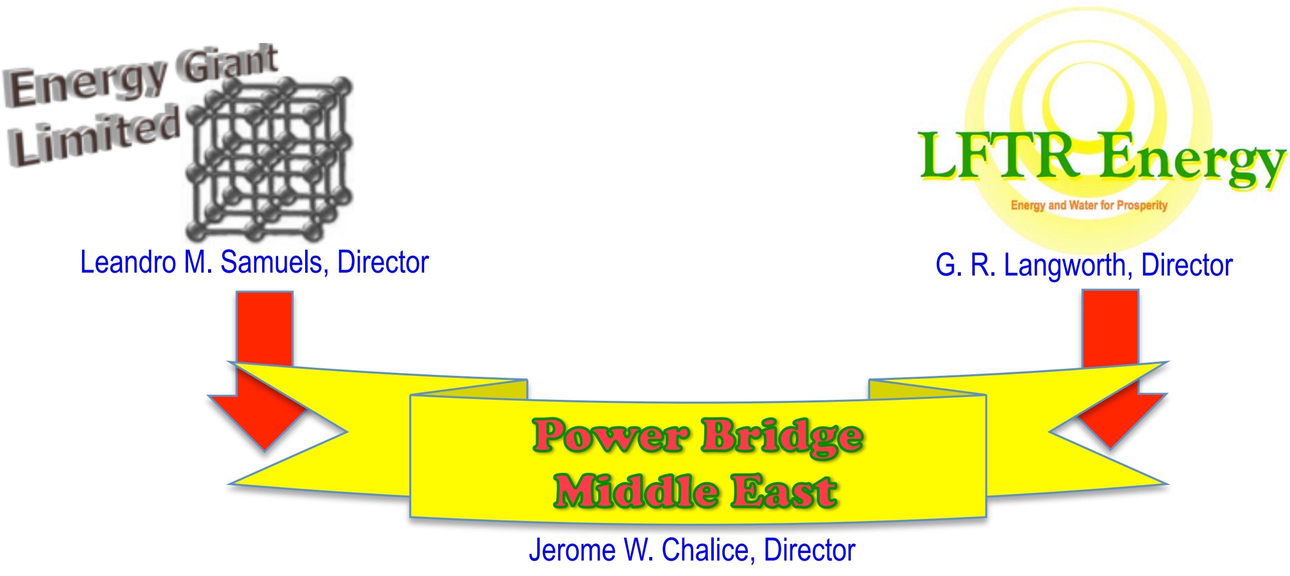
The Power Bridge to LFTRs Program

Overview



The Power Bridge Program

Gas Turbines are routinely tendered by Departments of Energy Generation around the Middle East as a means of generating steam for electricity. These tenders invariably constrain new technology – the new technology has to be justified to executives unaware of it and costs in excess of the tendered configuration put the innovator at another disadvantage. The result is that the price of electricity continues to go up.

Energy Giant and LFTR Energy are willing to finance and operate their new technologies under an Independent Power Producer business model. This approach enables the continuing deployment of innovation to reduce the cost of electricity without confronting the tender process.

