penalties for non-completion.

Project design

The first crucial decision was incorporating the Atlantic LNG pipeline team as part of the organisational structure to undertake this project. Clarence Harnanan

The Origin of the 56" pipeline





Vice President, Group Technical Operations – was appointed as NGC’s project manager, and Ian Cansfield had responsibility for Operations, Construction, Engineering, Contracts and HSE. In February 2003, NGC formed the NGC Pipeline Company Limited (NPCL) to own the CIP and insulate the Parent from potential liabilities of the pipeline company.

The next step was pipeline design. The pipeline was designed to conform to Ministry of Energy standards which adopted the US Code of Federal Regulation 49 CFR 192, the minimum Federal safety standard for transportation of natural and other gas by pipeline. The pipe material was API 5L X70 carbon steel pipe, with different wall thicknesses to meet three class locations as follows:

- **Class 1: 56.7 km with wall thickness 0.708”**
- **Class 2: 4.4 km with wall thickness 0.825”**
- **Class 3: 15.4 km with wall thickness 0.965”**

The design took into consideration construction challenges in areas where conventional techniques could have major environmental impacts, such as rivers, wetlands and marshes. In these areas, a less invasive process was proposed for laying pipe – Horizontal Directional Drilling (HDD).

This was a trenchless technology adopted from the oil well drilling industry. It involved drilling a pilot hole using a special slant rig, then enlarging the hole to about 72” to accommodate the 56” pipe. The pipe string would then be “pulled back” through the hole to the starting point.

This technology allowed for the burial of the pipes far below the normal depths of conventional crossings. It would be used to cross the environmentally sensitive Oropouche River, Guapo River and Clifton Hill Beach. A total of 2.1 km of HDD was planned with the deepest point being about 100 feet below the surface.

Another challenge was the Right of Way (ROW). NGC had to ensure that the pipeline corridor was available, otherwise, it would face claims for delays from the contractor. A detailed review of the ROW which contained the 24” and 36” pipelines existing revealed that in order to have adequate construction space, some 18 hectares of additional corridor lands had to be acquired, and 39 household structures purchased.

Safety and Environment Planning

One of the special features of this pipeline was the use of five mainline valve stations, which would allow for depressurisation of only a section of the line in the event of a pipeline leak. The other standard pipeline construction requirements such as coloured tape above the top of the buried pipe, pipeline identification at crossings, and evenly-spaced markers were included as safety features.

The pipeline was designed with an extra 0.25" of wall thickness as a corrosion allowance and internal and external coating of 3mm fibre-bonded epoxy (FBE) protection. In addition, cathodic protection was added externally to preserve pipe integrity. Special ultrasonic flowmeters were installed at Beachfield and Point Fortin to detect leaks. The entire pipeline would be continually monitored by a SCADA system.

During pipeline construction, a total of 85 hectares of forest was cleared in the Victoria/ Mayaro, Rochard Douglas and Morne L'Enfer forest reserves. In accordance with the Company's "no net loss" policy, NGC initiated a programme to reforest portions of critically degraded forest within 2.5 km of the pipeline corridor. This programme was implemented with the assistance of an experienced silviculture consultant. It would be executed in collaboration with the Forestry Division and nearby communities, with limited employment opportunities for planting and caring for the new forest.

Procurement of Pipe

The procurement of pipe was one of the next major tasks for the project team. Bids were invited from four mills, with Europipe GmbH having the lowest bid, and the most competitive offer in the major areas of consideration: coating cost with FBE, transport cost for delivery at Point Lisas or La Brea and export credit financing costs. A contract worth US\$44,454,800 for coated pipe to be delivered to the La Brea port was signed with Europipe GmbH in July 2003.

It was indeed a very proud and momentous day for NGC when the first shipment of pipe – 657 pieces weighing 6,627,238 kgs – arrived at the La Brea/Brighton port on the 'MV Marissa Green' from Germany on 15 September 2003. It is warmly recalled that two members of the shareholder companies observing the unloading of the pipe exclaimed that they never believed the pipe would arrive for the project.

This was the first major hurdle crossed. NGC had demonstrated that it was capable of managing this project and gaining the confidence of Atlantic LNG shareholders. For then Chairman of LABIDCO, Clarence Mitchell, it was a significant day as it represented the first major commercial activity for the expanded port and estate after the struggle for recognition as an industrial port and estate.

