The Corporate Quarterly Journal of
The National Gas Company of
Trinidad and Tobago Limited

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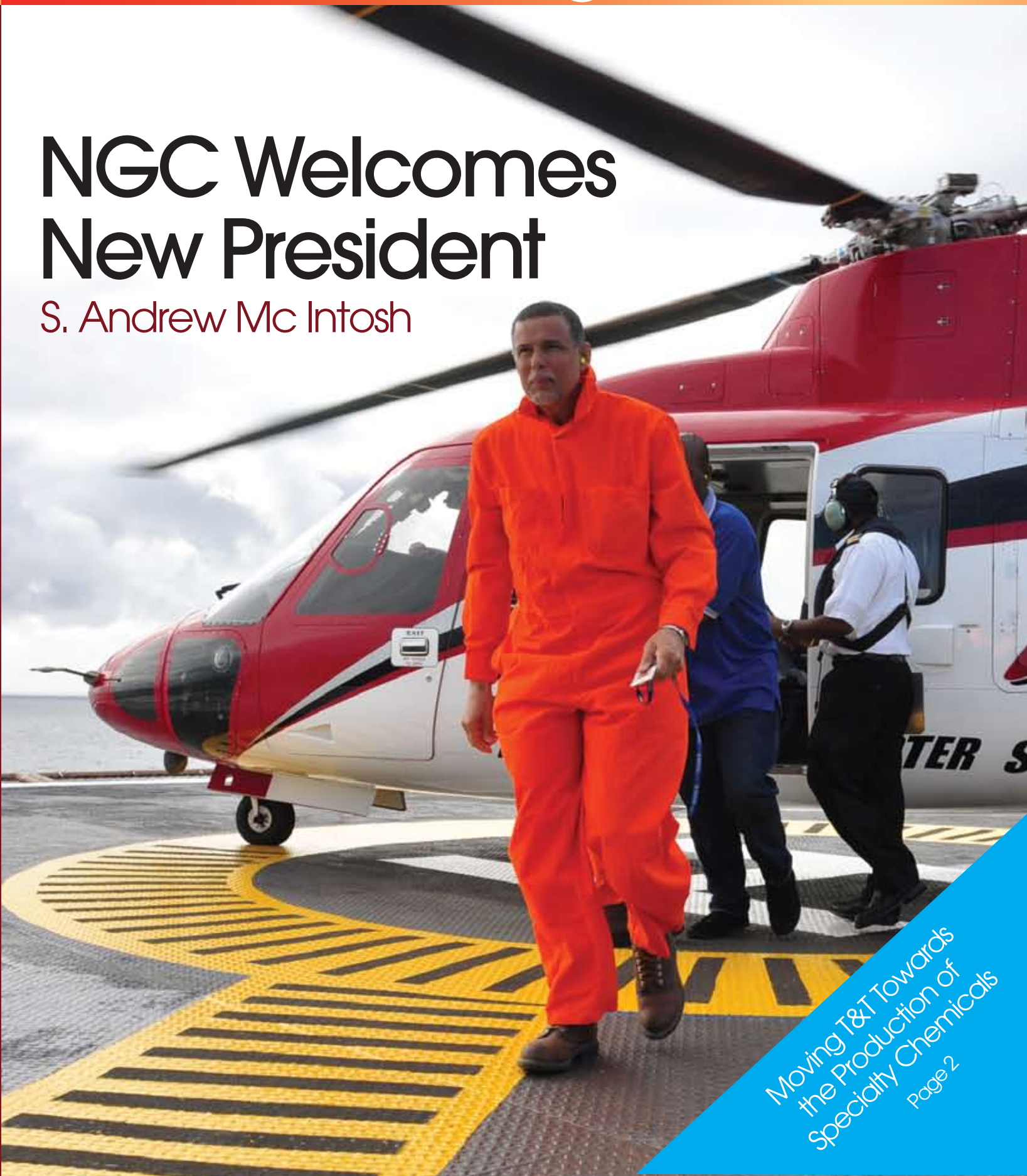
gascoNEWS

NGC Welcomes New President

S. Andrew Mc Intosh



Moving T&T Towards the Production of Specialty Chemicals
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Construction works at La Brea Dock.

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MOVING TRINIDAD AND TOBAGO TOWARDS THE PRODUCTION OF SPECIALTY CHEMICALS

Trinidad and Tobago has a well established natural gas industry that is considered a model for other gas producing countries. Trinidad and Tobago is a global leader in the export of methanol and ammonia, as well as the major LNG producer in the Western Hemisphere. In recognizing the country's maturity in the production of primary petrochemicals, the Government a few years ago advised, as a matter of policy, that all future energy projects must have derivative or downstream processing as an integral component. This would, in effect, result in the production of higher value commodities and provide a platform for the manufacture of further derivative chemicals and higher value products.

In this regard, development of the Carisal Project was approved by the Government in mid-2006. Carisal Unlimited is currently developing the first specialty chemical production facility in Trinidad and Tobago with construction of the facility due to begin in mid-2009 at the Point Lisas South and East Industrial Estate.

The estimated cost of the project is US$240 million and completion is expected in 2010. When completed,

By VERNON PALTOO, PhD
Team Leader – Business Development
National Energy Corporation

Carisal will produce the following chemicals:

- Calcium chloride 125,000 tp/y
- Sodium hydroxide (Caustic Soda) 100,000 tp/y
- Hydrochloric acid 8,000 tp/y
- Sodium hypochlorite 2,000 tp/y

Unlike traditional primary petrochemicals like methanol and ammonia, this plant will not use natural gas (a raw material), but rather as a fuel in the production process. Therefore gas usage will be relatively small in comparison to existing chemical plants. In addition, as with most specialty chemical plants, land and utility requirements will be considerably less than with primary chemicals.

Even though the plant is small in terms of resource requirements, it requires about 75 permanent employees, which is approximately the same number required by a methanol or ammonia plant.

This article will investigate the manufacturing process, as well as the markets and potential industries that can be created with the production of these specialty chemicals in Trinidad and Tobago.

Carisal Unlimited is currently developing the first specialty chemical production facility in Trinidad and Tobago with construction of the facility due to begin in mid-2009 at the Point Lisas South and East Industrial Estate

Production Process

Calcium chloride, caustic soda and hydrochloric acid will be produced via the following processes as illustrated in Figure 1:

- Electrolytic solution preparation
- Electrolysis of sodium chloride brine to produce chlorine gas, sodium hydroxide and sodium hypochlorite (Chlor-Alkali Process)
- Conversion of the chlorine to hydrochloric acid
- Reaction of hydrochloric acid with limestone to produce calcium chloride

Preparation of electrolytic solution

Brine as input material for the process will be received from the DESALCOTT desalination plant at Point Lisas or made with imported bulk salt. The brine will be fed to a triple effect evaporator, which will be heated by low pressure steam or hot oil, whichever is more economical. Purified sodium chloride is produced off

the bottom of the third stage and the vapour is condensed to produce distilled water. The purified salt will be diluted to form a 24% salt solution for feed to the electrolysis process.

Electrolysis System (membrane cells)

The basic reaction in the Chlor-Alkali process is as follows:

$$2NaCl + 2H_2O \rightarrow 2NaOH + H_2 + Cl_2$$

Brine is fed to the anolyte compartment of the cell, and water is fed through diluted caustic soda to the catholyte compartment. When direct current (DC) is applied to the cell, the ion selective membrane passes mainly positive sodium ions from the brine to the catholyte compartment. The chloride ions from the brine are oxidized to chlorine gas at the anode, while hydrogen and hydroxide ions are formed at the cathode. The membrane is highly efficient in separating the chlorine and the chloride from the hydrogen and caustic soda produced. A significant property of the membrane is the current efficiency (the higher the current efficiency, the lower the hydroxide leakage through the membrane). Hydroxide passing through the membrane into the anolyte compartment leads to the formation of oxygen and hypochlorite. The most efficient membranes offer a current efficiency of approximately 96% when producing 31-35% caustic soda. The process is illustrated in Figure 2.

The chlorine and hydrogen produced in the electrochemical membrane process leave the cells at a pressure slightly higher than atmospheric pressure. After cooling in heat exchangers, the gases will be compressed and fed to the hydrochloric acid production unit. The caustic will be concentrated up to 50% (normal trade quality) in a caustic evaporation system,

Figure 1: The Manufacturing Process *(Source: Carisal)*

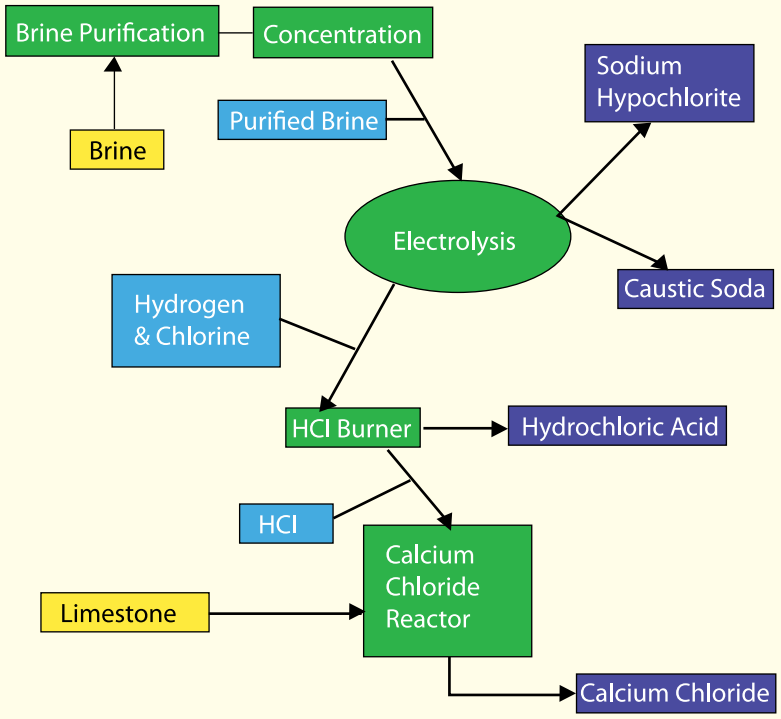
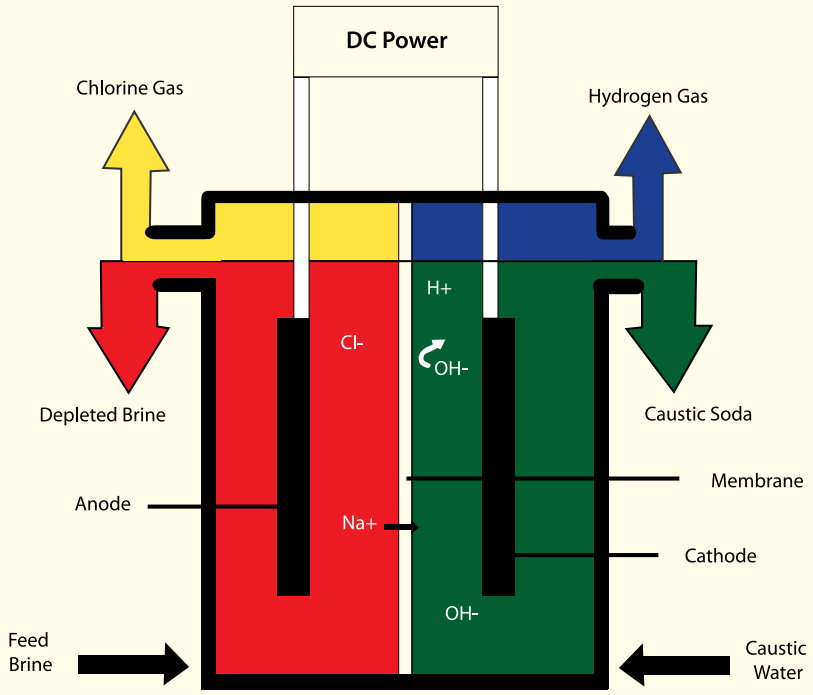


Figure 2: The Electrolysis Process *(Source: Carisal)*



which typically could be a single- or double-effect falling film evaporator.

The Chlor-Alkali membrane technology is in wide use internationally. The leading providers are UDHE, Aker Kvaerner and Ionics.