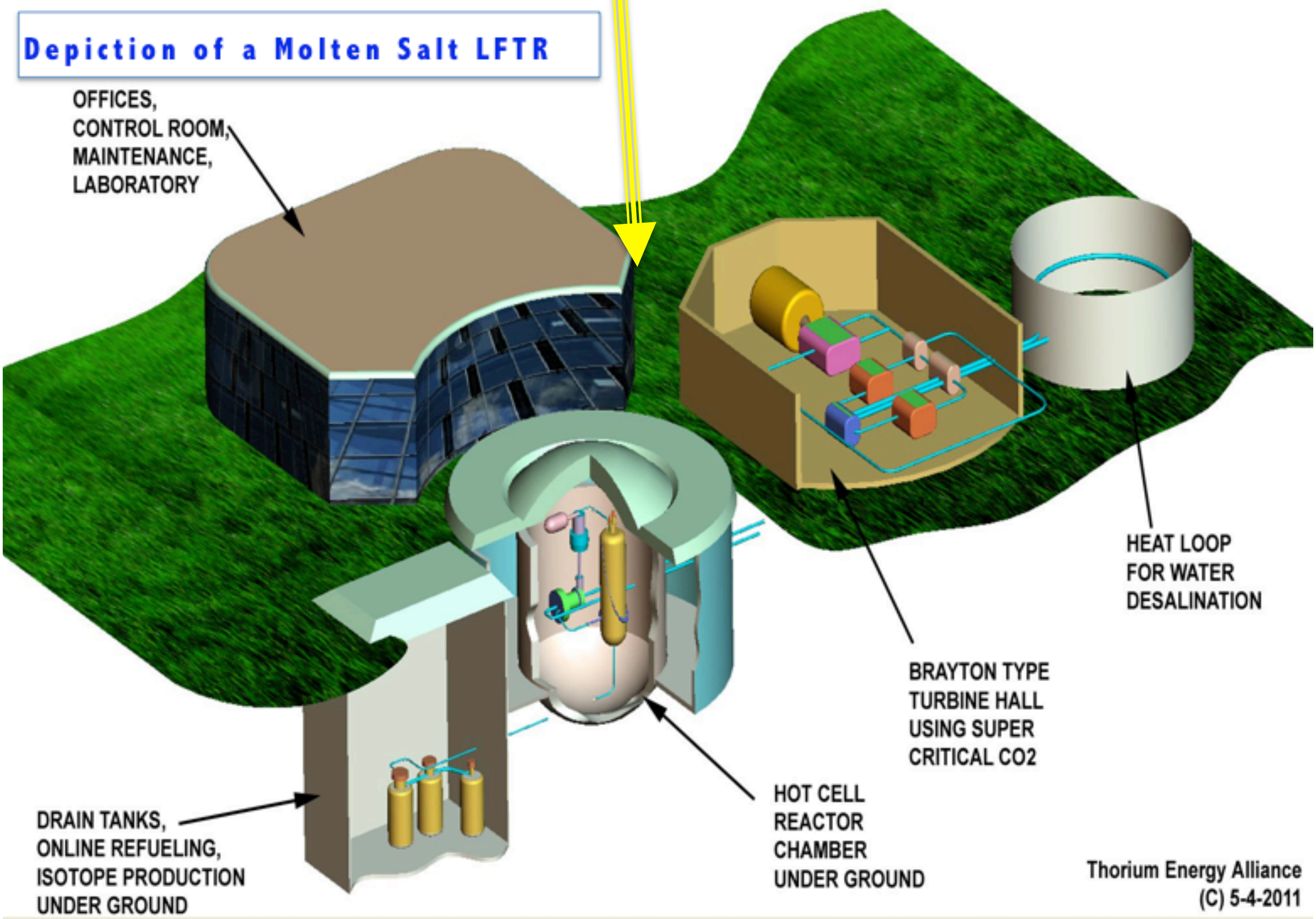
Energy Giant ("EG") is working with LFTR Energy to provide a near-term base-load electricity solution for developing countries. EG will install and operate gas turbine plants carefully integrated with energy enhancement sub-systems to produce the lowest cost electricity possible. After five years, molten salt LFTR power generators will be installed, and the gas turbine plants' output will be redirected to additional power requirements in the developing country market.

EG will be assigned a long-term power purchase agreement either with the Ministry of Electricity or a creditworthy heavy power user, backed up by a sovereign guarantee from the developing country's government, and finally perfected by a third-party performance surety bond. The buyers of electricity will not spend any money until the generators are installed, operational, and producing electricity. At that time, the buyers will be expected to pay for what they get.

This perfected collateral will be assigned to the Power Bridge Program to backstop the Credit Facility that EG seeks to fund the Program.

