



Implementation of a Gas Management System

for the 56 in. [76.5 kilometer]
Cross Island Pipeline (CIP)

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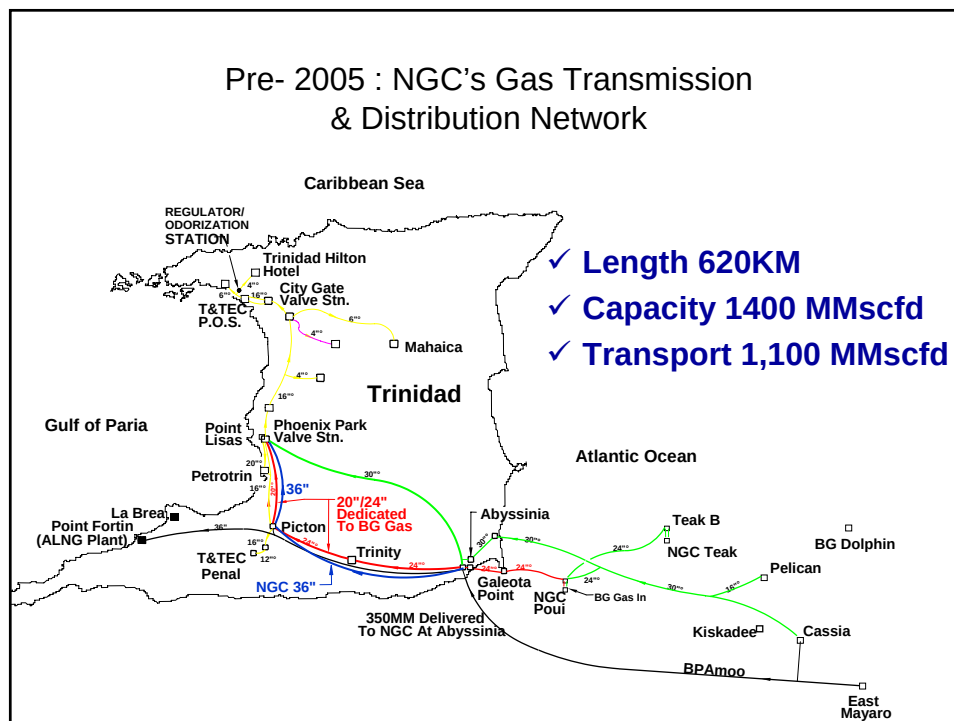
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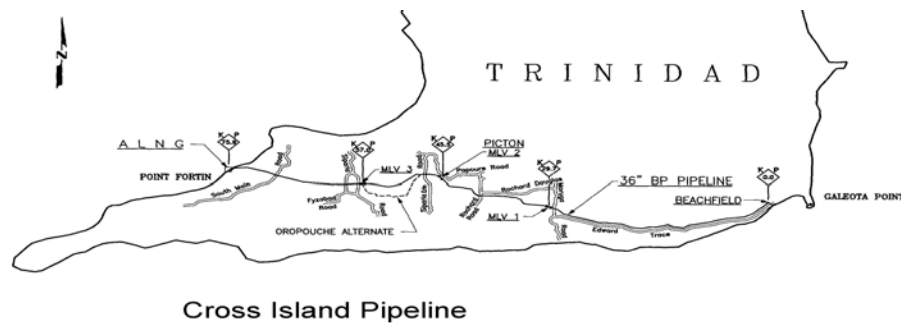
NGC Existing Pipeline Network excl CIP

- Since 1977 NGC owned and operated cross-country gas pipelines of max 30in. diameter
- Essentially transported its own gas
 - purchased from producers offshore Trinidad's east coast
 - compressed on its offshore compression platforms
- Sold after processing at PPGPL to :
 - major customers on the island's western located industrial estate
 - multiple small commercial customers spanning the western population centre



CIP - Key Facts

- ➔ The 56in cross island gas pipeline (CIP) began operations in December 2005
- ➔ largest of its kind in western hemisphere
- ➔ extends from Beachfield in Guayaguayare to the LNG Facilities in Pt Fortin - approx 76km
- ➔ Initial capacity of 2.4 BCFD
- ➔ Max operating pressure of 1050 psig



CIP - Key Facts

Pipeline built and funded by NGC to:

- Transport gas to the Atlantic LNG plant at Pt Fortin, primarily on behalf of ALNG train 4 shareholders, under firm capacity contracts
- Supply gas as pre-agreed, to other LNG trains (mainly T2 & 3) subject to pipeline operational constraints, under interruptible contracts
- Supply gas for its own needs e.g. at Union Estate, at Picton link
- Tariff fee and reimbursable cost mechanism for this service

