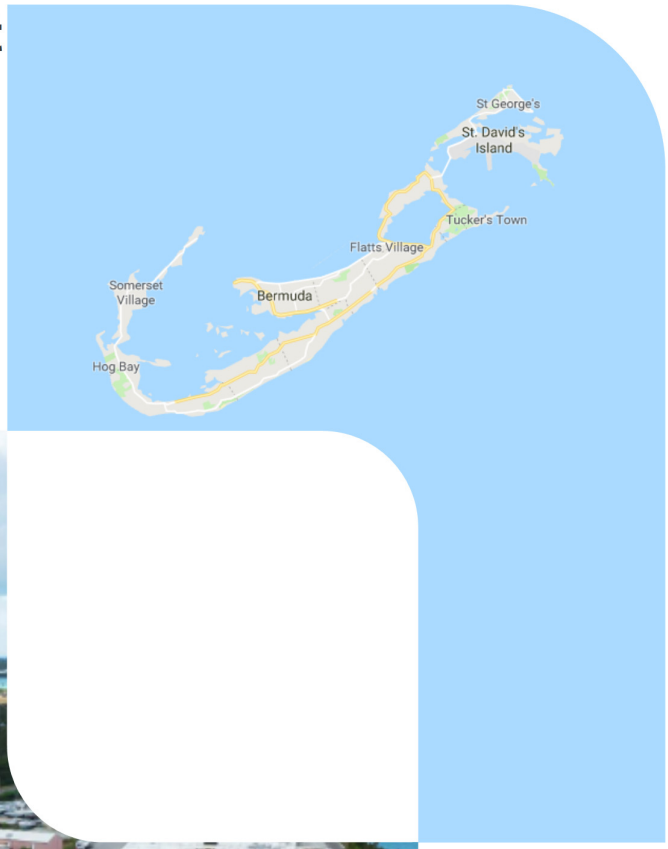
Ships Wharf Energy Plant Bermuda

BCM McAlpine /Bouygues Energies & Services Proposal



Date : June 29, 2018

Summary

1. Context: Bermuda Power sector

1.1. General Context

Electricity in Bermuda is provided by the Bermuda Electric Light Company Limited (BELCO), which is Bermuda's sole supplier of electricity, operating a generating plant, transmission and distribution systems throughout the territory.

BELCO's Central Plant is divided into the East and West Power Stations, in the Central Parish of Pembroke, with **21 diesel engines and gas turbines** (maximum derated amount of power : 167 MW).

The diesel engines carry the basic load of power used on a daily basis. They are slower to start up than the gas turbines but are more efficient to operate. In contrast, the gas turbines can be used almost immediately upon being started up.

The demand for electricity is always greater in the summer than in the winter, due to the use of air conditioners). To date, the highest summer peak demand of 123 MW was recorded in August 2010. Large commercial organizations use about 40% of electricity produced.

HFO (heavy Fuel Oil) is used to operate the four newest diesel engines (2005) and (LFO) light diesel fuel for the gas turbines. The fuel is pumped through a nine-mile (6-inch underground) pipeline from Esso's storage tanks to three bunker tanks on the BELCO property. In 2009, approximately one million barrels of fuel was used to produce electricity for Bermuda.

1.2. Price of Power

The import duty on the oil is very high, and electricity rates are very high by world standards.

According to the 2018 BELCO Integrated Resource Plan Proposal (IRP), the LCOE (Estimated Levelized Cost) is estimated at 170.80 $/MWh (Table 2-1). Refer to 2018 Integrated Resource Plan 2018 by BELCO (Bermuda Electric Light Company) dated Feb 15, 2018.

A fuel price forecast is given in Section 1.5 of the BELCO IRP proposal for the currently used HFO and LFO and also for Liquified Natural Gas (LNG) and Liquified Petroleum Gas (LPG).

1.3. Security of supply

As described above, the supply of electrical power to Bermuda relies solely on the single BELCO power plant located on Pembroke site in the Central Parish of Pembroke.

The existing distribution grid organization is thus subject to several hazards due partly to the age (decaying of the network) and the exposure to weather (most of the network is distributed overhead).