The Power Bridge is composed of a current power resource – a 200 MW(e) closed cycle gas turbine burning LPG -- that is projected to produce base-load electricity 80% of the time for a period of ten (10) years. Each Power Bridge Program's initial electricity production will be set to commence six to nine months after there is a commitment with Energy Giant LLC. After this 10-year 'base-load' mission, because of more complex, higher-cost operations & maintenance requirements, the 10-year-old Power Bridge plant will convert to a "peaker" power resource, operating just 25% of the time, only at 'peak' demands, for an additional 5 years.

Each 30-year Power Purchase Agreement consists of 5 years of CCGT operated by Energy Giant, then SA LFTR Energy commissions a 200 MW molten salt LFTR power generator to operate for 25 years. The CCGT is then reassigned to generate electricity for other customers.



Multiple-turbine plants give customers backup reliability during down times

- Each 200 MW plant is configured with a group of used open cycle gas turbines matched for waste heat recovery compatibility. First, they are carefully re-engineered to zero hours capabilities, then integrated with four energy efficiency enhancement sub-systems
  - First, inlet fogging skids are configured to cool the hot air of the desert and jungle sites for Power Bridge plants
  - Then steam injection or wet compression is used to increase the mass of hot gas flowing from the combustion chamber to drive the power generator.
  - Waste heat exhaust is then captured from the generator and channeled into steam turbines whose high pressure steam output expands electricity output another 10% to 15%.
  - Last but not least, LFTR Energy's 'flow acceleration' innovation will exploit the remaining 100˚ to 150˚ C. tail-end heat to boost still more electricity from the system
- Fitted to burn Liquid Petroleum Gas that generates 12% to 15% more heat per increment of weight than Natural Gas – burning an average of two metric tons LESS LPG fuel per hour to achieve the same heat production that requires two MORE metric tons of Natural Gas burned per hour.

Variables That Affect Fuel Costs

	Different Gas Turbine Plant Configurations			
200 MW Gas Turbine Fuel Consumption in Tons per Hour	**OCGT**	**CCGT**	**CCGT w/ Systems**	**CCGT w/Systems**
Heat to Electricity Efficiency ("H to E")	**39% H to E**	**57% H to E**	**65% H to E**	**75% H to E**
Why We Prefer LPG	**Tons Per Hour**	**Tons Per Hour**	**Tons Per Hour**	**Tons Per Hour**
Liquid Petroleum Gas (LPG)	35.5	24.3	21.3	18.5
Liquid Natural Gas (LNG)	38.5	26.3	23.1	20
At a Fuel Cost of $800 per Metric Ton, what are the annual savings for a 200 MW gas turbine operating at 80% capacity?	*$ 16,819,200*	*$ 11,212,800*	*$ 10,091,520*	*$ 8,625,231*
Fuel Consumption When Operating at 80% of Capacity	**Tons per Day**	**Tons per Day**	**Tons per Day**	**Tons per Day**
Liquid Petroleum Gas (LPG)	**682**	**467**	**409**	**354**
Fuel Cost Per Plant Per Year at $800 per MT	$ 199,027,200	$ 136,235,520	$ 119,416,320	$ 103,502,769
Fuel Cost Per Plant Per Year at $700 per MT	$ 174,148,800	$ 119,206,080	$ 104,489,280	$ 90,564,923
		0.1052		0.08
Liquid Natural Gas (LNG)	**739**	**505**	**444**	**384**
Fuel Cost Per Plant Per Year at $800 per MT	$ 215,846,400	$ 147,448,320	$ 129,507,840	$ 112,128,000
Fuel Cost Per Plant Per Year at $700 per MT	$ 188,865,600	$ 129,017,280	$ 113,319,360	$ 98,112,000
Est. LPG Lifecycle Fuel Savings w/ Different Configurations	**OCGT**	**CCGT**	**CCGT w/ 3 Systems**	**CCGT w/ 4 Systems**
Per 200 MW CCGT Plant	**39% H to E**	**57% H to E**	**65% H to E**	**75% H to E**
10 Years of Base Load Operations at 80% Capacity	$ 1,990,272,000	$ 1,362,355,200	$ 1,194,163,200	$ 1,035,027,692
5 Years of Peak Load Operations at 25% Capacity	$ 310,980,000	$ 212,868,000	$ 186,588,000	$ 161,723,077
Fuel Costs	$ 2,301,252,000	$ 1,575,223,200	$ 1,380,751,200	$ 1,196,750,769
	Savings over 39%	**$ 726,028,800**	**$ 920,500,800**	**$ 1,104,501,231**
		Savings over 57%	**$ 194,472,000**	**$ 327,327,508**
			Savings over 65%	**$ 184,000,431**