Hydrochloric Acid Synthesis

Hydrochloric Acid (HCl) will be produced from the H2 and Cl2 gases in a hydrochloric acid synthesis unit. The HCl synthesis reactor includes a burner tube assembly, a combustion chamber, a hydrochloric acid absorber and a tailgas scrubber. Hydrogen gas is supplied from the main hydrogen header from the electrolysis system and chlorine gas from the main chlorine header. H2 and Cl2 gases enter the combustion chamber and react according to the following highly exothermic reaction to produce hydrogen chloride gas.

$$H_2 + Cl_2 \rightarrow 2HCl$$

Cooling water will be used to remove the reaction heat.

Hydrochloric acid is produced by absorbing HCl gas in process water. The water is introduced in the top of the tailgas scrubber and flows countercurrent to the HCl gas through the absorber down to the HCl pump tank. From the HCl pump tank the 32-35% hydrochloric acid is pumped to the HCl storage tanks. HCl technology providers include Ionics, Aker Kvaerner and UDHE.

Calcium Chloride Production (Limestone Acidic Digestion)

Chemical Reactions:

There are two basic reactions in digesting limestone with hydrochloric acid.

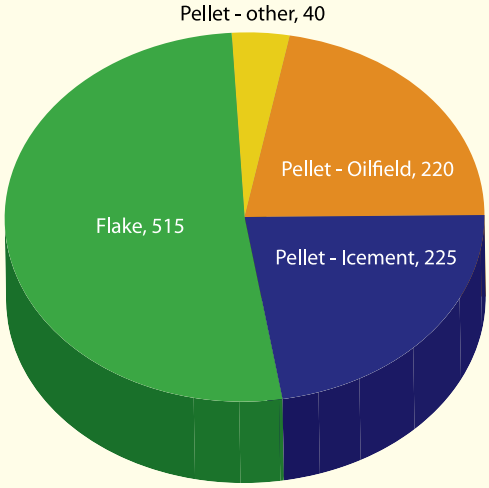
$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$
$$MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2O + CO_2$$

There are two post-digestion reactions associated with $CaCl^2$ recovery processes.

$$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + H_2O$$
$$Ca(OH)_2 + MgCl_2 \rightarrow CaCl_2 + Mg(OH)_2$$

Process limestone, CaCO3, is to be received in bulk from either local Trinidad quarries or imported. The limestone is fed to the digestion reactor where it is contacted with hydrochloric acid to produce a solution of calcium chloride in water (approximately 50%). The solution is fed to an evaporator and concentrated to 77%. A portion of the 77% solution can be packaged for shipment (to supply specific uses in the oil services market) while the balance is fed to a fluid bed drier for drying to 94% (dehydrate). This product will be shipped in pellet and flake form depending on customer requirements.

Figure 3: Demand for Calcium Chloride ('000 tonnes) *(Source: Carisal)*



Calcium Chloride

Dry calcium chloride can be produced in pellets or flakes which makes it convenient for shipping. Carisal intends to use the calcium chloride produced from this plant at one of its facilities in the United States to produce ice melt which is used to de-ice roads in winter. Ice melt is made by combining calcium chloride with rock salt.

Even though this is the primary intended application for the product, calcium chloride has numerous other applications. The other major application is in the use of oil drilling operations as high density brine fluid. Calcium chloride pellets are converted into a liquid near the oil drilling site and it is injected into wells as a heavy liquid. The solution pushes the remaining oil out of the wells during the completion process. When added to oil well brines, calcium chloride also helps to stabilize clays found in the formation. The product stabilizes the surrounding geologic matrix, binding clay layers and maintaining borehole integrity.

Calcium chloride is a very versatile product. There are over 40 other applications for calcium chloride including manufacture of concrete accelerator, soil stabilizer, food additive, industrial applications, and a freeze-proof additive for mining ore products.

The total dry calcium chloride market is over 1,000,000 tonnes, and is segmented into the different products as illustrated in Figure 3.

Expected average annual growth rate in demand for the period 2006 to 2011 is in the region of 2.8 to 3.3% for the dry

form and 1.4 to 2.3% for the liquid form. The average historical and projected price of calcium chloride is illustrated in Figure 4. These trends indicate that the market of calcium chloride is expected to be stable in the short-to medium-term.

Caustic Soda

There are three types of commodity caustic soda based on the method of production. Carisal will be producing the membrane grade, which is the highest grade of the material.

Caustic soda is a versatile alkali that has major uses in the production of chemicals, pulp and paper, alumina, soap and detergents, and cellulosic materials. Other applications include water treatment, food, textile and metal processing, mining and glass-making.

The market for caustic soda is currently about 46 million tonnes, and is segmented in the applications shown on Figure 5. New supplies are focused in the Middle East and China. China continues to expand its vinyls industry, which will generate surplus caustic soda. It is estimated that China will increase its exports of caustic soda to 1.4MMtpy by 2011 up from nearly 1MMtpy in 2006.

Hydrochloric Acid

Hydrochloric acid (HCl) is a very useful chemical and its major applications include derivative chemical production, food processing, brine treatment, and steel pickling. The market shares for these applications are illustrated in Figure 6. This excludes HCl used by EDC (ethylene dichloride) producers. The

Figure 4: Projected Average Price Forecast for Calcium Chloride *(Source: Carisal)*

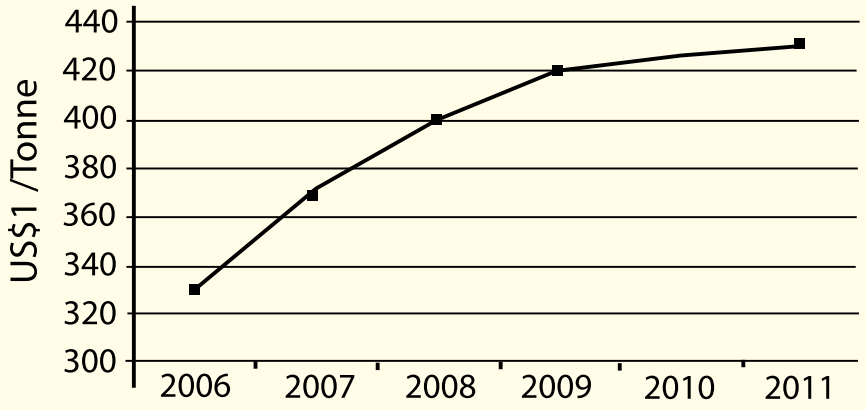
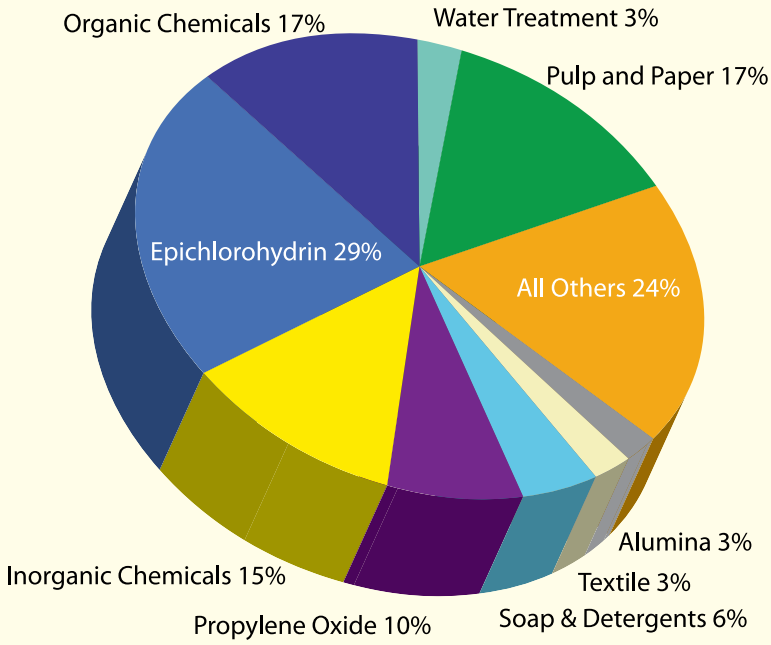


Figure 5: Caustic Soda Market *(Source: Carisal)*



Caustic Soda is a versatile alkali that has major uses in the production of chemicals, pulp and paper, alumina, soap and detergents, and cellulosic materials. Other applications include water treatment, food, textile and metal processing, mining and glass-making

HCl market transformed itself during the 1990s from seasonal shifts between oversupply and balance, to shifts between balance and very tight supply.

In the past, isocyanate producers combined anhydrous HCl with water to produce wet acid for the merchant market. Now, more isocyanate manufacturers are directing their anhydrous hydrochloric acid to EDC

producers. The captive demand is growing faster than that of the merchant market. The market for HCl in 2008 was approximately 3.7 million tonnes up from 2.8 million tonnes in 2003. Historical growth rates have been in the region of 5% per annum, while future projected growth rates have been forecasted to be lower at about 2.5% per annum.

Sodium Hypochlorite

Sodium hypochlorite (NaOCl) is used primarily in the production of bleach for household and industrial use. The market for household applications is dominated by laundry bleach as shown in Figure 7, while the market for industrial applications has major outlets in water treatment and swimming pools as illustrated in Figure 8.

The household solution market is a steady but slow-growth sector, generally in line with population growth. Major applications include laundry bleaching and surface sanitizing, but a variety of household cleaning products contain sodium hypochlorite including dishwashing detergents, drain openers, and mildew stain removers. Future annual growth is estimated at 1.2%. Demand for household NaOCl (5.25% concentration) is expected to be 580 million gallons in 2009 up from 553 million gallons in 2005.

Water treatment, which is the largest sector for sodium hypochlorite in the industrial market, is also the fastest-growing sector at about 5% annually. Beginning in 1999, the EPA required major chlorine users to have emergency response plans, which highlighted the downside to handling chlorine. Hence, sodium hypochlorite is favoured over chlorine for potable water, wastewater and cooling water treatments where safety is a concern, particularly operations situated within or near concentrated populated areas. Other consuming segments for industrial-strength hypochlorite are stable, zero

Figure 6: Markets for Hydrochloric Acid *(Source: ICIS)*

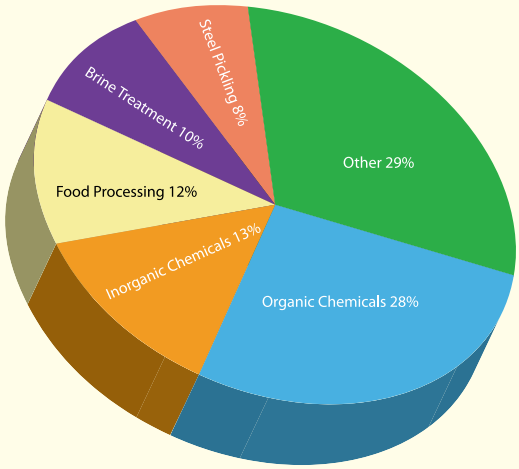


Figure 7: Markets for Household Sodium Hypochlorite *(Source: ICIS)*

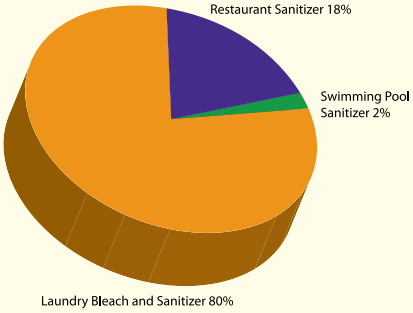
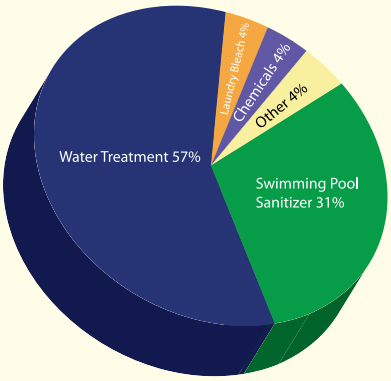


Figure 8: Markets for Industrial Sodium Hypochlorite *(Source: ICIS)*



to low growth markets. Consequently, future growth is forecast at 2.5% annually. Demand for industrial NaOCl (12.5% concentration) is expected to be 340 million gallons in 2009 up from 310 million gallons in 2005.