New NGC Transporter Responsibility

- Taking custody, without ownership transfer, of gas belonging to various entities
- Transporting gas streams and having to redeliver at the end of the line
- With the expected differences in each entity's gas quality and the inherent commingling that would occur during the transportation, there is
- Obligation to account for virtually every molecule of each customer's gas and condensate, accurately, fairly, timely and in a transparent manner

Transporter Services

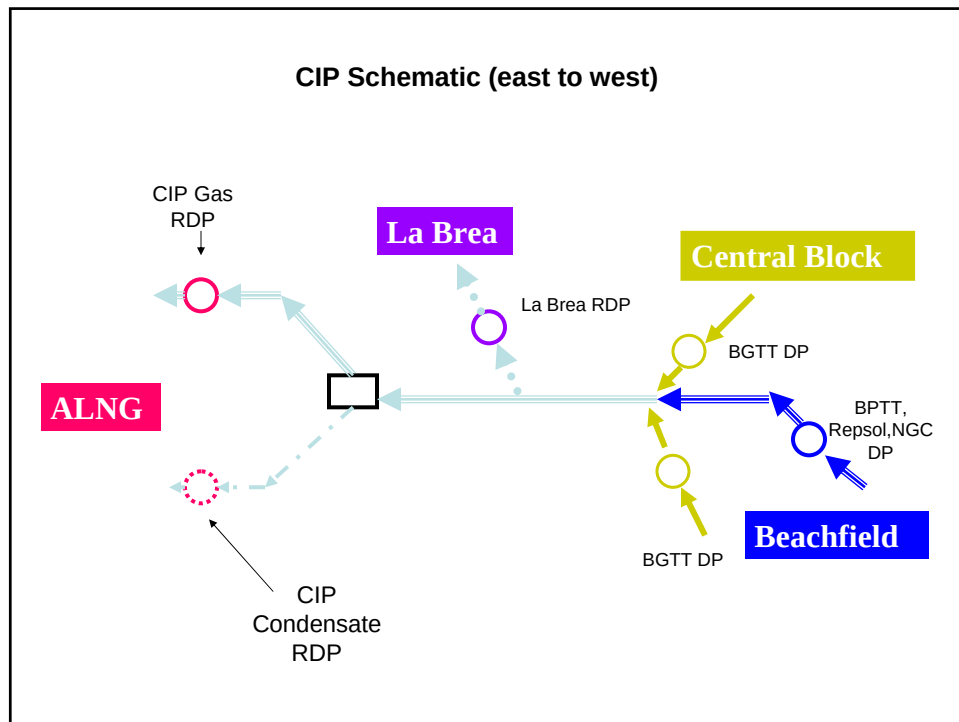
- Different **quality** gas put in by each party
→ Commingled gas [uniform quality] stream will be redelivered from the pipeline
- **Quantity** of gas put in by each party will decrease in relation to gas redelivered due to:
→ Condensate drop out; Line leakage/ losses; Retention within the line pack
- **Actual gas input and redelivered gas** will always differ from what was pre-scheduled / planned / confirmed before actual gas flow
→ Need for transparent, equitable **hydrocarbon accounting system** - Equitable **allocation** of flow and components
→ **Major commercial function of Gas Mgmt Sys**

Other Transporter Responsibilities

- Smooth, efficient, uninterrupted **operations and maintenance** of physical facilities
- Reliable consistent **measurement**
- Secure, timely and accurate **information flow** and communications
- Really a **Gas Transportation Activity** as well as a **Service** to customers /shippers including:
 - delivery requirement calculation
 - allocation services
 - imbalance accounts maintenance
 - invoicing
 - policing the line / behaviour of customers to ensure conformance with rules

Complications

- Custody transfer points
 - At the delivery points (3), the upstream metering facilities are not owned by the Transporter, but rather the Shippers/ DPO's
 - At the redelivery point at Pt Fortin, the slug catcher as well as gas and liquids metering facilities, although owned by Transporter are actually operated by ALNG - the only current offtaker