The Power Bridge goal is to push the 'heat rate' down from 11,000 BTUs to produce one kWh, to 5,000 BTUs per kWh.

Direct inlet fogging converts demineralized water into a fog by means of special atomizing nozzles operating at 2000 psi. The fog cools when it evaporates in the gas turbine's air inlet duct, allowing close to 100% effectiveness in attaining 'wet bulb conditions', thereby giving the lowest temperature possible without refrigeration. Direct high pressure inlet fogging is used to create a compressor intercooling effect – allowing excess fog into the compressor, boosting the power output considerably. In general, fog cooling gives a power boost of about 0.5% for every 1^0 F of cooling (0.9% per ^{0} C) . Fog inter cooling gives a power boost of about 5% for every 1% (of air mass flow) of fog injected.

A detailed study (*Tawney, R., Pearson, C. and Brown, M.*, ***'Options to Maximize Power Output for Merchant plants in Combined Cycle Application'***, *ASME Paper No. 2001-GT-009*.) evaluated several options for power augmentation for combined cycle power plants. The option with the least EPC cost impact was **inlet fogging** – the only option that also provided a small augmentation in heat rate, while all other alternatives **worsened** the heat rate. Many existing gas turbines use older technology media type evaporative coolers – this is especially true in hot arid areas. A media type evaporative cooler creates a pressure drop that results in a significant drop in the turbine's power output.

*ASME Turbo Expo 2000, 8-11 May, Munich, "**Inlet Fogging of Gas Turbine Engines, Part B: Practical Considerations, Control, and O&M Aspects**"*

*ASME Turbo Expo 2002, 3-6 June, Paper 2002-GT-30559, "**Inlet Fogging of Gas Turbine Engines: Climatic Analysis of Gas Turbine Evaporative Cooling Potential of International Locations**", Mustapha Chaker, PhD, C.B. Meher-Homji*

"**STIG**" means steam injection in gas turbines. STIG is a technique which can increase a plant's ability to generate extra power without burning extra fuel and requiring moderate capital investment. One low-cost operational method is to use a high strength, thin walled, high temperature nickel alloy once through steam generator in the hot gas path to provide superheated steam suitable for use in the gas turbine. STIG systems operate as an enhancement to the combined cycle. Most gas turbine vendors offer a standard kit that is suitable to convert their turbines to accept steam injection from an external source. Benefits of steam injection include:

- 5% to 25% more power from the base gas turbine
- 2.5% to 15% reduction in base fuel consumption
- Reduction of NOx emission
- Injects maximum steam when electric prices are high
- Flexible process (steam injection 50% to 100% load)

*Oil & Gas Science and Technology – Rev. IFP, Vol. 63 (2008), No. 2, pp. 251-261, "**Gas Turbine Performances Improvement using Steam Injection in the Combustion Chamber under Sahara Conditions**," A. Bouam, S. Aissani, and R. Kadi*

In electric power generation a **"combined cycle"** is an assembly of heat engines that work in tandem off the same source of heat, converting it into mechanical energy, which in turn is used to drive electricity generators.