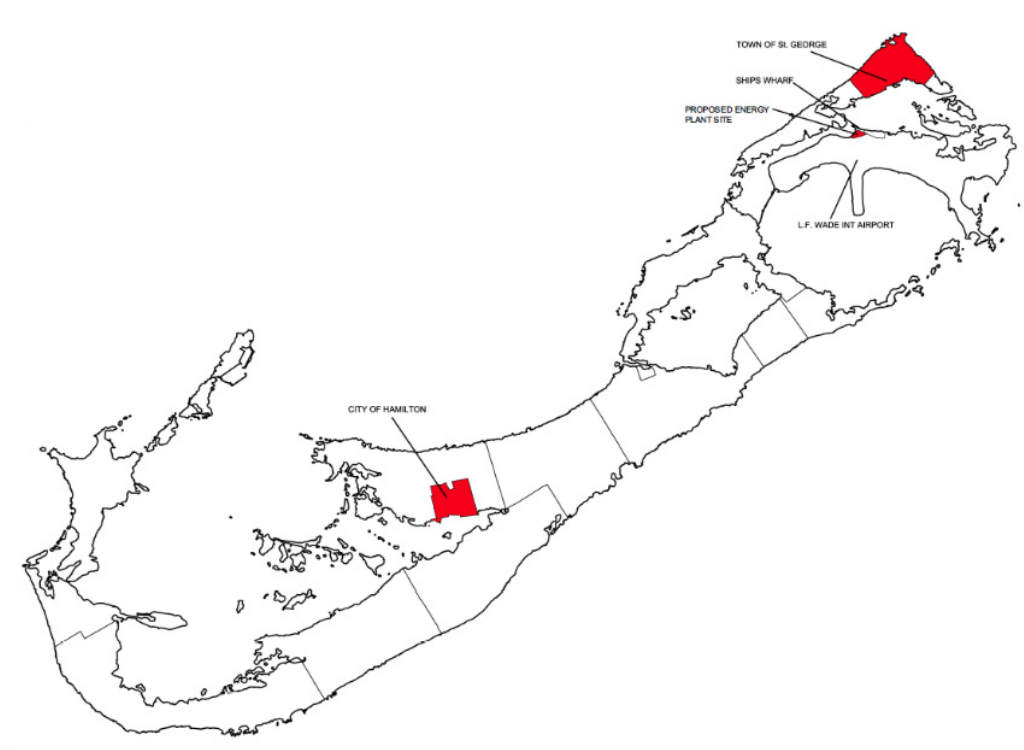
The decentralization of main power production sites on the island would help a lot in mitigating the risks associated with the state of the existing grid.

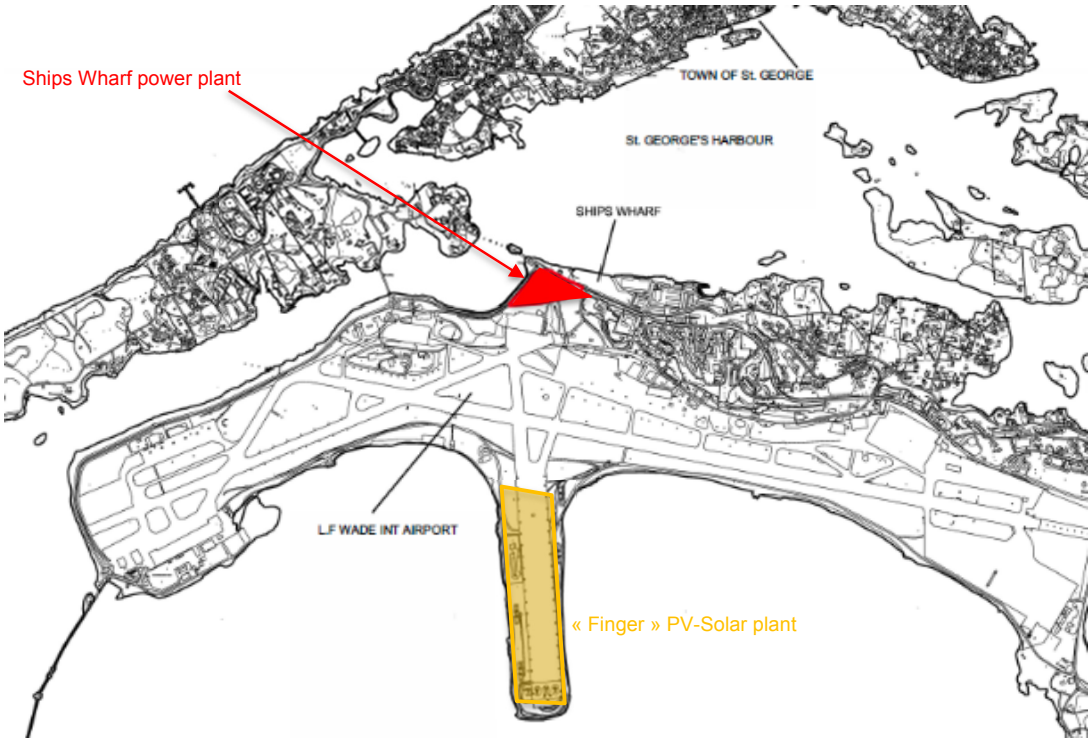
Solar and other renewable energy sources are not yet used in Bermuda, on a utility scale, however, there is a project due to start shortly to erect a 6MW-solar farm on the disused ex- US Air Station runway and munitions store area, also known as “the Finger”. In the previous administration, the One Bermuda Alliance government put out a Request For Proposal for the site in December 2016 with the goal of selecting a developer by April, 2017. Under the current Government this project was continued and should start construction at the end of 2018. This is the first project that may help in decentralizing power generation on the Island.