Selection of the Construction Company

The third major task was the selection of a construction company. The project anticipated pipeline construction taking place over two years, with the recognition that Trinidad's rainy season could severely affect the heavy earth-moving, trenching, welding and backfilling construction activity. On 22 April 2003, tenders were invited from six international pipeline contractors. Bids received ranged from US\$65 to US\$109 million.

The tenders were evaluated by a team of NGC personnel in conjunction with NGC's Engineering and Project Management consultants – Kellogg Pan American Corporation. The evaluation process involved analysis of commercial, technical and contractual terms and conditions. In addition, there was a consideration of local content, training and community relations proposals.

The Board selected Bechtel International Inc., with the sum of US\$69,318,585, as the preferred supplier at a special meeting on 15 August 2003. Bechtel had promised US\$30 million in local content and identified API Pipeline Construction Company as the main local sub-contractor.



This contract had terms that were unusual for the industry as it allowed for adjustment in contract price if there was an increase in the minimum wage of construction workers in the energy sector. As a state enterprise, there was a requirement for understudy for expatriate employees in this project. NGC also had the right to audit for monitoring wages, training, local content and community relations.

Construction of Pipeline

Construction commenced on 5 January 2004 with clearing and grading of the ROW.

One of the first issues in the construction phase was the logistics of getting 6,500 lengths of 56" pipe, fittings and other construction materials to the ROW in a timely manner. There were laydown yards in Siparia, Monkey Town and Rochard Douglas in addition to La Brea and Beachfield. The pipes varied in weight from 7.5 to 10.2 tonnes each, depending on wall thickness. The trucks could only carry up to two pipes per truckload, bearing in mind the weight-bearing capacity of bridges and the rural roads. Also, because of truck size and the number of truckloads – about 500 per month – there were concerns about road congestion, noise and dust which would cause inconvenience to other road users and the community.

As a result, the Department of Highways helped coordinate traffic. The movement of pipe was spread over 17 months, from November 2003 to March 2005, in a total of 8,900 truckloads. Construction commenced on 5 January 2004 with clearing and grading of the ROW.

The first of the three horizontal directional drills commenced on 19 January 2004 at Guapo River and was completed in June 2004. The technical challenges in the HDD included maintenance of hole stability; avoidance of kinking of the pipeline; and getting the pipeline in neutral buoyancy. The latter meant ensuring the pipeline did not drag on the bottom or float to the top, causing damage to the pipeline coating or causing the pipeline to get stuck in the hole, which would have led to abandonment of the HDD. The success of the three HDDs is noteworthy especially with this large diameter pipe, given the industry experience that one in three HDDs has to be abandoned.

With 6,500 joints, it was projected that welding could be completed on the long spreads during the first dry season. While the preferred method to join the pipes was automatic welding, it was recognised that there must be significant local content in this project. However, there had to be a balance between manual welding which would require two man-days of welding per joint and

automatic welding which would require two to three hours per joint. Peak employment was projected to be 450 persons during the first dry season and about 225 in the second dry season. Instead, recruitment reached some 665 personnel during the first quarter of 2004 and up 1,150 in 2005.

The first dry season was unseasonably wet. The first major work stoppages occurred on 20 February 2004, when striking workers from the Train 4 construction site forced the closure of construction work on the pipeline. This strike continued for 11 weeks, causing major disruption in the completion schedule. It was eventually settled through the intervention of Minister Lenny Saith who got the parties together and hammered out an increased wage solution by 6 May 2004. Bechtel increased hourly wages, introduced attendance allowances, overtime premiums and safety incentive bonuses. At the end of May 2004, the projected completion milestone of 67.6% was not reached – actual progress was only 22.3%.

To get back on schedule, Bechtel requested US\$57 million to meet the original target completion date otherwise they projected completion by the dry season of 2006, with the increased cost of US\$50 million. NGC considered many options, including termination of the Bechtel contract and holding discussions with another supplier to complete the project. In addition, NGC sought the assistance of a claims consultant to examine and advise on Bechtel claims.