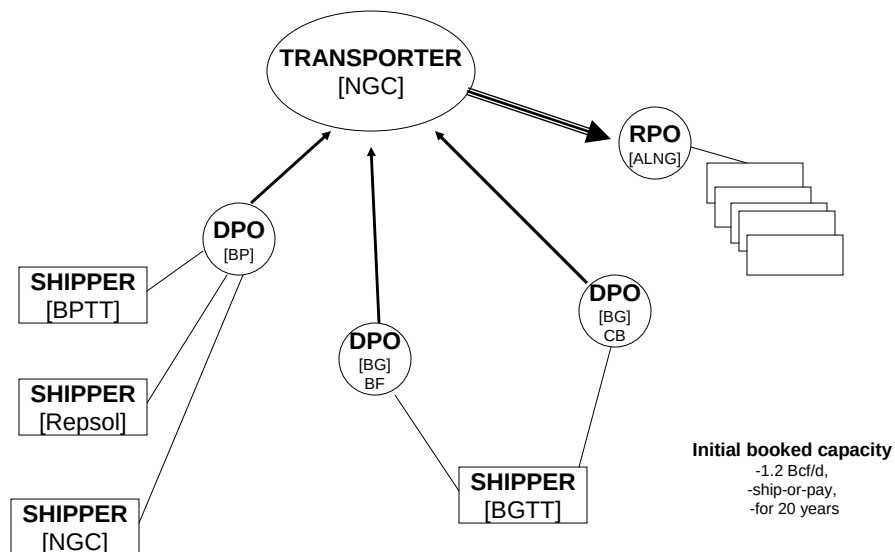
Resultant Operational Issues

- Measurement Issues at delivery points
- Withdrawal (drafting) or line storage (packing) issues at redelivery point (ALNG)
- Transporter Control issues at all entry and exit points (monitoring & enforcement)
 - ➔ Realtime direct access to suppliers' metering facilities
 - FO and microwave links with meter operators sites
 - NGC Control room physical link-up & data communication
 - Realtime access to quality and flow data at delivery points
 - Verification and audit process acceptable to all shippers

Remedies

- Appoint point contacts – Meter & meas't reps
- Must agree clear protocols for conformance, enforcement &/or penalties
- Communication – need regular meetings with all operatives
- Physical SCADA & FO links with NGC control room
- Monthly operations meetings – all DPO & RPO
- Establish lines for regular contact between PO's

GMS Key Players & Relationships



What is a Nomination ?

- **A request [to Transporter] by a shipper to transport a certain quantity of his gas between two points along the line from a DP to a RDP**
 - **It would state:**
 - quantity, quality, period / date, category of service “firm or interruptible”
 - **It must be confirmed by Transporter** on the basis of:
 - Deliverability at the DP [with the DPO]
 - Shipper’s entitlement in terms of “firm”, “interruptible”, “imbalance account”
 - Compatibility with the redelivery requirement [with the RPO]
 - Pipeline capacity and requests by other shippers

What is a Nomination ?

- **It is subsequently used as the basis for:**
 - Payment of invoices and ship or pay exposure
 - Proration of gas actually input at a common delivery point [DPO confirmation/ true-up]
 - Proration of gas & condensate actually withdrawn at a common re-delivery point [may be supplied by RPO]
 - Imbalance calculations [in the absence of “true-ups” and DPO/ RPO prorations]

Allocations

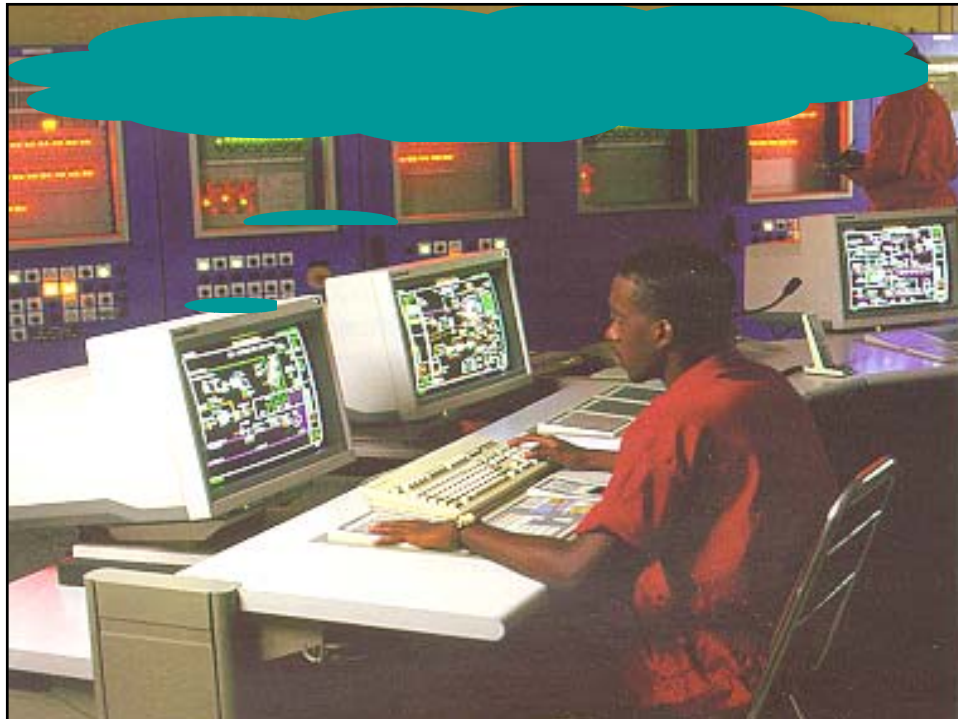
- Allocations take place after the gas flow
- Allocations are prorations of the redelivered gas or condensate bearing in mind:
 - commingling that would have taken place with other shippers' gas
 - losses or gains in the line

What are Imbalances ?