Conclusion

Carisal is embarking on an ambitious project to produce commodities that are non-traditional for this country. It represents significant diversification within the chemical industry and could serve as a platform for the development of spin-off industries including water treatment and oil wells servicing. Furthermore the project has minimal demands on resources and infrastructure. Consequently every effort should be made to encourage and continue development of industries such as these where specialty chemicals are to be produced in Trinidad and Tobago.

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THE HERO'S QUEST... NGC'S LEADERSHIP DEVELOPMENT PROGRAMME – THE JOURNEY

By VALARIE WALTERS

Programme Team Lead
Leadership Development Programme

With leadership and capable employees, NGC is today one of the State's jewel organizations. NGC has demonstrated solid financial performance and contributes more than 4.3% of total National GDP and controls the distribution and transmission of natural gas in Trinidad and Tobago.
The Company's financial statements have shown solid growth in its asset base and sales over the years, particularly over the last five years. With rapid growth of its asset base and staff levels which increased from approximately 500 employees in 2000 to 800 in 2008, one question arose – was the organization sufficiently robust to effectively manage this growth?

NGC has had a long tradition of developing its people, inclusive of their leadership capability. As part of its corporate priority, senior leaders and those who demonstrated leadership potential were sent on various management training programmes to develop their managerial and leadership capabilities. While there were many benefits from this approach, the transfer of experience, knowledge and skills was typically isolated, with very little diffusion and visible impact across the organization.

While some may call it visionary, most will agree that former President and programme sponsor, Frank Look Kin, in his awareness of the nature of the energy industry, recognized the immediate need for the Company to become more efficient. Despite efforts, NGC was facing an immediate succession issue as several senior leaders were approaching retirement age. There were leadership gaps affecting its performance and inadequate communication that resulted in teams operating in silos. Further, leaders were not always holding their people accountable for performance.

NGC was attracted to the consultant, Evolve Partners, and its philosophy and style of combining lectures and hands-on training. With stories of their success at other energy companies, NGC decided that Evolve could effectively engage its top management team in a year-long programme and effect changes that would be experienced by a wider section of the company. In so doing, NGC could ensure a more rapid diffusion of knowledge across the company.
To address the immediate leadership succession issues facing the company, the Programme focused on Leadership and Management Development.

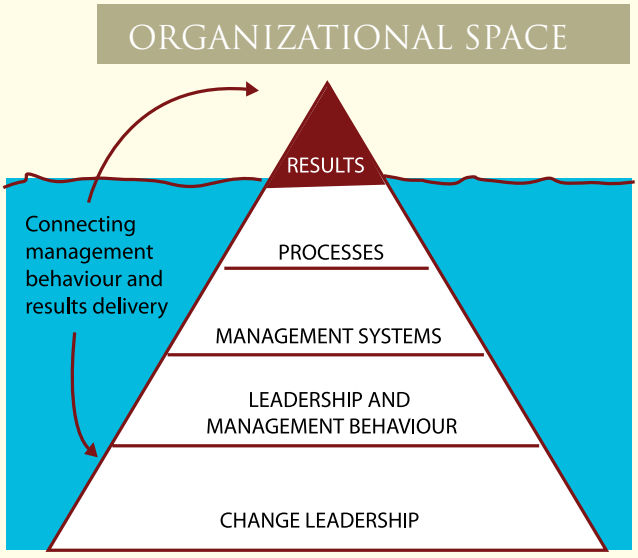
Evolve, in collaboration with NGC's Executive Management Team, set a 2010 Vision of: ***People Excellence, Commercial Excellence, Operational Excellence and Diversification for the Organization.***

A six-member internal consultancy team was selected and trained to work full time with Evolve to complete a diagnostics of NGC to determine its readiness to realize this vision.

Working across the Organizational Space Model, the diagnostics revealed deficiencies along all levels of the Pyramid: Processes, Management Systems, Leadership & Management Behaviour and Change Leadership. However, the Company needs to further expand its management systems proportionately to efficiently manage its business.

The initiation

The Leadership Development Programme (LDP) introduced a new



approach to manage and measure performance. It exposed the Top 12 Leaders to new skills and assisted in minimizing the Company's risk exposure by establishing a structured management system.

How emotionally connected were the Top 12 Leaders to the process of developing a system that would help them focus on results in a structured way? As in all change programmes, the process of new learning was at first difficult because it meant leaving behind the old way of doing things.

Another significant hurdle was the time-intensive nature of the programme and the fact that it was all about learning by doing. It became a challenge for the Company to balance the demands of running a business, as well as devoting quality time to the demands of the programme. According to the Programme Champion, Maria Thorne, "We did not realize the demands it would make on you … leaders lived out the demands and requirements of the programme every day on the job."

In order to resolve resistance, Evolve and NGC's Leadership Development Team institutionalized a behavioural and systemic modification system called a System Installation Schedule (SIS). The purpose of this system was to measure how well the teams were embracing the new way of working so at the end of the programme it would be sustained. At different stages of the Delivery Phase, teams were expected to be at a SIS Score of 3 "Compliance" and SIS Score of 4 "Understanding."

Many lingered in the zone of Compliance SIS=3, revealing data (KPIs, Outcome Maps, Action logs) on planned versus actual performance with little problem-solving or actions to address variances and to meet targets.

Another significant hurdle was the time-intensive nature of the programme and the fact that it was all about learning by doing. It became a challenge for the Company to balance the demands of running a business, as well as devoting quality time to the demands of the programme

Leaders chaired their meetings, without challenging each other, or diving into the data to drive performance and move results.

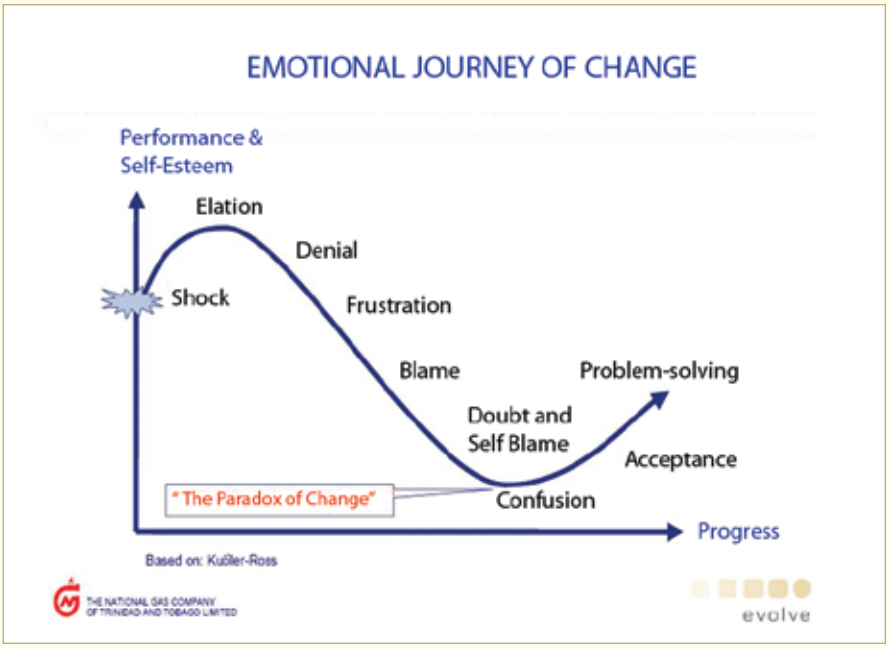
The programme was structured with well-timed experiential leadership events aimed at assisting the Top 12 Leaders understand their range of emotions along the journey of change. The Internal Programme Team supporting the Top 12 Leaders participated in events that resulted in them experiencing these emotions ahead of the leaders, and able therefore to better help them on their emotional journey of change.

Further, sessions such as the Nail Game challenged the 40 most senior leaders of NGC to pool their collective wisdom to think out of the box to find the solution. One leader reflected that it opened his mind to possibilities. *The Problem Solving and Mid-Term Review* (a.k.a.Yoshido Motors) workshop revealed to these leaders the significant difference they could make to their results if they worked as a team using their expertise appropriately.

While all these interventions played a part, only when NGC's Top 12 Leaders experienced the difference at a personal level did breakthrough begin.

Additionally, the Top 12 Leaders who

received direct coaching from Evolve focused on improving their business results. They were introduced to different techniques and ways of leading and were also required to make specific commitments. Feedback on these commitments were obtained mainly from their direct reports and peers and reviewed at monthly Leadership Check-In Sessions. Describing her experience of these Check-Ins, the programme champion, Maria Thorne, reflected: "By the second Check-Ins we started seeing the change … the feedback from supervisors … nothing is stronger than when you actually see people who report to you and your peers giving you good feedback and telling you that they are seeing a difference… that alone will give you the confidence to want to do better.



The return

On December 9th 2008 at a Sustainability Workshop, the Top 12 Leaders reflected on their journey during 2008 LDP. While they agreed that the journey was a challenging one, they recognized the benefits of having systems and structures in place to measure and improve performance.

Programme Sponsor, Frank Look Kin commented that "As the effects of the global recession impact the Company, having systems whereby we are able to focus on results and how we measure them, take action and implement them would allow us to make corrections to the Company's policies and procedure" and be better prepared to weather the storms ahead. Affirming this view, other leaders noted that, "Structured meetings have brought about greater efficiency in how we use our time and there is greater use of quantitative data." The leaders also recognized the work of the Internal Programme Team in the overall process and identified as a critical success factor their continued support for the Team in the second phase of the Programme.

What then is the outlook for the future? Current President and Programme Sponsor, S. Andrew Mc Intosh who joined NGC in March, a month into the second phase of the LDP, had experienced Evolve's philosophy in other organizations. He stated: "I have unequivocal support for and belief in the Programme." He sees the overall change process as adding greater value to NGC's business as its leaders "take ownership for and visibly demonstrate passion and commitment to the values of change." Mr. Mc Intosh believes that only when this commitment to the change process is transferred to and owned by every NGC employee can we truly make a difference. He envisions NGC becoming a "data-centric organization where leaders at all levels depend on data to make decisions, understand the critical success factors of the business, know what the deliverables are and develop strategies to monitor, review and take any necessary corrective actions to get back on track."

Above all, Mr. Mc Intosh said that with working management systems, the company's performance in all key areas should be made visible to all employees so that they would know how the business was performing

Above all, Mr. Mc Intosh said that with working management systems, the company's performance in all key areas should be made visible to all employees so that they would know how the business was performing. He affirmed that increasing the level of connectivity among departments and employees would get them emotionally involved in owning the business. He sees this as a true indication of successful change.

Given this vision for the future, Programme Team Leader, Susan Campbell-Nicholas and Programme Team Member, Valarie Walters, in collaboration with the Top 12 Leaders, the five team leaders of the 2009 LDP and the programme sponsor, will take up this new challenge to support the organization in moving closer toward improving its business performance and leadership capability as the process of change conntinues to be embedded deeper into NGC.

ECOLOGICAL RESTORATION OF MANGROVES
– PART 2

Part II of this article concludes earlier segment carried in the December 2008 Gasco Journal.

By DR. REEZA MOHAMMED, PhD
NIKESHA ANN VICTOR, MSc
SHAZAM EDOO, DipNEBOSH

Mangrove Regeneration

Studies have shown that mangrove habitats around the world can self-repair or successfully undergo secondary succession in 15-30 years if:

1) The normal tidal hydrology is not disrupted;
2) The availability of waterborne seeds or seedlings (propagules) of mangroves from adjacent stands is not disrupted or blocked.

A series of aerial photographs depicting mangrove recolonization along the Gulf of Paria shoreline from the period 1966-2003 (See Figures 6-10) supports this finding. The 1966 aerial photograph defines the Sea Lots area prior to the creation of the government fish market at the National Petroleum's Harbour Berthing facilities.

The 1980 photograph shows the same area after the first stage of the harbour and berthing facilities for the government fish market and National Petroleum (formerly Shell Trinidad Limited) in 1974. The dredged material was used for both reclamation for the NP Tank Farm area and also deposited to the south and east. This is where the mangrove growth occurred.