In July 2004, NGC claimed force majeure and held negotiations with the pipeline shippers, seeking a financial contribution to offset the Bechtel claim. Initially, the shippers offered one-third of the Bechtel claim with a cap of US\$10 million. After negotiation, Bechtel reduced their claim to US\$35 million. In August, the LNG shippers agreed to finance US\$15 million by increasing Bechtel's completion bonus per mscf produced from the early completion date to the projected date had the acceleration not been implemented.

As part of the acceleration programme, Bechtel agreed to add a second spread at the start of the 2005 dry season.

Also, the work week was extended to include Sundays and night-time work where safe and productive was also added to increase productivity.

In the design of the construction work through the swampy areas in Oropouche, Bechtel had bid on the basis of using screwed anchor and concrete coating for buoyancy control to prevent the 56" pipe from 'floating' up to the surface in the rainy season. However, the production rate of drilling the anchors and placing concrete collars around the pipeline was very slow, and it would have taken months to lay the pipeline through the swamp. NGC considered the alternate solution of using 'Sak-weights', essentially polyethylene bags filled with heavy iron ore fines placed as a saddle on the pipelines to weigh them down. NGC agreed to implement this simple and speedy solution for laying the line through the swamp to accelerate project completion.

At the end of October 2004, actual progress was still slow at 36.5%, compared to the projected completion of 71.3%.

At the beginning of 2005, the second spread was mobilised with equipment as well as foreign welders.



By April 2005, there were revised projections of the available-for-service date, with the optimistic forecast of September 2005 but a more realistic projection of mid-December 2005 based on the rate of progress.

In November 2005, the pipeline was cleaned and gauged and the final golden weld was completed on 17 November 2005. After pressure testing and dewatering, the pipeline was filled with nitrogen on November 23, followed by first gas fill of 207 mmscf at 750 psi on 25 November 2005. The pipeline was ready for service on 1 December 2005. On 17 January 2006 the pipeline was certified for service by Det Norske Veritas, meeting the requirement of the Ministry of Energy.



Public Relations Activities

Following the decision to build this pipeline, NGC developed an extensive Public Relations programme to ensure that there was public support for this major infrastructure project. Presentations were made to the Standing Committee of Energy, the South, Trinidad and Point Fortin Chambers of Commerce, as well as the Permanent Secretaries of various Ministries to sensitise them about the project in terms of safety and environmental concerns, job creation, procurement opportunities for suppliers, challenges during construction and economic benefits to the nation. Consultation meetings were held with residents of various villages that would have been affected by the construction activities in terms of damage to roads from heavily loaded trucks, road closures and general construction activities. The pipeline route design anticipated 57 road crossings. The contractor used 38 open cut trenches across the road while the remaining 19 crossings were made using simple boring under the road. At the end of the project in 2006, NGC resurfaced roads that were affected by the project, sporting facilities were improved or newly built for some villages, and physical improvements were made to some schools. Enhanced community relations were developed so that in the event of any incident relating to the pipeline, the communities would advise NGC for corrective actions to be taken. The Company allocated \$500,000 to provide educational grants to a maximum of three students per pipeline community over the period 2005 to 2010.