The exhaust of one heat engine is used as the heat source for another – thus extracting more useful energy from the heat, increasing the system's overall efficiency. The 'combined cycle' works because heat engines are only able to use a portion of the energy their fuel generates (usually less than 50%). The remaining heat (expelled as hot exhaust fumes) from combustion is generally wasted. Combining two or more thermodynamic cycles results in improved overall efficiency, reducing fuel costs. In stationary power plants, a successful and common combination is the Brayton cycle (e.g., a turbine burning natural gas or synthetic gas from coal) and the Rankine cycle (e.g., a steam power plant). Multiple stage turbine or steam cylinders are also common.

http://www.ormat.com - ***"Utilization of Turbine Waste Heat to Generate Electric Power At Neptune Plant"***, *11 Mar 2010, P. Nasir, S. Jones, D. Schochet, D. Posner*

Malakoff Berhad ***CCGT – "Operations Review of the 1,303 MW Lumut Power Plant, in 2002 the largest combined cycle power plant in the country"***

LFTR Energy's "**Flow Acceleration**" innovation, in the words of the engineer / scientist inventors:

"…Water, steam injection seems be promising, but we have no experience with it

- *In comparison with standard gas-steam combined cycle this is an easily achieved system, and its investment cost will be lower than the combined cycle*
- *We must make some basic calculations to have survey about it in short time*
- *Important advantage of pure OCGT is no necessary cooling*
- *The demineralized water consumption can be a problem in the Middle East and Africa*
- *Any cooling of exhaust gas is limited by dew point, or using special materials*
- *Using B-SCO_2-FA in CCGT is connected with small modification of low pressure turbine*
- *Cooling is necessary for CCGT and also for cycles with B-SCO_2-FA, but cooling heat for CCGT twice higher*
- *The principal goal is to achieve approx. 80% heat-to-electricity conversion efficiency*

…It is supposed that the cycle can be developed with:

- *Input heat temperature in the range of 100° to 150° C. equivalent to 212° to 302° F.*
- *Efficiency increase of* ***30%*** *to* ***40%*** *heat to electricity conversion*
- *Only waste heat is used as input in the cycle…"*

If we were to achieve 75% efficiency it would mean a savings of $327.3 million over fifteen years in fuel costs per 200 MW Power Bridge CCGT plant from today's average CCGT's 57% efficiency performance

ENERGY Giant, LLC, (EG) a new Special Purpose Vehicle, has been formed in Hong Kong to finance, own and operate its Power Bridge combined cycle gas turbines (CCGTs) through a series of regional Power Bridge subsidiaries. EG will deploy a series of 200 MW(e) Power Bridge CCGT plants in each Host Country program.

LFTR Energy was organized in the Isle of Man to organize and fund a supply chain composed of a builder (Deutschland LFTRs in Germany), a system integrator (Calcutta LFTR Export in India), and an owner / operator (SA LFTR Energy LLC in Isle of Man) to verify the molten salt reactor technology originated and proved in the 50s and 60s, then build, own, and operate molten salt LFTR power generators (operations of which begin before the end of 2016) under LFTR Energy's 'Trusted Destinations' private sector nuclear initiative – fully transparent to oversight by the International Atomic Energy Agency of the United Nations.

LEADERSHIP

Leandro M. Samuels, Director, Energy Giant (HK) LLC

Education – Diploma in Industrial Metallurgy

Director of Anglotel (Pty) Ltd, 1994 to 1999: For the provision of turnkey solutions in the broadcast and telecommunications fields (e.g., Radio Safari: commissioning of Radio Safari, the world's first wild life radio station) in addition to various broadcasting projects across Africa, including such countries as Gabon, Zaire, and Lesotho.

Director of Fieldstone Southern Africa (FSA) 1994 to 1999: Fieldstone is headquartered in New York, USA and is reputed to be the largest project financing entity in the world today, specializing in major capital projects such as hydroelectric schemes, toll roads, aircraft finance, and various other forms of finance, including mergers and acquisitions, as well as structured finance. Mr. Samuels was one of the founding directors of Fieldstone's SA office, responsible for the NSB transaction, together with various other pending mandates for many South African and international companies.