- Created because actual flow during “gas day” is different to what was scheduled
- Imbalances are the differences between the actual input [at the DP] into the line and the actual output from the line [at the RP] net of system losses
- Imbalances are computed for each shipper for each flow path by energy (ht content) and natural gas components

Effective GMS needed to assist Transporter

- Decision Support Tool
- Effectuated by an electronic {hardware & software} solution
- Enables **seamless integration** of two major aspects of the gas transportation
 - ➔ Administration of the commercial transactions
e.g. nominations, allocations, scheduling, curtailment, accounting and invoicing, etc.
 - ➔ Efficient monitoring and management of the behaviour of the physical pipeline



Two Phase Implementation

- Two phases
 - First phase done completely in-house
 - Second phase to seek the involvement of external specialists
- Preferred over external bidding process that provides a “Turn Key Solution” upfront
- Such a course of action would:
 - Ensure upfront involvement by the NGC’s personnel with such new technology
 - Ensure familiarity with the system’s needs and avoid implementing some vendor’s off-the-shelf solution
 - Avoid dependency on the provider for problem-solving and future customization
 - Avoid implementation of proprietary software solutions in “black box fashion”

Phase 1 Activities Done to date

- Semi-automated Spreadsheet model was built in-house and has served to:
 - Receive redelivery requirements from shippers
 - Compute the estimated composition of the commingled stream
 - Calculate the volumes of gas the shipper must input to meet its redelivery requirement
 - Maintain shipper daily energy imbalance accounts and track distribution of shipper components by flow paths
 - Keep account of shipper’s components for determination of compensation for loss or gain in component value

Phase 1 Implementation

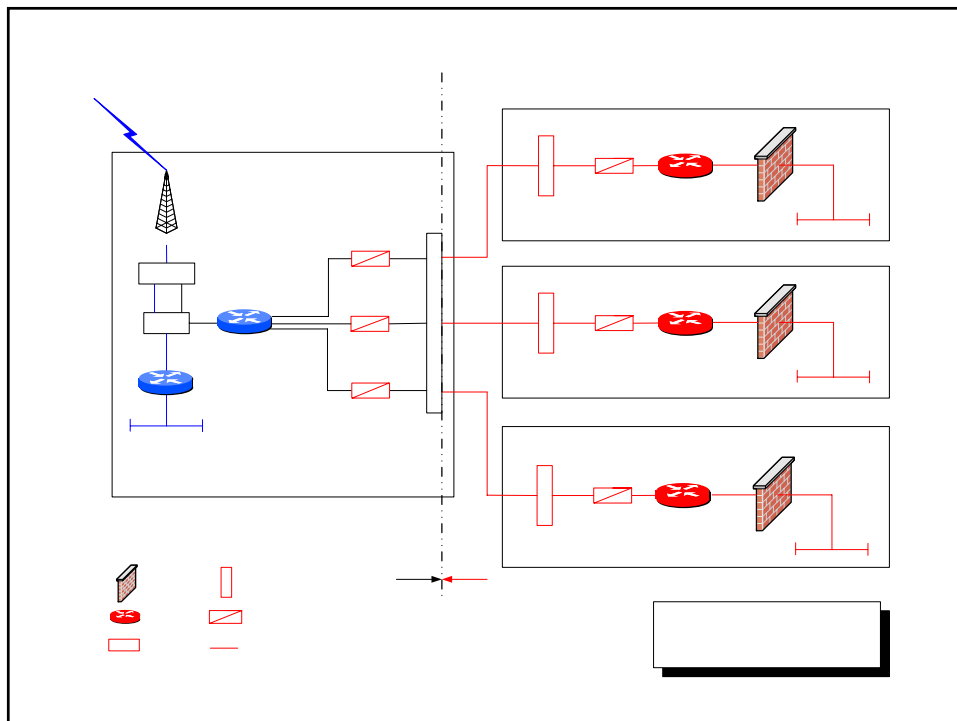
- The spreadsheet is also expected to:
 - Provide a “blueprint” specification for hiring of a suitable contractor during the Phase 2 tendering process and
 - Serve as a manual backup to the fully implemented automated system