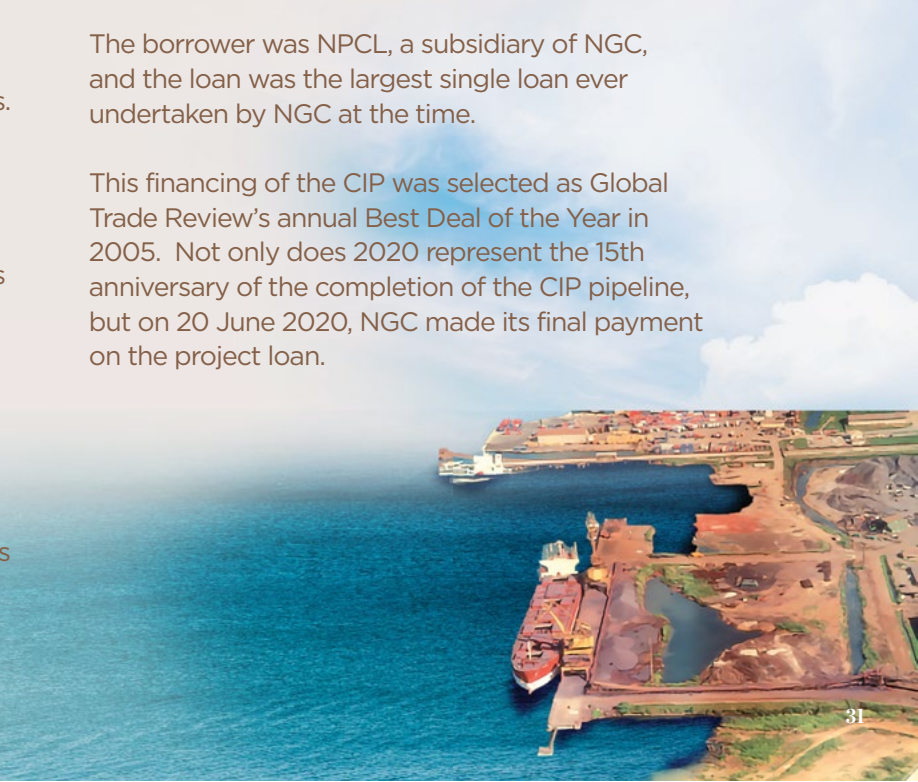
Financing Plan

Faced with owning, constructing and operating a pipeline with an estimated cost of US\$260 million, NGC obtained the services of a financial adviser on a competitive tender.

The CIP was the first pipeline project financed in Trinidad and Tobago. It was a groundbreaking deal for all previous pipelines had been financed by loans guaranteed by revenues from NGC's gas sales contracts. Atlantic LNG had been extremely successful in the previous five years and this pipeline project was seen as critical to the operations of Atlantic's Train 4.

The borrower was NPCL, a subsidiary of NGC, and the loan was the largest single loan ever undertaken by NGC at the time.

This financing of the CIP was selected as Global Trade Review's annual Best Deal of the Year in 2005. Not only does 2020 represent the 15th anniversary of the completion of the CIP pipeline, but on 20 June 2020, NGC made its final payment on the project loan.



Conclusion

The 76.5 km 56" diameter Cross-Island Pipeline was successfully completed and available for use by the Atlantic LNG Train 4 before the plant was ready for natural gas. This project was a monumental task to be completed in time for the LNG plant, financed at a very competitive international rate and within budget. The final project cost was US\$260 million. NGC was able to overcome the scepticism that the project could be completed ahead of the Atlantic LNG Train 4. In reality, the gas supply to undertake the performance test was not available until March 2006. NGC was able to demonstrate world-class capability to own, build and operate major natural gas pipelines. This project earned NGC respect as a global natural gas pipeline company.

Frank Look Kin
17th September 2020



Personal Note

I am grateful for the invitation to prepare this paper on the Cross-Island Pipeline to mark the 15th Anniversary of the completion of NGC's largest and most expensive (at the time) pipeline infrastructure. In the preparation of this paper, I went through hundreds of documents from the project files that I had kept and consulted with Project Manager - Clarence Harnanan to recall some of the details and critical decisions of this three-year project which had started 18 years ago. There were occasions when I had to use monthly reports of Atlantic LNG Train 4 to reconstruct what had occurred on the pipeline project since there was monthly reporting on the pipeline to the Atlantic shareholders. Finally, I was able to access the Minutes of Board meetings which helped confirm the facts on this project.

The research and personal recollections of the Cross Pipeline Project have made me appreciate

and recognise that this project was the most successful ever undertaken by NGC during my tenure as President. My sincere thanks and gratitude must go to Clarence Harnanan, the NGC Project Manager, and to then Chairman of the Board, the late Keith Awong. Clarence was able to manage the Project team headed by Ian Cansfield without unnecessary conflicts and delays which could have occurred with an international project team and with the shareholders from the Atlantic LNG Train 4 team. The Chairman of the Board facilitated timely and speedy decision-making when crucial high-value decisions had to be taken. The entire group of NGC staff from Legal, Finance, Technical Operations, Commercial, Safety and Security and Corporate Communications functioned as a dedicated team to complete this project within cost and schedule. It was a great team effort.

**LABIDCO LAYDOWN YARD
DURING CIP CONSTRUCTION**