Founding Director of Energy and Utility Group, from 1998 to present: The emphasis for this company was providing development for the African continent in electricity, gas and related activities. Formed the **Consolidated Empowerment Initiative (CEIN**) that procured the rights for **Cisco** for Sub-Saharan Africa. The company was comprised of seven IT empowerment role players who partnered with **Persetel Q Data** for the roll out and implementation of its business projects.

Founding Director of Madiba Bay from 2000 to present: Together with Mr. Fezekile Mahlati, Mr. Johan Dreyer, and Mr. Tumelo Motsisi, fellow partners in the Eastern Cape Project. The project's objective was the extension of Black Economic Empowerment, job creation, and the transfers of skills with the core foundation of the project underpinned around sustainable development.

Director of TalkWithUs (Pty) Ltd., from 2008 to present: Developed the power grid network with George Langworth

Director of Energy Giant LLC, HKSAR, formed 2010 to present: Developed the Power Bridge Program with George Langworth

G.R. Langworth, Director, LFTR Energy

Member, startup development team for Unisys Corp.'s SNAPnet retail brokerage support system, a pre-Windows UNIX-server-based distributed IT environment that managed 25 real-time applications for several hundred registered brokerages representatives at each office where it as installed.

Member of the six-person start-up team for the USD$ 1.65 billion FLAG submarine cable system (landing in 17 countries from the United Kingdom to Japan)

Developed design and implementation strategy for **MARUBENI TRADING / GLOBAL CROSSING** terrestrial network project in Japan

Recruited and collaborated with the Global Buyers' Cooperative Networks (GBCN) team of seasoned and world-class telecommunications experts in the conception, design, technical engineering, and business models for:

- The "**DATA CALL**" – a dedicated bandwidth business-to-business transport service delivering the high Quality-of-Service value of a leased private line provided at a fraction of its cost on a 'pay-on-as-used' basis
- The '**LOCAL FULFILLMENT FACILITY**' – a revolutionary private network solution that captures and backhauls mobile voice and broadband sessions for cellular operators on a wholesale basis – providing 500% more broadband in a macro-cell' footprint at 30% of the cost of a macro-cell.
- The '**POWER GRID NETWORK**' – a fiber optic and power-line communications metro area network environment that supports and markets fully resilient mission-critical smart grid, residential, and business-to-business networked application services.
- The '**LFTR POWER GENERATION SUPPLY CHAIN**' – a self-contained commercial supply chain composed of manufacturing, certification, and deployment enterprises that solve long-term low-cost renewable power generation and fresh water requirements for developing countries.

Jerome W. Chalice, Director, Power Bridge-Middle East

Education: Matriculated in 1980, Data Processing Diploma (P.E. Technikon), BCom Information Systems (UNISA), Business Management (Paris Chamber of Commerce)

Director for J.C. and Associates from 1995 through 1997.

Managing Director of ARMADA from 1998 through 1999.

Managing Director of A2A Global Technologies from 2002 through 2003

President, TalkWithUs (Pty) Ltd. operator of outdoor wireless networks, covering more than 100,000 square km of under serviced rural areas in South Africa. Projects include Kwa-zulu Natal Network, Magaliesburg, Thabazimbi, Vaal Triangle Network, Majhabeng Municipality, BHP Billiton Mine Group in Hotazhel, Illovo Sugar Mills in natal, Alazon Connexions, Metro Rail's video surveillance network, and Gateway VoIP at shopping centers across SA, working in conjunction with BCX and Datapro.

Lindsay Dempsey – Chief Engineer, Power Generation

EDUCATION - University

The most recent studies were towards a Diploma in Business Studies (Engineering Management) at the University of Auckland. Papers completed to date include; Financial Management, Resource Management, Quality Management and Quantitative Methods for Managers (short course).