The 1986 photograph reflects the area after the next stage with extended dredging. The dredged spoil was deposited into the eastern area for reclamation and in the southern area. The eastern area was bounded and reclaimed; mangrove to the south/east was destroyed during the dredge spoil disposal area.

The 1994 photograph shows the extended growth of the mangrove in the area to the south and the regrowth of the mangrove where it was previously destroyed. The 2003 photograph (Figure 10) reflects the recolonization progress.

Design and Implementation of Restoration

Restoration of mangrove may be defined as the establishment or reestablishment of native mangrove species in order to provide ecosystem structure and functions similar to that of the undisturbed mangrove forest for long periods of time. Mangrove restoration has become increasingly important in various parts of the world especially as the effect of loss of mangroves has been linked to the loss of coastal fisheries productivity, livelihood of coastal communities, and loss of life and property in the wake of storms and tsunamis. Furthermore, in cognizance of the ecological and socio-economic importance of mangroves and the implementation of legislation aimed at their protection, mangrove restoration projects have gained major prominence within recent times.

Technologies required for mangrove restoration and replanting are neither new nor complex. Some hundreds of mangrove replanting projects have been undertaken worldwide. Mangroves

Figure 6: Aerial photograph of Sea Lots Mangrove area (1966)

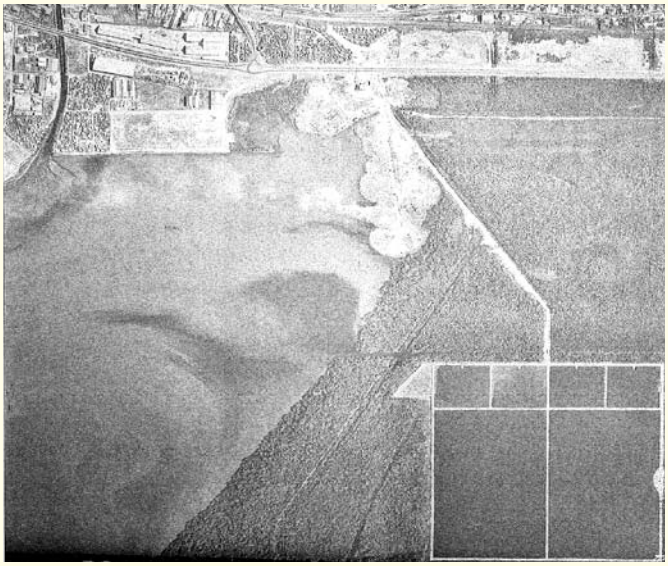
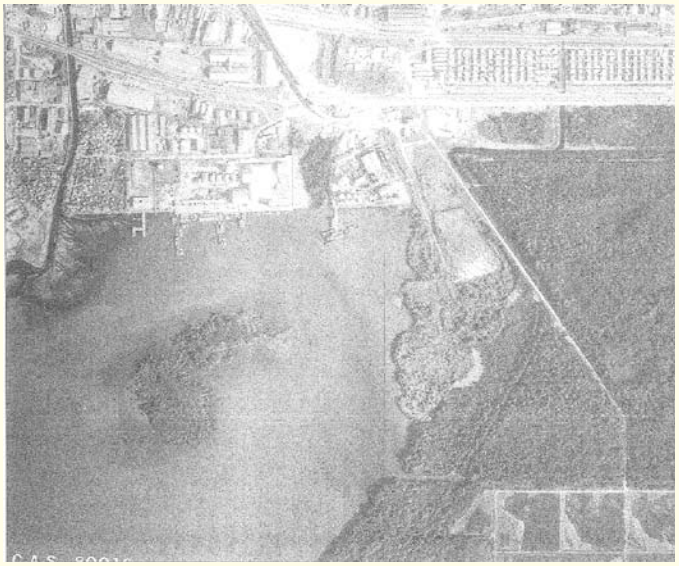


Figure 7: Aerial photograph of Sea Lots Mangrove area (1980)

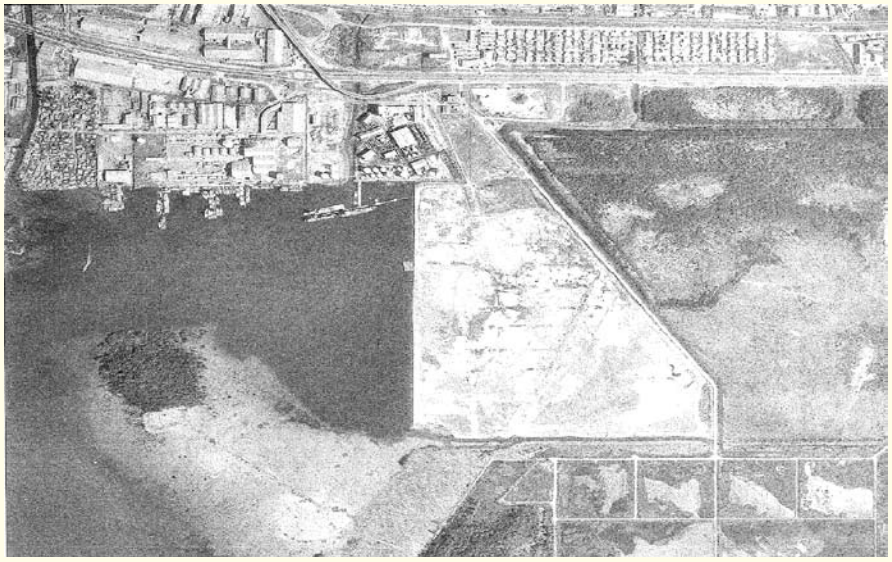


have been planted as part of a forestry management regime and as coastal protection measure in countries such as Thailand, Malaysia, Indonesia and Bangladesh. However most of these are economic plantation projects intended to yield firewood, construction timber and forestry products for the livelihood improvement of the local community. Recently, especially in areas such as India, Sri Lanka and Thailand, mangrove replanting schemes have been geared towards the reestablishment of a "coastal bioshield" to help protect shorelines of countries most vulnerable to storm surges, tsunamis and other natural phenomena.

For our purposes, therefore, the objective of a proposed mitigation is to restore and create mangrove habitats as compensation for impacts associated with the construction of the proposed Pt. Lisas Industrial Estate Port. This would be to reestablish mangrove habitat that is functionally equivalent to areas impacted by the development. However, a comprehensive restoration plan must be developed. This plan will be formulated based on basic principles of ecological restoration.

Ecosystem restoration must have a series of clear and specific goals to be attained. With this in mind, NEC will design its Mangrove Restoration Project using the best known management practices for encouraging the growth and succession of a mangrove community while implementing rigorous experimental and design methodologies to quantitatively determine if and when goals are met.

Figure 8: Aerial photograph of Sea Lots Mangrove area (1986)



Mangrove species require the following basic environmental conditions for their luxuriant growth:

- Low wave energy
- Muddy substratum or accumulated deposit of sediments
- Salinity of water that undergoes constant variations due to freshwater flow (mangroves require low saline conditions for optimum growth and reproduction)
- Regular flushing by tidal water
- Soil saturated with or covered by low saline water at some time

Figure 9: Aerial photograph of Sea Lots Mangrove area (1994)

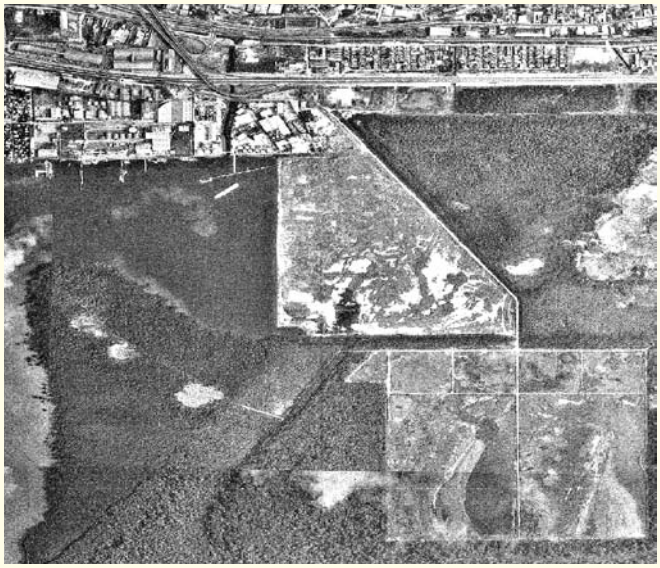
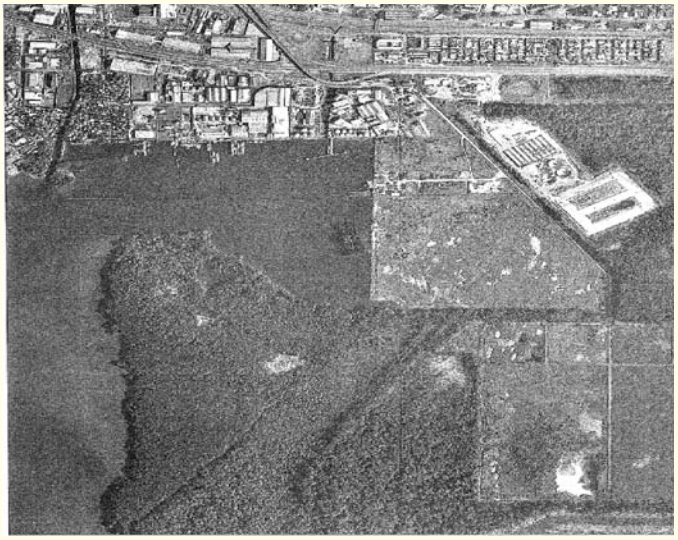


Figure 10: Aerial photograph of Sea Lots Mangrove area (2003) Source: Lee Young & Partners (2008).



during the growing season of every year.

To successfully achieve the objective of mangrove wetland creation the first step would be to avoid the common problems that can adversely affect the restoration project. These include:

(1) Incorrect planting elevation, which is probably the single most common problem plaguing restoration planting attempts (Cintron 1996)

(2) Exposure to excessive wave or current energy in that mangroves do not establish well unless the shoreline has a considerable degree of protection from natural fetch, boat wakes, etc.;

(3) Planting on unsuitable soil since mangroves grow best on mixtures of organics (peat), silts and clays.

(4) Elevated soil salinities resulting from poor "flushing" by tides or freshwater runoff adversely affect survival and growth of mangroves (*Rhizophora mangle* and *Laguncularia racemosa* to a greater extent than *Avicennia germinans*);

(5) Lack of nearby natural propagule source is also cited by Cintron (1992) as potentially a problem in terms of long-term recruitment into the population.

The design of this project will be informed by ecological principles set forth by Lewis and Marshall. According to Lewis and Marshall 1997 there are five major ecological principles that must guide the design and implementation of any mangrove restoration project. These are listed below:

Principles of Mangrove Ecological Restoration (Lewis)

1. Understand the autoecology (individual species ecology) of the mangrove species at the site, in particular, the patterns of reproduction, propagule distribution and successful seedling establishment.
2. Understand the normal hydrologic patterns that control the distribution and successful establishment and growth of targeted mangrove species.
3. Assess modifications of the original mangrove environment that currently prevent natural secondary succession.
4. Only utilize actual planting of propagules, collected seedlings or cultivated seedlings after determining (steps 1-3) that natural recruitment will not provide the quantity of successfully established seedlings, rate of stabilization, or rate of growth of saplings established as objectives for the restoration project).
5. Design the restoration programme to restore appropriate hydrology and, if possible, utilize natural volunteer mangrove propagule recruitment for plant establishment.

At present, due to the impact of the project activities for the past few years, the community is well organized and is able to leverage support from development schemes sponsored by the government agencies.

Table 1: Suggested ranges of elevations for Mangrove Replantation

Species	Ranges in meters (National Geodectic Vertical Datum)
Rhizophora mangle	0.3 – 0.5 m
Avicennia germinans	0.43 – 0.60 m
Laguncularia Racemosa	0.3 – 0.6 m

Source: Proffitt et al., 1996

Using the restoration principles as a framework, the mechanism of mangrove wetland creation will entail the following:

1. Survey of mangrove forests in the vicinity of the planned project to determine typical ranges of elevations above 0.0 NGVD (sea level) within which the various species of mangroves are abundant and appear vigorous. In addition to this, the natural slope of the forest should be determined as well. Previous studies indicate that transverse gradients in mangrove forests vary from 1:100 to 1:1000. The values for nearby natural sites will be used in constructing the site and in planting.