2. Project Description

In this context, BLDC (Bermuda Land Development Company Limited) are proposing to develop a new power plant close to Marginal Wharf in the parish of St Georges.

2.1. Site location





2.2. Description of the Site

Site area: the approximate size for the land allocated by BLDC for locating the proposed Energy Facility is 29,169 Square Meters.

The proposed lot allocated by BLDC is sufficient to build at least a 20MW power plant.

The proposed location for energy production is adjacent to Ships Wharf, which is part of a separate project by the BLDC, to establish a new port facility.

This adjacency means that the new port could become a new supply entry for the fuel of the future power plant.

3. Technical solutions

In determining the best solution for a power generating plant on this site, several different potential solutions will be studied, and compared against one another.

A full and detailed analysis will be required to select the best technical and economical solution for Bermuda, while keeping in mind the security of supply, however, briefly for the purpose of this proposal we provide the following different technical solution (with pros and cons).

Note that a fuel (HFO/LFO/LNG/LPG price forecast has been described in Section1.5 of BELCO IRP.

3.1. LFO/HFO

LFO (Light Fuel Oil) and HFO (Heavy Fuel Oil) powered engines are a well-known technology for power plants.

These fuel types are the ones currently used at the BELCO power plant.

They are reliable, easy to use, readily available, and the facilities to import, unload and store them are already in place. Note the HFO is currently piped from the import facility in St Georges to the BELCO Pembroke power generation site. Should an HFO/LFO solution be determined as the best solution for the BLDC plant a similar pipeline delivery method would be considered.

The main weakness of a power plant using this type of fuel are:

- Fuels are subject to high volatility of fuel price
- Combustion of these fuels causes pollution (flue gas emission)

The price of HFO delivered to Bermuda was $77.93 per barrel in January 2016[1].

3.2. LNG

The volume of LNG gas available worldwide has increased a lot in the past 10-20 years, leading to a less expensive gas price. New shipping routes are now also available, further contributing to the competitiveness of pricing.

LNG (Liquified Natural Gas) engines and turbines are a much cleaner technology than the old HFO/LFO engines. Furthermore, it is now a robust technology with a proven track record.

To tackle the security of supply, power plants running dual fuel (gas/LFO) engines are now available on the market. Bouygues has recent experience of this type of engine as we have very recently completed such a project (80MW power plant built in 2018 in Gibraltar).

Bulk liquefied natural gas can be delivered to Bermuda directly from the USA, to the existing Fuel Oil depot facility (located at the Oil Pier west of the town of St Georges). It is proposed that an approximately 1.5 mile pipeline will be built from this depot location to the proposed new power plant location at Marginal Wharf.

[1] http://www.royalgazette.com/article/20160224/NEWS/160229870

3.3. Biomass

A biomass power plant, burning wood pellets, would also be considered. It would consist of a boiler, a steam turbine and a generator to produce the base load power.

Wood pellets, sourced in sustainable USA forests, are commonly used for biomass power plants, including in Europe (such as the Drax biomass power plant in the UK).

The location of the proposed power plant, very closed to Marginal Wharf (and the proposed new cargo facility), is very convenient for a direct unloading of the wood pellets from the delivery vessel, and for storage in the vicinity of the proposed power plant.

This technology provide a clean, reliable, and renewable source of energy.

3.4. Conclusion

Below is a basic comparison of the different technologies.