Bachelor of Engineering Degree, direct entry to the Second Professional year in Mechanical Engineering at the University of Auckland 1988, completed in 1989.

<u>Marine Engineering Technical</u>:

Class 1 Marine Engineer (Motor) 1990 NZCE (Power & Plant) 1984-87;
Class 2 Marine Engineer (Motor) 1985;
Second Class Coastal Motor 1982 Trade (fitting and turning);
Third Class Steam 1982 Advanced Trade Certificate 1980.
Trade Certificate 1979

WORK EXPERIENCE - GENERATION SOLUTIONS LTD

In May 2003 Generation Solutions Limited (GSL) was formed. GSL provides engineering and consulting services to the New Zealand electricity and energy sector with thermal power plants being the core specialty. Core services offered to clients include:

· Asset management planning; · Maintenance planning review and analysis; · Retrofit and upgrade analysis and advice; · Power station performance analysis; · Collection, collation and reporting of generator/equipment reliability statistics to NERC/GADS and IEEE 762 Standards; · Feasibility Studies for thermal power plants, cogeneration options small and large, innovative generation and energy solutions; · Peer review for thermal power plants, and cogeneration options small and large; · Thermodynamic analysis of novel power cycles and thermal process design; · Investigation of major equipment failures; · Management of insurance claims in relation to major equipment failures; · Generating equipment selection and specification; · Negotiation of long term service agreements for gas turbines and combined cycle plants; · Breakdown and incident reviews; · Collection, collation and dynamic reporting of operational data and statistics: - Application of Statistical Process Control methodologies to operational data to highlight performance, data integrity or other issues; - Spreadsheet Automation for Budget Tracking and reporting; - Statistical Process Control analysis and reporting.

Recent activities have included: · Relocation investigations for 155 MW open cycle GT plant; · A feasibility study for 45 MW cogen plant including major equipment selection, process design, capital estimates and economic evaluation; · Peer review of the concept design of 125 MW combined cycle power station; · Specific optimisation assessments for a 125 MW combined cycle power station; · A review of emergency generation systems for Waikato District Health Board; · Participation in a working group reviewing a proposed industrial cogeneration project for Waikato District Health Board; · Selection, thermodynamic performance analysis and simple business case preparation of upgrade opportunities for a combined cycle power station; · Design and construction of spreadsheet based HS&E statistics data collection and reporting system; · Major overhaul of generator reliability recording and reporting system; · Major upgrade to a budgeting workbook for a major combined cycle power station to incorporate new GL codes and reporting requirements; · Provision expert advice to a law firm seeking to make a financial recovery from a gas turbine manufacturer; · Reviewed the technical aspects of a proposed relocateable genset portfolio including machines up to 5.2 MW capacity; · Completed the design, thermal cycle simulation and analysis for a high temperature, high efficiency externally heated thermal cycle; · Developed a concept design and thermal analysis for the integration of a new gas turbine into an existing coal fired power station using the GT exhaust heat for feed-water heating.

Lindsay Dempsey – Chief Engineer, Power Generation (continued)

NGC (NOW VECTOR) AND TRANSALTA NEW ZEALAND (TANZ)

Feb 02 to May 03 Asset Manager - Generation. As a result of an internal restructure, this position was created to provide asset management services in support of the four generating plants managed by NGC. Responsible for the development of asset management plans, asset performance monitoring, heat engines of GT replacements, upgrades, and maintenance contracts . During this period there were two insurance claims for machinery breakdowns on two different machines. Both were successfully resolved and settled promptly with the insurance companies concerned.