2. Establish the slope of the natural forest

Establishing the appropriate slope is of critical importance to the replanting of mangroves. The slope needs to facilitate proper drainage. Gentle slopes are required (<10:1) to increase the area of optimal zone and help survival during low tide periods, due to the lesser drainage rate.

3. Determine the tidal ranges of the natural mangrove forest

The tidal amplitude and period ranges from local oceanographic data of the natural forest will be determined. This step is cited as the most important to the restoration of mangrove habitat. Each mangrove species thrives at a different substrate level, which in some

part dictates the amount of exposure the mangrove will have to tidal waters. For instance most *Avicennia* species thrive at lower substrate levels (deeper water) while other species may thrive at higher substrate levels (shallower water). In this regard, it is necessary to study tidal charts at the study site and take measurements of a healthy mangrove relating substrate height and depth to various species of mangrove that exist at that each depth. (See Figures 11-12)

Failure to properly assess the existing and proposed hydrologic conditions is the primary cause of failure in mangrove restoration projects (Lewis, 1999). Large-scale planting of propagules of *Rhizophora spp.* on existing un-vegetated natural mudflats, for example, where natural tidal conditions are typically too wet for mangroves to establish naturally or thrive, have resulted in large-scale failures and a waste of limited funds for mangrove restoration (Lewis 1999).

4. Compare soils of the natural forest with the site selected for mangrove creation

The type of substrate to be utilized has an important influence on growth and survivorship of mangrove seedlings, and thus the success of the mangrove replanting project. In this regard, a comparison of the soils of the natural forest with the site selected for mangrove creation will be undertaken.

Good growth of mangroves is often achieved on soils that are high in silt/ clay size classes and has a relatively high organic content (Cintron 1992). Soils comprised of hard-packed dredge material or sand (Cintron 1992) or those with large amounts of rock or clay (Lewis 1990a) may not support rapid mangrove development or may even stunt surviving plants. On nutrient-poor soils, a slow release fertilizer may enhance growth rates (Cintron 1992, Darovec et al. 1975, Teas 1977).

Figure 11: Measurement of Substrate Level
Source: www.mangroveactionproject

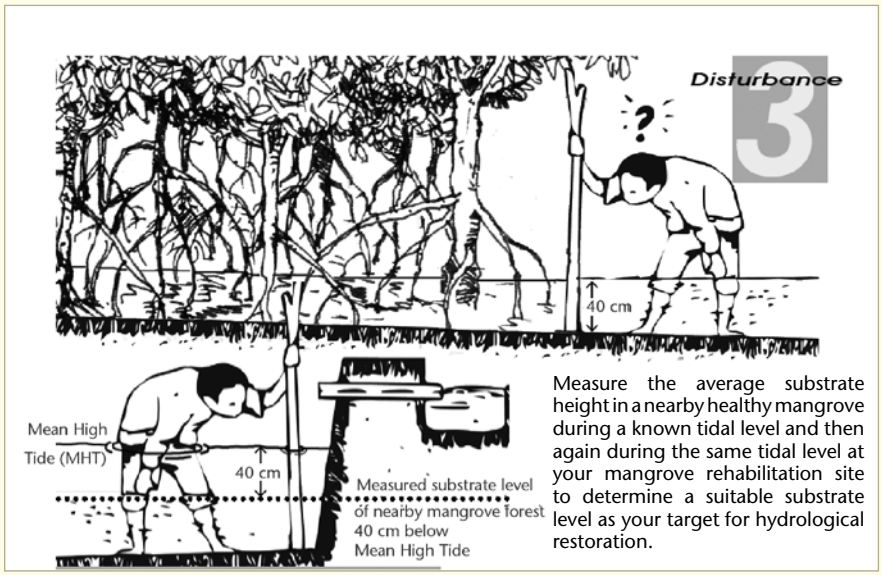
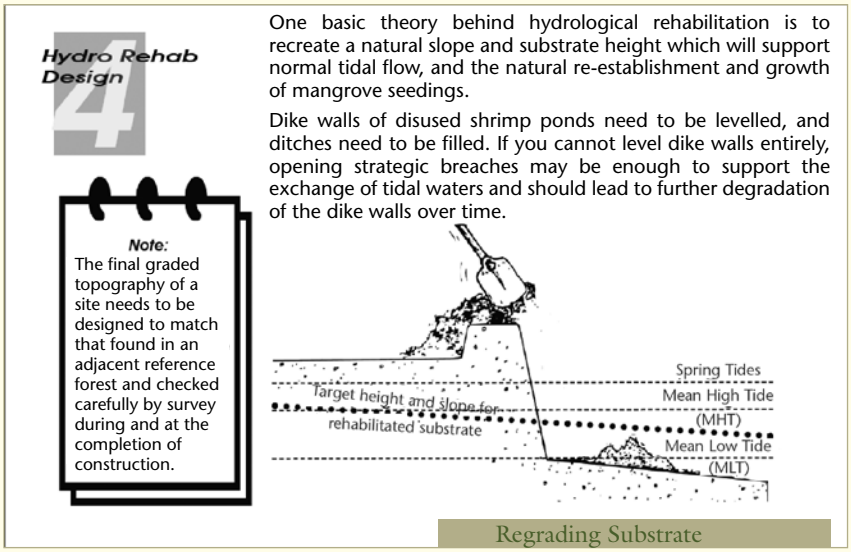


Figure 12: Regrading of substrate level
Source: www.mangroveactionproject



5. Grade the site to the elevations and slopes characteristic of natural forests

The site will be graded to the selected elevations and slope under the close supervision of specially appointed persons. If the site is large, construction of one or several meandering or branching "flushing channels" to facilitate water exchange and enhance mangrove growth along channel edges. Grading the site to the elevation that provides the optimal hydrologic regime (duration, frequency and depth of inundation) for the targeted mangrove species is vital to the success of the mangrove restoration.

6. Install Plants

According to goals and methodologies outlined in the site specific of the restoration. This will involve planting several mangrove species.

Planting Practices

Plantings should be made using the species dominant at nearby locations with similar tidal elevation and flooding regimes.

1. Red Mangrove: should be planted below the Mean High Water Mark (MHW) inserting gently into the sediment so that they will not fall over (only 4-7cm,) growth rates of transplanted mangle seedlings are 18-30cm per year (Crewz and Barnett 1989).

2. Black and white mangrove small plants and propagules at Mean High Water, slope 1:5 (10°), protected. Seeds are very susceptible to being carried away by tidal action resulting in losses of greater than 95 percent (Lewis and Haines 1981). For these reasons the most viable option appears to be germination of the seed in a nursery to produce a potted seedling that is then planted after a short growing period of 3-6 months (Lewis 1982).Growth rates of transplanted A. *germinans* and *L. racemosa* are in the 60-75cm per year range (Crewz and Barnett 1989).

3. Planting Density: the spacing of the seedlings or planting stock is of critical importance to the economics and ultimate success of the restoration process. The recommended spacing for propagules or seedlings is 0.6-1.2m for *Rhizophoar spp.* and 1.5m for *Avicennia spp.*

Community Participation

It is anticipated that the execution of this mangrove replanting exercise will be very labour intensive. Herein lies the opportunity for community involvement, especially those most dependent upon the mangrove resources of the impacted area. Mangrove replanting scheme should include participation from villagers dependent on mangroves through training in the scientific values and functions of mangroves and techniques involved in nursery planting.

Design and implementation of monitoring programme

The adequate design of a mangrove restoration programme must include goals and metrics, which must extend over the entire time frame required for development of a mature mangrove forest.

The success of a restoration project is determined through the establishment of quantifiable goals in terms of biological and environmental parameters associated with "important" ecosystem functions.

Studies will include one or more carefully selected natural mangrove areas as "reference sites". These reference sites will be used as a yardstick by which to judge the rates of attainments of value of mangrove systems for a suite of ecological functions.

A framework of variables to include in the monitoring of the success of the mangrove replantation project may include the following:

A. Initial Data (after site preparation, but before planting):

A mapping of the spatial dispersion of these variables over the study site may help explain localized differences in survival and growth (and other variables) later.

1. Site elevations and slope;
2. Sediment grain size, organic content and nutrient concentrations;
3. Tidal inundation (depth and frequency).

B. Post Planting (or host "natural colonization" for unplanted sites) Data:

1. Physiochemical factors to be quantified:

a) Annual (if necessary) analyses of sediment grain size and especially of organic content;
b) Salinity of standing and pore water;
c) Air and sediment temperatures in open areas and below plants;
d) Per cent light penetration to ground level;
e) Tidal inundation (depth and frequency);
f) Rainfall and other freshwater inputs;
g) Nutrients.

2. Biological factors

a) Survival of planted mangroves and those colonizing the site. Tagging should be used to ensure that these can be distinguished.
b) Growth (at least height and trunk diameter) and reproductive output of mangroves.
c) Density of planted and volunteer plants. Also, dominance in the canopy and leaf area index should be determined.
d) Litterfall and litter "fate" (% exported versus % decomposing in situ) should be assessed. Primary mechanisms of decomposition including relative importance of microbes and invertebrate littervores should be studied.
e) Colonization and population densities of selected "typical" mangrove fauna (to include species in the canopy, on the forest floor, and those encrusting prop roots) should be studied. Population sizes and grazing rates of important herbivores especially insects and the crab *Aratus pisonii.*

INDIA –
CASE STUDIES/ STUDY AREAS

The Godavari and Krishna wetlands in Andhra Pradesh are located in the coastal plains of the deltaic regions between 16° 30' - 17° N and 82° 23' E in the East Godavari district and between 15° 42' - 15° 55' N and 80° 42' - 81° 01'E in Krishna and Guntur Districts (Figure 13).

The project was started at May 29th 1997 and ended May 29th 2004. Community members replanted a total of 515 hectares of mangroves in Godavari and Krishna regions. (See Figure 14) Details of the area restored, the area