	Capital Expenditure (CAPEX)		Operational Expenditure (OPEX)	Security of supply	Environmental criteria
	Power plant	Fuel supply (storage/handling)			
HFO/LFO	5	4	3	5	1
LNG/LPG	4	2	5	5	4
Biomass (pellets)	3	3	3	4	5

Very good	From 5="very good" to 1=poor
Medium	
Poor	

A full and detailed analysis will be necessary to determine which fuel and engine technology solution provides the best solution for Bermuda's power supply at this proposed facility, and over the long term.

4. Team expertise

4.1. Team organization

The team of Bouygues Energies and Services and BCM McAlpine combines the global experience of a power plant supplier with the local experience of Bermuda's oldest construction company. Bouygues Energies and Services have a proven track record of engineering and constructing facilities worldwide and particularly in island and remote environments. BCM McAlpine have been building in Bermuda for over 90 years and have been involved in many of the country's largest projects.

Bouygues and BCM McAlpine have assembled a team of experienced Bermuda companies to provide design and other support services to ensure that the best possible turnkey solution is provided to BLDC and Bermuda. These companies and their relevant disciplines are as follows:-

- Mechanical & Electrical Bermuda design support – ABM Limited
- Civil and Structural Engineering design – Entech Limited
- Environmental Impact Studies Project Support – BEC Limited
- Permitting and local architectural design: OBMI Architects

Additional information on these companies is provided in section 4.4 below.

4.2. Bouygues Energies & Services

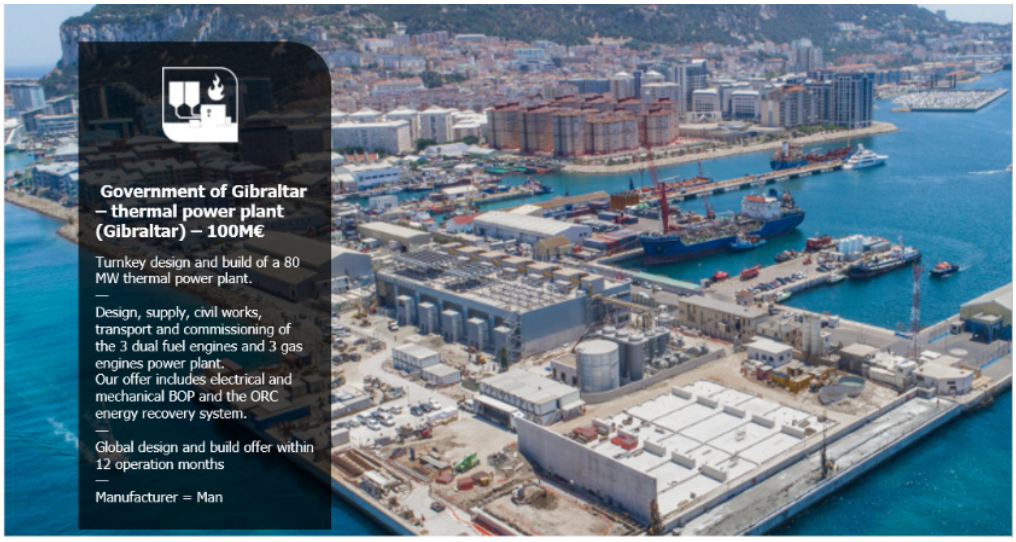
4.2.1. Description

Bouygues Energies and Services is a French EPC (Engineering, Procurement, Construction) company specializing in technical facilities construction and revamping including Power plants (thermal, biomass or solar). Bouygues Energies and Services is part of Bouygues Group, which was founded in 1952, is located in 80 countries, with 135 000 employees for 32 billion € of revenue.

- Bouygues Energies and Services have developed successful power plant projects with blue chip customers such as EDF, Gibraltar Electricity Authority, New Nuclear Build, and Albioma, Neoen. Bouygues is well known for managing turnkey projects all over the world.
- In addition, Bouygues is a leading construction firm that has engineered and built many infrastructures, buildings and roads across Africa, Asia, America and Europe for more than 50 years.
- Finally, Bouygues Energies and Services is as an independent expert for Energy efficiency which always ensure the best practices for its clients. Thanks to close relationships with the equipment manufacturers (engine, turbines, boilers,…), we select the best one depending on the project.
- Bouygues Energies and Services is registered as Proponent with BLDC for the Ship's Wharf Energy Plant RFQ

With unique multidisciplinary consulting, design and build capabilities from financing to O&M, including civil works, mechanical & electrical balance of plant, instrumentation & control, engineering, procurement, construction and commissioning, we offer a turnkey solution with low risk and fast track mode of delivery to drive innovation and sustainable growth.