Feb 01 to Feb 02 Manager Projects and Engineering - Generation. Responsible for managing the supply of engineering and project management services to the generation section of NGC who had bought out and absorbed TransAlta NZ in late 2000. Projects included the supply and installation of new transformers at Cobb Power Station ($3M) and the first C inspection (major overhaul) at the 360 MW Taranaki Combined Cycle Power Plant ($12M). During the C inspection Lindsay was also acting plant manager for the full duration of the outage. Engineering activities included investigation of power augmentation options for the CCGT plants, analysis of upgrade options for Cobb; creation and imulation of a new offer model for Cobb. Commercial activities included supporting NGC's valuation and sale of its share in the Silverstream Landfill Power Station and initial negotiations with GE for a long term service contract ($30M) for two LM6000 gas turbines.

Contribution to LFTR: Can take care of the non-nuclear part of the power station. Can run teams to build heat engines – Brayton Cycle system familiarity. Is working on a Heat Engine Cycle using helium which is confidential but under NDA would share it with us and believes technically it could fit into our programme.

Skill Sets: Chief Engineer of Power Generation Systems.

Specialists whose solutions we plan to incorporate in our Power Bridge CCGT systems:

http://www.liburdi.com/default.aspx
http://www.bfi-automation.de/en/inhalt.php?bereichid=2
http://jasc-controls.com/
http://www.otsg.com/start/home/?
http://www.meefog.com/technology/

Engineering, Procurement and Construction (EPC)

Dr. Cliff Lewis, former chief engineer for Eskom, RSA's energy generation parastatal, and his partner, the equally esteemed **Dr. Pieter Du Plessis**, have enjoyed a long relationship with Mr. Samuels. They head up our EPC and operations for Power Bridge CCGT plants via their firm, FIRST TECH GROUP.

First Tech founded in 1995, doing business under the trade name, POWER PROJECTS AFRICA (PPA)

Essence of this service was the pre-development and deployment of power projects for third-party investors, including –

- Prospecting of opportunities
- Energy project research
- Techno-economic feasibility studies
- Pre-development and development of power generation projects
- Owners engineer assignments

REPRESENTATIVE PROJECTS –

- Belle Vue Mapou Mauritius 72 MW – co-developer and EPC Contractor for Duke Engineering
- Bell Bay Repowering for Duke Energy in Tasmania
- Synchronous Condenser, Richards Bay Minerals – part of a 160 MW Power Plant
- Developer and engineer, construction and commissioning for New Castle Co-Generation Project of a 15 MW 100 tons-per-hour steam for IPSA
- Developed 600 MW Coal-Fired Power Station in Mozambique (in process)
- Developed 600 MW Temane combined cycle project in Mozambique for GDF Suez
- Developed DoE, 1,000 MW Open Cycle Gas Turbine Project for GDF Suez
- Elgas Acquisition / Expansion to 2.4 MW (2010-11) – Expanding to 4 MW (own, operate, and maintain) – engineering, construction, and commission

REPRESENTATIVE TECHNICAL STUDIES --

- Power supply strategy for Riversdale Mining, Mozambique
- Power generation plan, Malaysian Mining Corp for Myanmar
- Power generation strategy for BHP Billiton
- Power generation master plan for Durban Metro
- Tongaat Hulett Biomass Power Project Strategy
- Energy Strategy for The Gambia
- Bagasse Power Development Strategy, for the government of Swaziland
- Supply replacement strategy EB Steam, for Eskom
- Waste incineration power raising strategy – SABS and Durban Metro
- AngloGold Ashanti power strategy for Africa

REPRESENTATIVE CLIENTS –

- SASOL (Gas & SCI)
- BHP Billiton
- Iscor
- Dow
- PPC
- RBM
- Mondi
- MMC (Malaysisa)
- Elgas
- Isegen
- SAPREF
- ENGEN
- Tongaat-Hulett
- Riversadale Mining
- AngloGold Ashanti
- Eskom
- Suez-Tractebel
- Duke Energy
- SIDEC
- CEB (Mauritius)
- SEB (Swaziland)
- EDM (Mozambique)
- Macquarie
- NEDCOR
- COFACE
- CGIC
- MCR (Mauritius)
- The Gambia
- Mozambique
- Swaziland
- CSIR
- SABS