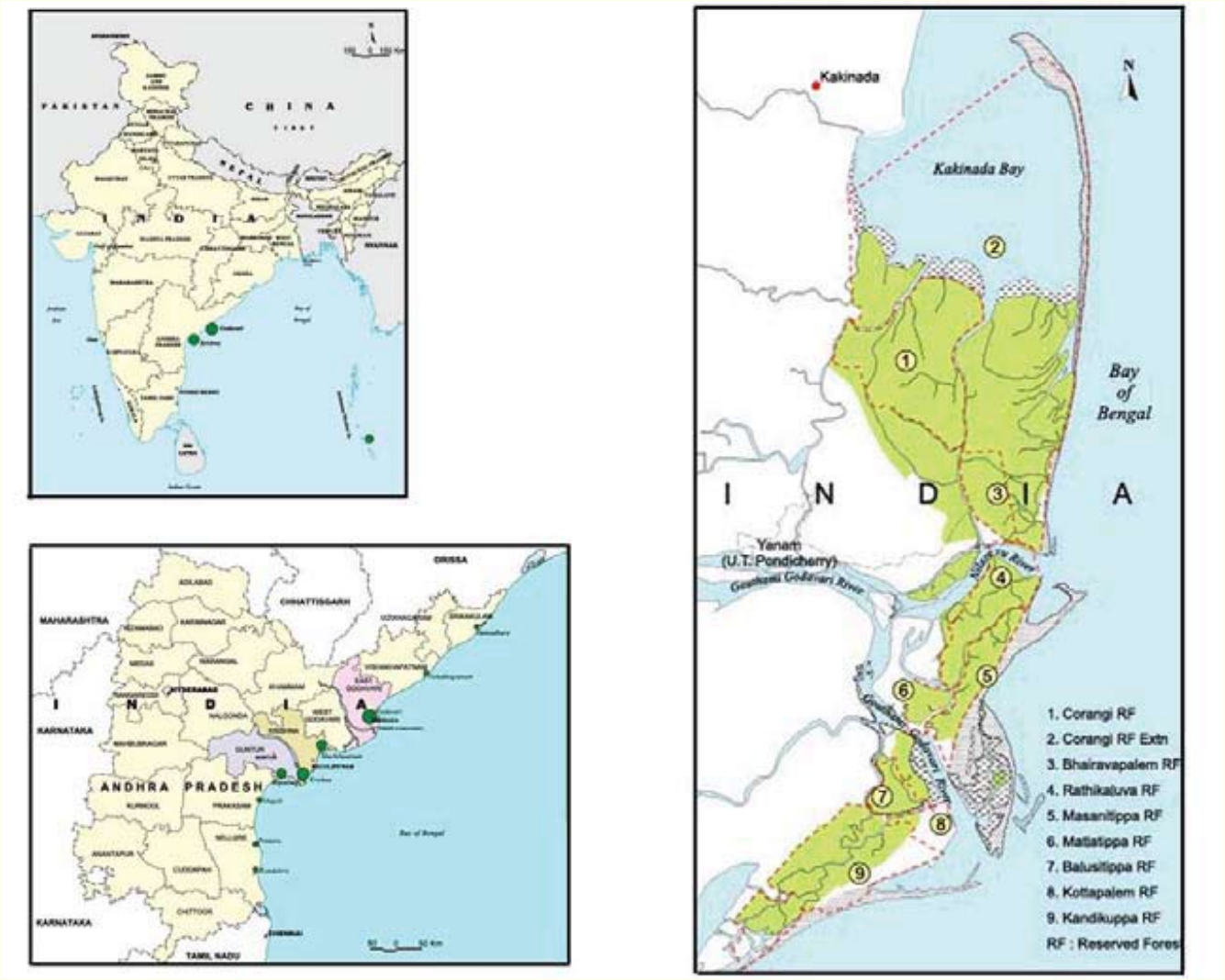


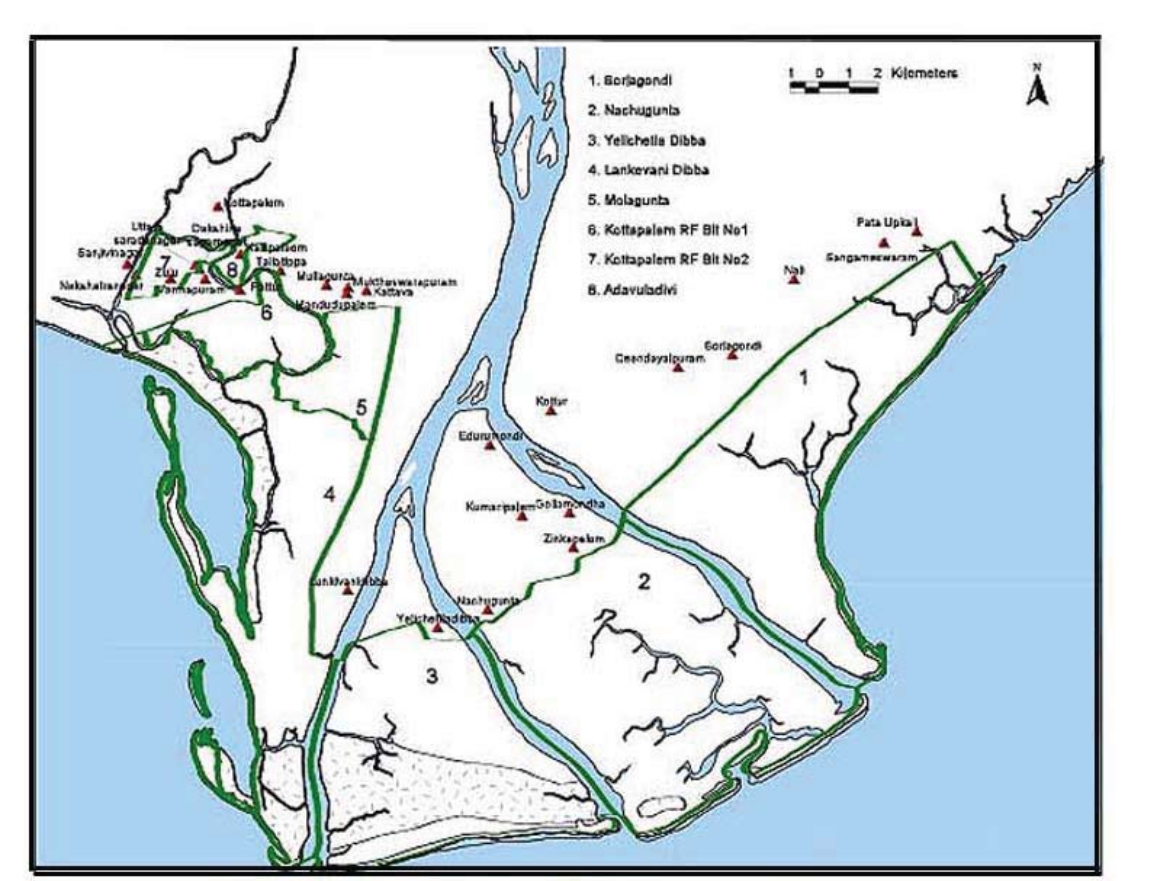
Figure 13: Map showing location of the Godavari Mangroves
Source: Ramsubramanian et al. 2005

Table 2: Details of Mangrove Restoration and Management

Demo Village	Restoration area (ha)	Propagules planted	Survival rate
Malayalam	5 ha	4,000	80%
Dindu	25 ha	25,000	90%
Kobbarichettupeta	35 ha	28,000	80%
Bhairavalanka	75 ha	29,000	80%
Dheenadayalapuram			
Nali	230 ha 5 ha	100,000	85%
Gadimoga	25 ha	25,000	80%
Zinkapalem	115 ha	-	-
Total	515 ha	211,000	

Source: Ramsubramanian et al. 2005

Figure 14: Map Showing Location of Krishna Mangroves
Source: Ramsubramanian et al. 2005



under the Mangrove Management Units, the number of saplings planted, their survival percentage and the year of planting are given in Table 2 on page 15.

The mangrove dependent fishermen were involved in raising mangrove saplings and in the selection of degraded mangrove areas, canal alignment, digging and planting. This case study emphasizes the need for community-involved forest resource management. The study has succeeded to improve both the ecological conditions of the mangroves and the livelihood of the community

At present due to the impact of the project activities for the past few years, the community is well organized and is able to leverage support from development schemes sponsored by the government agencies. The participation of women in the project activities has empowered them to raise their concerns in the village and obtain government support for the socio-economic development of the village. The participation of the community in the project activities has made the people realize the importance of mangroves for the wellbeing of the coastal community.

Failure to properly assess the existing and proposed hydrologic conditions is the primary cause of failure in mangrove restoration projects

Methodology

These restoration activities were implemented by the M.S. Swaminathan Research Foundation (MSSRF) and carried out over seven years under the auspices of the project "Coastal Wetlands: Mangrove Conservation and Management."

A survey of the entire Godavari and Krishna mangroves was carried out in order to identify the degraded areas. Restoration began with the digging of canals to reduce salinity, facilitate tidal flushing, and drain stagnant water. A fishbone design was utilized in order

to facilitate easy inflow and outflow of tidal water (See Figure 15). The main canals were dug at an angle of 45° to the natural creek, and the side canals were dug at an angle of 30° to the main canal. The canals were dug in a trapezoidal shape in order to plant the saplings at the mid level of the canal. This is to ensure that the plants receive tidal water, but at the same time they are not submerged. The distance between side canals was 12.5m during the first year of plantation; however, in subsequent years, this distance was reduced to 8m in order to ensure a dense canopy.

After a buffer period of three months, nursery-raised mangrove saplings were planted along the trapezoid-shaped canals.

The planting was done in October and November, after the southwest monsoon, as the influx of rainwater during this period reduces the salinity of the soil. The eight-month-old saplings were planted along the slopes of the canals (20-25cm from the top) with a gap of 2m. (See Figure 16).

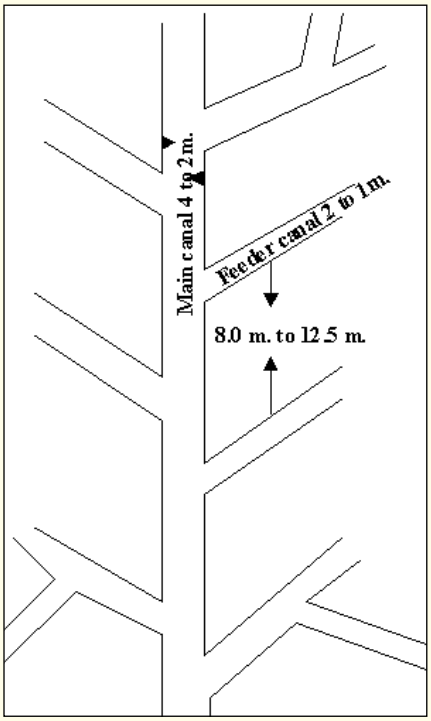


Figure 15: Fishbone design of canals for mangrove restoration
Source: Ramsubramanian et al. 2005

Figure 16: Dimensions of Canals for Mangrove Restoration
Source: Ramsubramanian et al. 2005

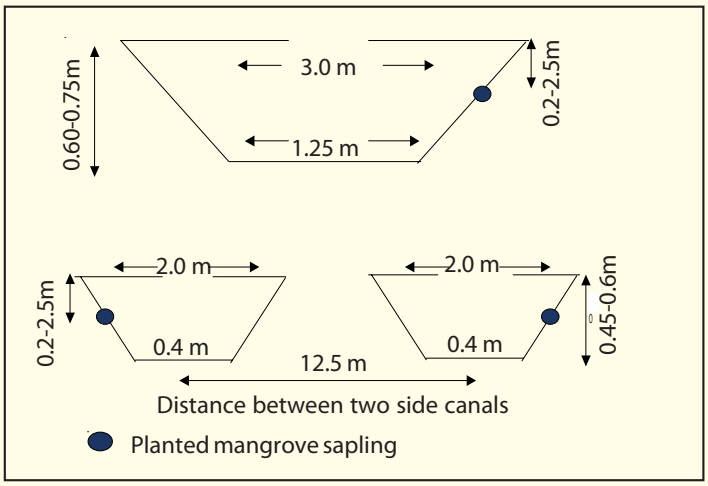


Figure 17: Progress of Mangrove Restoration 1999-2004
Source: Ramsubramanian et al. 2005

The species *Avicennia marina*, *Avicennia officinalis* and *Excoecaria agallocha* were selected for planting, as these species tolerate a wide range of salinity. *Aegiceras corniculatum*, *Bruguiera gymnorrhiza*, *Rhizophora apiculata*, *Rhizophora mucronata* and *Xylocarpus moluccensis* were also planted in order to ensure genetic diversity.

A total area of 520ha of degraded mangroves was restored in the Godavari and Krishna mangroves. Initially the growth rate of new seedlings was slow, but after two to three years their growth rate had improved (See Figure 17).

KENYA

A project entitled "Community Participatory Forestry for the Rehabilitation of Degraded Mangrove Forests at Gazi Bay, Kenya" was drawn and implemented in 1993/95. Under this project, more than 300,000 mangrove trees were planted in areas that were initially clearfelled for industrial fuelwood. Support of the project was solicited from: the Kenya Belgium Project and from the Biodiversity Support Programme – A USAID funded consortium of World Wide Fund for Nature (WWF), World resources Institute and the Nature Conservancy. The activities related to rehabilitation and the monitoring of its success fit into a rigorous research framework on mangrove vegetation dynamics, regeneration and restoration.

Approach and Methodology.

1. Species Selection

For any restoration work it is necessary to establish the past and present composition of the vegetation in the area selected. This was achieved through discussion with the local elders and by conducting stump counts of the selected area. Assessment of the Gazi plantation site indicated that it had a good potential for reafforestation with *Rhizophora mucronata, Ceriops tagal, Bruguiera gymnorrhiza, Avicennia marina, Xylocarpus granatum, Heritiera littoralis* and *Sonneratia alba*.

Figure 19: Rhizophora mucronata ***propagules gathered.***

Figure 20: Mangrove nursery in Gazi Bay (Kenya).