Phase 1 Implementation Limitations

- Spreadsheet model key Limitations;
 - Interactivity in terms of input data
 - Ability to store and recall historical data
 - Logistics in settling imbalance accounts between shippers
 - Further complications as more shippers and redelivery points introduced
- Realtime access to pipeline data by GMS commercial unit

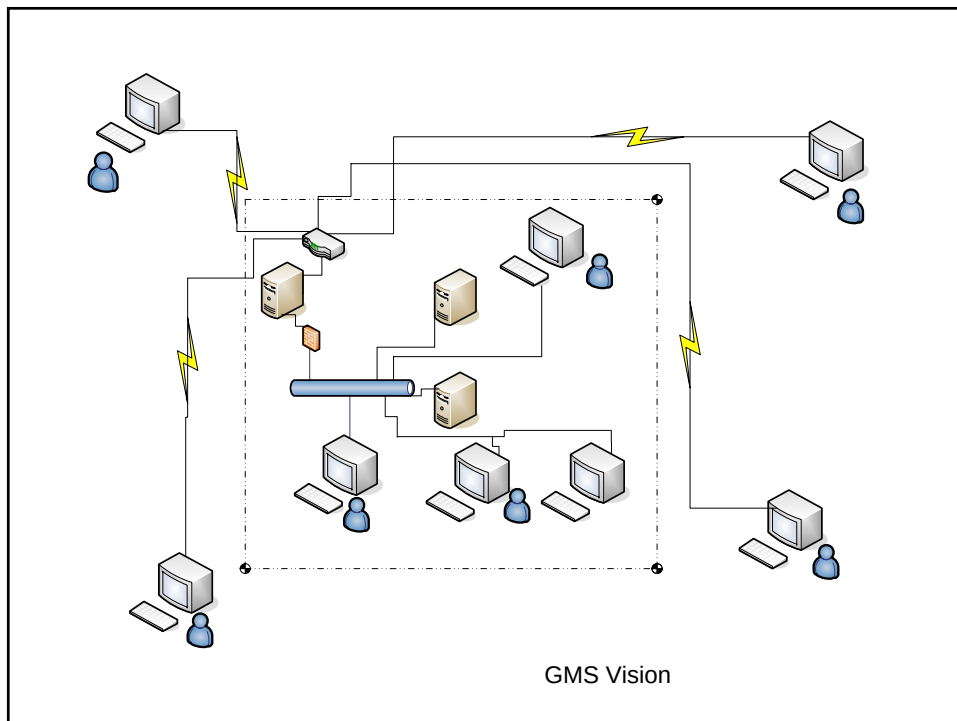
What would Phase 2 bring ?

- **Integration of applications [hardware & software solns]**
 - Linkage of commercial transaction / nomination software with pipeline operations activities
 - Interlinking, networking, multisiting [multiterminals]
- **Automation of various activities**
 - monitoring of line inventory
 - monitoring of system faults or to ensure gas flow in accordance with nominations
 - Provision of display graphics projections regarding flow, line pack, pressure profiles etc.
- **Flexibility, accuracy and speed**
 - In retro-computations, corrections, historical comparisons
 - Flexibility [switching] regarding options
 - Flexibility in reporting, output ranges and formatting



GMS in Final Form ?

- Website based Bulletin Board - secure / password protected
- Commercially sensitive data will only be available by password to those authorised on a need-to-know basis
- The CIP GMS Bulletin board will be required to interface with bulletin boards operated by Redelivery Point Meter Operators for automatic data exchange Shippers or their reps to place nominations electronically for each Flowpath
- GMS database will be updated electronically
- Automated electronic issue of reports
 - In-day progress statements/ graphs
 - End of day allocation statements and monthly allocation statements
- Provision for additional modules (e.g. pipeline simulator) in future as required



Summary & Conclusions

- An effective GMS crucial to NGC's new transporter role
- Implementation method ensures against "black box" introduction of new technology
- Two-phase implementation
 - provides training ground for all parties
 - serves as blueprint to keep second phase vendor "in line"
 - Provides manual backup system to the final product
- The transportation activity will be facilitated with an easy to use, windows and web-enabled nomination, scheduling, allocation, and invoicing system that integrates shipper nominations with pipeline and business data to schedule the movement of gas
- Provides opportunity for integrating shipper interaction, business administration, operational results, and leading edge technical applications for scheduling and optimization
- Ensures that the business needs of the pipeline and its customers are met and enhanced.

Thank You