Collection, transportation and storage of seeds and propagules

Collection of seeds and propagules is done mostly in the months of highest fall. This is normally between the months of March and June, coinciding with the long rainy season. Mature propagules are collected from the mother tree or litter under trees or rank on beaches. Local people are trained in identifying and selecting mature and healthy propagules. A distinct cotyledonary colour in the hypocotyls of *Rhizophoraceae* family differentiates young propagules from mature ones.

After field collection, propagules are packed in plastic bags and transported to the planting site. Extra care is taken not to damage the growing parts during transportation. The propagules are stored for 2-3 days under natural shed, and kept wet by sprinkling water throughout the period. (If moisture is maintained under natural shed, propagules of *Rhizophoraceae* family can be stored for more than six months). Before storing the propagules, quality control is done to remove all the damaged, infected or malformed propagules. Nearly, 10-15% of all the propagules collected get discarded during this phase. After quality control, the propagules are ready for direct planting or nursery raising.

Figure 18: Planting of Mangroves in canals
Source: Ramsubramanian et al. 2005

Figure 21: Mangrove Replanting activities in Kenya

"These mangrove trees are my future..." (Wasini Island)
Planting activities in Gazi Bay (Kenya)

Figure 22: Artificially Planted Mangroves in Kenya

Two 8-year-old Ceriops tagal *stands artificially planted in 1992 in Gazi Bay (Kenya) under different site conditions.*

Mid-intertidal area, inundation class 3 Landward area, inundation class 4.

A 9-year-old Bruguiera gymnorrhiza *stand artificially planted in 1991 in Gazi Bay (Kenya).*

2. Field planting

Planting of selected mangroves species in the field is carried out by the local community as well as by visiting teams of schools and colleges. Installation of the *Rhizophoraceae* propagules does not require deep knowledge once the plantation area is selected. In our case, care was always taken to follow natural pattern of distribution or zonation during planting.

During planting, nearly 15cm of the *Rhizophora* propagule is embedded in the soil by making a bore using wooded rod. Planting distance was initially set at 1m x 1m matrices. However, this spacing resulted to crowding and was increased to 1.5m x 1.5m.

The seedlings of *Sonneratia alba*, *Xylocarpus granatum*, *Heritiera littoralis* and *Avicennia marina* were first raised in nurseries and transplanted after 6 months when they had attained a height of 30-40cm. Planting of saplings in the intertidal area was done at low water. Holes were dug using transplanting augers at 2m x 2m matrices.

3. Survival and Growth

Data on growth performance and survival/mortality were collected fortnightly, monthy, 2, 4, 6, 8, 9 and 12 months after planting/transplanting. the survival of the transplanted saplings or propagules was better (80 - 100% of 70,000 after 24 months) than for sapling (< 5% after 12 months). Planting of nursery saplings gave a higher survival rate (80-100% after 24 months) compared to transplanting of wildings. In almost all the observed parameters, *C. tagal* shows the lowest growth rates of less than 0.5 m/year. The maximum growth rate of 1.18m/year was achieved by *Sonneratia alba* that were planted on the seaward denuded areas.

4. Care of the planted forest

The restored mangroves in Gazi, Mida, Tsunza and Wasini were all surrounded by a population that depends to a large extent on the resources of the area. Damages are caused by those entering the forest to dig out fish baits

1995, day of plantation

1996, 8-month-old stand

2000, 5-year-old stand

Figure 23: A re-afforested **Rhizophora mucronata** *stand in Gazi Bay (Kenya) photographed at three different periods in time. Source : Kairo 1995*

(annelids), as well as trampling and herbivory by animals. In Wasini Island mortality rate of 10,000 saplings was reported in *Ceriops* and *Avicennia,* three months after planting.

Dialogue was initiated with the local people seeking their cooperation in protecting the plantations. The goat keepers in villages agreed that they would not allow the animals to enter new plantations to graze. Instead they tied the animals until the trees were established. Others agreed to graze their animals elsewhere. Awareness programmes have also been promoted in the local schools about the need to conserve the mangrove.

5. Monitoring of the artificial regeneration plots

Of the marine ecosystems most studied from a restoration perspective, mangroves appear to be among the most amenable to restoration attempts because of the ease of access, life history characteristics, their value in environmental economic terms, and simple floristic composition.

There is an increased need for the monitoring of artificial regeneration plots with respect to faunistic and floristic secondary succession (recruitment of species) and with respect to the establishment of ecological functions.

It also includes an investigation of the gain in species richness under certain circumstances such as the faunistic and floristic recruitment of species new to a monospecific planted mangrove stand.

UNITED STATES – FLORIDA

The photographs herein illustrate a time sequence over a period of 78 months from the completion of a portion of a hydrologic restoration at a 500ha mangrove restoration site at West Lake near Fort Lauderdale, Florida. Lewis (1990a) describes the details of the work, but again success resulted from using a reference site, and targeting final constructed grades as the same as the adjacent undisturbed forest. This resulted in a final sloped grade from +27cm to + 42cm Mean Sea Level.

Figure 24: Progress of Hydrological Restoration in Florida
Source: Lewis, 2005

Extensive constructed tidal creeks were also added to the original plans, which had been designed without them. No planting of mangroves took place or was necessary. All three of the Florida species of mangroves (red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*) and white mangrove (*Laguncularia racemosa*). volunteered on their own.

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Construction work for marine pipe-laying.

NEO/Tobago Gas Pipeline Project – Update

Design works on the NEO/Tobago Pipeline Project are in the final stage, and Technip USA, the Engineering designer and Consultant, has mobilized 100 specialists to complete design work. The project, which will route two lines from the BHP Billiton Gas Export Platform off the North East Coast, and also involve the construction of a gas receiving facility, is being managed as a single engineering project. The 84km, 36-inch-diameter NEO marine line will travel southwards from the platform to landfall at the Mayaro Bay Regulator station, while the 54 KM, 12-inch-diameter Tobago marine line will travel northwards to the south coast of Tobago, coming ashore at the Cove Eco-Industrial and Business Park.

The NEO pipeline to the Mayaro Bay Regulator station will tie into the BUD Slug Catcher facility at New Abyssinia, and the Tobago pipeline will service the Gas Receiving facility at Cove Park where liquids will be removed before the gas is sent as a fuel to the 75-megawatt T&TEC Tobago Power Station which will be constructed at Cove and to businesses tenanted in the area. The overall cost of the two-pipeline project is US$550 million which is being managed together to effect economies of scale.

Highlights

Pipe was bulk purchased for cost effectiveness, and delivery from WellSpun of India and Tenaris of Mexico has already begun at La Brea's Brighton Port. The concrete coating of the pipe by Bredero-Shaw is being undertaken at the Union Industrial Estate, and expected to be completed in August 2009.

Carillon has been contracted to handle the civil structural works, managing the construction of roads, drains, underground cabling and fencing for the gas receiving plant in Tobago. Procurement for this aspect of the project will begin in May with a completion date of December 2009. Commissioning of the plant is expected in August 2010.

During the shoreline approaches at Mayaro and Cove Estate, efforts will be made to minimize environmental impacts by using Horizontal Directional Drilling (HDD) technology. In Tobago, the HDD will not disturb the environmental integrity of the shoreline since construction will begin at sea to avoid sensitive areas by drilling to 100 feet beneath the coral ecosystems before surfacing roughly 300 metres inland along a one-mile drilling path. Tenders for this phase of the process will be invited early in 2010.

The environmental process evaluation is completed, and the project is awaiting a CEC. Consultations are in progress with residents of Mayaro and areas close to Cove Estate in Tobago to sensitize the communities to the impact of the project. A number of commitments were made in Mayaro for sustainability projects.

Gasco Welcomes NGC's New President

S. Andrew Mc Intosh took up the role of NGC's President on March 9, 2009, replacing outgoing President Frank Look Kin who retired after 12 years of distinguished service.

Mr. Mc Intosh has had extensive management and engineering experience in the oil and gas energy sectors, having had a distinguished career at the Trinidad and Tobago Oil Company, Trinidad Marine Limited, Petrotrin, Cliffs and Associates Ltd, Atlantic LNG, bpTT and Lurgi Metallurgie Gmbh over a 31-year period.

Mr. Mc Intosh was very kind and gracious to discuss his career and vision for NGC just six weeks of taking up his new portfolio with the company.

Q. Your career has given you a wide-ranging view of energy development in Trinidad and Tobago over the last 30 years. What have been some of the exceptional projects that you have been involved with during that time?

In my opinion there were three memorable projects which stand out as career highlights in the local industry.

The first was in April 1986 when there was a major fire at Trinmar (then known as Trinidad Marine Ltd), where I served as the Chief Engineer. Among other things, the blaze effectively destroyed the compressor platform that was crucial to the gas lift process. Overnight, Trinmar's production output dropped two-thirds or from 40,000 barrels to 17,000 barrels per day and my critical mission was to get the platform up and running. The next day, I prepared a letter for my Chairman, Mr. Kenneth Birchwood, which outlined the timeline necessary to return the platform to full production. Mr. Birchwood placed his confidence in my ability to get the job done as he asked me to project-manage the restoration of the company's gas lift capability. In that period, I recall that we met every deadline on that project, bringing production back up to capacity by February 1987. Because so much of the infrastructure had to be rebuilt, we were able to not only retool with safer systems, but also more efficient ones. We changed the way that work was done at Trinmar. The spirit of commitment and cooperation on that team was unparalleled in my experience. People on that team are still very close to me today.

The second was in 1994 when I was appointed Executive Manager for the Energy Sector Programme and asked to lead the first refinery upgrade. At the time, Petrotrin was engaged in secondary recovery of oil offshore using the injection process and was beginning workovers of their land-based assets. US$400 million was raised from a coalition of financiers which included the Inter American Development Bank (IADB) and the Japan Development Bank. It was a formative time for me, as I had to oversee the complexity of the loan arrangements, the sheer size of the fund and the ongoing multilateral discussions with the government. The experience ignited a fire in me to learn more about the financial operations of the energy sector.

The third experience followed in 1997. I was the first local hired at Cliffs and Associates Limited (CAL), a hot briquetted iron plant. As the Senior Operations Manager, I oversaw the plant's construction and commissioning. The project was a collaboration between German and US interests that brought together people from 25 companies to forge a new and unique business culture. At CAL, we encouraged our people to develop cross-disciplinary skills that made it possible for them to have a deeper understanding of the work processes. It was there that I stopped being a technical engineer to become a process engineer. The experience was my first "hands-on"experience in assembling and leading an operation of that scale.

The investment that the company and its people have made in re-engineering their work, the placements of new technology into older systems on the platforms, for instance, is very impressive.

Have you found the reality of NGC to be different from the perspectives you had of the company while working in the upstream and downstream sectors?

I never conceived of NGC as having such an extensive operating network. I knew the offshore operations well and the technology in use was something that I had worked before. It has been the on-land system that I have found quite remarkable – the extensive network of pipelines, the routing systems, SCADA which is the technology, particularly the control systems. The investment that the company and its people have made in re-engineering their work, the placements of new technology into older systems on the platforms, for instance, is very impressive.

I want to particularly note the role that Frank Look Kin has played in developing and growing NGC. I offer praise where praise is due. The work that Mr. Look Kin has put into growing this organization and developing its network infrastructure and controls is first class. His understanding of the sector and his work on the contracts that NGC has negotiated over the last decade are deeply instructive and set a high standard.

The contractual arrangements are more complex that I had expected. The need to balance the terms of the contracts with the market realities is very intricate and delicate, particularly at this time, when the supply and demand equation is unbalanced by excess supply.

The midstream role of NGC is more crucial than ever in managing the situation, and the challenging situation that presently exists in the world today. More than 70 per ent of our revenues come from products like ammonia and methanol whose prices are extremely volatile in the world markets. Recent rises in the price of ammonia have given us cause to hope that prices will improve at least incrementally, since fertilizer demand is rallying in response to the world's need to grow food.

Our demand customers are asking for help and we have been examining ways to stretch payments over longer periods of time. This is an opportunity for NGC to sustain and position itself as a valuable partner with our customers. Conversely, our suppliers would like to have more transparency in the processes that NGC uses to balance supply and demand, and to the extent that we can, I'd like to try to do that.

You have come to the helm of the company at a challenging time. What is your evaluation of the company's current position?

This challenging period of slowed growth offers us an opportunity to evaluate our human capital, to look at training, fit for work, succession planning, policies and accountability. The biggest part of my immediate agenda is to focus now on the people of NGC. This is where the future of the company lies. The other part of my portfolio is to concentrate on our business processes, learning both from our best practices and our errors. I will be developing a project controls group to assist in the development of projects, our procedures for managing operating costs and expenses.

We need to be able to gain that kind of insight on a monthly basis. SAP is, admittedly, not for the faint of heart, but it is a tool that can pull together the kind of data that helps in the kind of planning and evaluation that we need to be doing in real time. That will be crucial in our work going forward.

You can't do it all in one shot. You have to pick what will be done first, choose the low hanging fruit and the quick wins. Part of my job I believe would be to excite the organization about the possibilities of change and one measure of that will be improving our results in the employee satisfaction survey.

Mr. Mc Intosh interacting with staff on familiarization tour.

Do you see opportunities in the challenges that NGC is currently facing with the decline in global markets?

As gas resources decline, we will begin to get stranded gas or the resources that we can't get into the system. Eventually, individual suppliers will have to start thinking about that, but if we can begin looking at the possibilities as an industry early on, it will be possible to develop systems that are integrated and can deliver more cost-efficient technologies to all the fields in Trinidad and Tobago.

NGC may well be best placed to play a role in designing and deploying systems that address this issue on a national scale, providing the services to all suppliers in the upstream industry in a more cost-effective way so that each company's focused efforts might be able to deliver.

The challenge, with new opportunities like floating LNG and supplying gas up the Caribbean archipelago, is timing. New initiatives will have a lead time of two to three years and we must embrace not just the current reality, but the future dynamics. NGC will therefore be a part of the future energy initiatives that are under consideration and which may emerge from ratifications that are made by the OAS as a result of the decisions made in the Summit of the Americas.

What are your goals for your role in the company in your first 100 days and your first year?

In my first 100 days, I have committed to fully understanding the organization; its infrastructure, the people who run its operations and the way that things get done. Then I will develop a plan that will inform my first year here. That plan is something that I will first share with my executive team, where it will be discussed and decisions will be made on how to make the strategies operational. My immediate goal is to visualize just what I would like to have accomplished by December 2009, every strategic decision that I propose will be informed by those goals.

Pt. Lisas Estate, South and East

Infrastructural design works on the estate's expansion project is 90 per cent in train with a completion schedule of June 2009. Tender documents for access roadways have been prepared, and bidders will be invited by the end of 2009 for the first phase of works – Port Road C, Port Corridor Road, the development of the Light Industrial Estate and the Southern Main Road Overpass, which will link the expanded industrial estate with the new port.

The expansion project will cater for domestic support and service industries, providing 50 two-hectare fully-serviced plots designed for anchor industries. A claims consultant, Ellis and Associates, has been retained to evaluate claims that are tendered during the course of the project's duration.

Pt. Lisas Port, South and East

Detailed design works are complete on the project and contractor Saipem is awaiting the outcome of the decision to grant a CEC to begin works. It is hoped that the CEC will be granted by the end of June, 2009. More than half of the materials are on site in the NEC laydown yard and the project is 25 per cent complete overall. Substantial procurement has been achieved with 9,000 tonnes of steel pile material currently stored on site and field geotechnical and bathymetric services completed. Tender for local content on the project has been completed, and local sub-contractors for construction and materials supply have been identified. The emphasis on the project at this stage is on strict compliance with the requirements of the EMA and on meeting the requests of the public that the environmental impacts are minimized.

With regard to the latter concern, 250 hectares of reclamation works and 100 hectares of mangrove removal have been removed from the project's scope, and the loss of seabed has been reduced by 350 hectares. Under the current project plan, only four hectares of mangrove will be impacted and a mitigating mangrove replanting exercise will be undertaken at a site to be identified.

The EIA study was revised to accommodate the changes and the scope of the study was broadened to take into account more quantitative and qualitative assessments and hydrodynamic analysis of the fish resources as a source of livelihood. The draft document for engaging the community and addressing their concerns has been sent to the EMA. Two focus group meetings have been held and approaches to communicate details about the project in audience appropriate media are being designed.

A communications centre will be established in the direct impact zone of the project to disseminate information on the project, to receive questions and to provide feedback. Minister of Science, Technology and Tertiary Education the Honourable Christine Kangaloo is in receipt of a copy of the plans for community involvement and engagement on the port project.

Galeota Port

GLF-Jandenul has been awarded a joint venture contract for the construction of the Galeota Port project. The new port, is a major upgrade to the original bpTT sufferance port and will facilitate the expansion of upstream production. Bathymetric and geotechnical surveys and detailed designs have been completed, and materials for the project, including steel sheet piles, anchor rods, and whale beams have been procured and are expected by July 2009. Discussions with bpTT are proceeding with regard to the clearance of the existing sufferance port and the relocation of the guard hut and water pumps for fire control.

Other infrastructure works include the development of a new 1.2 km access road independent of the existing bpTT property. The project master plan includes the establishment of the Coast Guard's Southern Command Centre, planned for a site adjacent to the Galeota port, as part of the shared infrastructure and overall EIA study to effect cost savings.

The EIA study has been completed and is before the EMA. NEC awaits the award of this CEC to begin works. Environmental mitigation includes assistance from the local fishing community through the provision of a fish landing facility. Completion of the Galeota Port project is scheduled to take 24 months from the granting of the CEC.

Oropouche Bank

In response to an EMA request for additional data about the project, NEC engaged Technital to address the issues that were raised to meet the Terms of Reference to obtain a CEC. In order to achieve the required level of detail, substantial preliminary designs were undertaken, involving more extensive hydrodynamic modelling, infrastructure planning and socio-economic evaluation. Data collection on the project was necessary to prepare the EIA study, and details about the proposed island's location, shape, fill sourcing, stability and coastal protection have been outlined in a detailed report which will be submitted to the EMA at the end of May, 2009.

After this phase, detailed designs as well as data collection will be undertaken through monitoring over 24 months of climactic and geographic changes to the area. A physical land use plan onshore, in conjunction with the road development plan, will select a route to link the reclamation area with the

Union Industrial Estate

mainland. Preliminary meetings with stakeholders have been held, and a detailed study of the impact of the project on the fish resources in the Gulf of Paria and on the inland estuarine flow associated with the Godineau River is underway.

Union Industrial Estate

A CEC has been awarded to Petrotrin for the removal of two tanks in the buffer zone on the Alutrint site. Works related to the removal of these structures will be completed by July 2009.

Alutrint has commenced infrastructural works on the foundations and drainage systems on the site and dynamic compaction of the site's surface continues.

NEC's Engineering, Design and Construction Department continues to collaborate with the Drainage Division of the Ministry of Works and Transport to develop a comprehensive drainage plan that adequately addresses the drainage needs of the estate.

Construction has begun on the power plant site. The internal access road to the 720 megawatt T&TEC substation is complete, providing access to the Trinidad Generation Unlimited and NGC's valve station. NEC continues to ensure compliance with the CEC for all onsite activities on a fortnightly basis.

Construction work at La Brea

Alutrint Dock

Piling works for the 307-metre keywall is 85 per cent complete and earmarked for completion by the end of May. The project is a "cut and fill" operation that moves earth from five hectares of backland to fill four hectares of the dock reclamation area. Eighty per cent of the earthworks being removed, roughly 450,000 cubic metres of earth, is being reused as landfill for the reclamation of the port. An access corridor 15 metres wide and 450 metres long, from Labidco to the Alutrint port site, is 60 per cent complete and will be finished by November. Concrete works for the coping beam on the keywall and apron are 50 per cent complete.

An EPC contract has been awarded to Grandi, Lavori Fincosit (GLF) for the second phase of the project – the construction of the Alutrint materials storage and handling facilities. This phase will create the storage silos, conveyor system, administrative and support structures such as fire-fighting systems and sewage treatment for an operational port facility.

Both first phase and second phases will overlap and proceed to completion by December 2010. To reconcile a planning overlap in the port layout, one hectare of TOFCO's facility was relocated inland to the east. This phase of the project has been successfully completed.

Capital dredging of the port is currently awaiting a CEC to deepen and widen the planned channel basin. The completed port channel basin will be 150 metres wide, with a turn basin of 500 metres. The dredge depth is 12.8 metres to accommodate Panamax class vessels.

La Brea Dock: Berth No. 1

The reconstruction of La Brea Berth #1 at Brighton Port is 23 per cent complete with the driving of most of the total number of tubular piles for the works. Preparations for the next stage of reinforced concrete works have been started and the contractor, LMCS Limited, is on track to maintain the approved schedule with a completion date of August 2009. This project has achieved 35,000 accident-free hours.

PCS Nitrogen Blast

In March, there was a fire at the #4 ammonia plant at the PCS Nitrogen complex at Pt Lisas. The plant, which produces 2,200 tonnes of ammonia per day was immediately shut down for officials to conduct safety checks. Port Pt. Lisas located in close proximity to the plant was also shut down for two hours as a further safety measure. The plant resumed full operations within a four-day period after the cause of the blast was traced to a crack in the welding of two pipes. The other plants in the PCS Nitrogen Complex quickly resumed operations after the checks were completed. Fortunately there were no injuries or deaths resulting from the incident.

Alutrint Set to Begin Production in 2011

CEMEC, the construction company contracted to build the smelter, has started compaction and piling works with the buffer zone being cleared.

The smelter will offer business opportunities for downstream aluminium manufacturing works, including the production of roofing materials, aircraft parts, automotive body parts, weather-resistant panels, utensils, electrical conductors and more.

Energy Minister Calls for Renewable Energy

The Minister of Energy and Energy Industries, Senator Conrad Enill, has endorsed efforts to develop local renewable energy projects as an alternative to fossil fuels. Minister Enill expressed these sentiments at the launch of a conference by the Society of Tribologists and Lubrication Engineers entitled "Energy Supporting Energy – An Alternative to Fossil Fuels."

While a number of methods of drawing energy from natural sources have drawn attention, the Energy Minister said that ocean currents, geothermal and hydroelectric power offered the greatest potential for providing an ample, continuous supply of energy.

Minister Enill endorsed efforts to deepen research and understanding and noted that the Renewable Energy Committee launched in February 2009 had been tasked with producing a Green Paper for public discussion on the subject.

LNG boat at ALNG.

LNG Exports Diversify

In 2006, 89 per cent of Trinidad and Tobago's LNG was exported to the US, but by March 2009, LNG was being exported according to the best prices the exports fetched on the open market.

Prices at Henry Hub have averaged US$5.80 MMbtu in late 2008 and in 2009 while prices in Europe (US$15.18 MMbtu) and Japan (US$14.14 MMbtu) have proven to be more attractive. Energy traders have therefore leveraged contract provisions to divert cargo to more lucrative markets.

In the last quarter of 2008, 34 per cent of LNG cargo exported from Trinidad and Tobago was shipped to the US market. The other major export markets for LNG are Spain (29 per cent) and Mexico (13 per cent). The Far East accounted for approximately 15 per cent of LNG exports.

Venezuela's $multi-billion Plan for Maritime Gas

PDVSA has announced the signing of a $19.65 billion joint venture with Portugal's Galp Energia, US Chevron, Argentina's Energia, Japan's Mitsubishi-Mitsui and Itochu Corp to develop an estimated 28.8 trillion cubic feet of natural gas reserves close to the southern maritime boundary with Trinidad and Tobago and on the northern Paria coast, also close to Trinidad's northern offshore oil and gas fields.

The plans call for the development of offshore extraction and pumping facilities, production facilities and pipelines to take the gas to the planned SIGMA (Mariscal Sucre) Complex to be constructed next to the City of Guiria, which will also host two LNG trains.

one moment please

to reflect on the beauty that surrounds us here in Trinidad and Tobago

DAY AT THE BEACH: A magnificent leatherback turtle lumbers ashore at the Mon Plaisir Estate in Grande Riviere to lay her eggs at the height of the nesting season. The largest living sea turtle, the far-ranging leatherbacks have made Trinidad and Tobago one of their significant nesting areas in the Atlantic Ocean. *Photo by Leizelle Kerryann Guinness*

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