4.2.2. Power plant references




Albioma– gas turbine power plant (Reunion Island) – 25 M€
Turnkey design and build of a 45 MW gas turbine power plant
–
Design, supply, civil works, electrical and mechanical BOP, transport and commissioning of the gas turbine power plant.
–
Global design and build offer
–
Manufacturer = GE


EDF – EDG power plant Hinkley Point (UK) – 200M€
Turnkey design and build of a 74.4 MWe emergency power plant.
–
Design, supply, transport & commissioning of the 8 9.3 Mwe emergency diesel generators (EDG) power plant located in 4 buildings.
–
Global design and build offer
–
Manufacturer = Hyundai


Electra – Palmeira Thermal Power Plant (Sal Island - Cape Verde) – 22.9M€
HYUNDAI
Turnkey design and build of a 17 MW thermal power plant
–
Design, supply, transport & commissioning of the 3 diesel fuel engines power plant.
–
Global design and build offer
–
Manufacturer = Hyundai

BYTP/DTP Mining / Power plant Bauxite (Guinea Conakry) – 7,5 MVA

Construction and operation of the future bauxite mine power plant.

—

Design, Engineering procurement and construction of the plant.

—

Five 1500 kVA CAT 3512B engines, running on diesel

AssetGen – Biomass gasification plant at Hoddesdon in Hertfordshire (UK) - 82 MGBP

Turnkey delivery of a complex, large-scale energy infrastructure project. Output of the biomass power plant = 10 MWe, 76.000MWh/year of green electricity to the grid

Design & build contract = 49 M GBP
10 years O&M contract = 33 M GBP

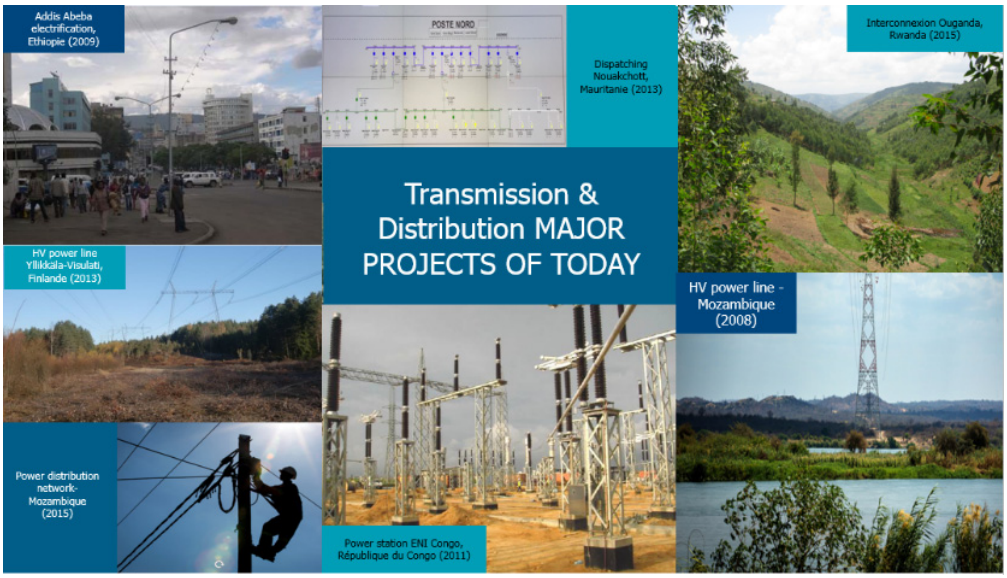
Over 90.000 tons of waste-derived fuel from local commerce & industry


Biomasse
New Waste-to-energy gasification plant in Belfast (Northern Ireland) - 146 MGBP
Turnkey solution using advanced thermal Technology developed in conjunction with Biomass Power Ltd, Output of gasification plant = 15 Mwe, 100GWh net/year of green electricity to the grid.
150 000 tons of C&I waste/year
–
Total costs contract = 146 M GBP
17 years O&M contract = 58M GBP
EPC (27months) = 88M GBP
–
Saving 50.000 tons of carbon / year.
More efficient & less pollutant than combustion


Biomasse
Dalkia – Biomass power plant in Orléans (France)
Design and build of the electrical power plant of the biomass power plant.
Biomass boiler and exhaust treatment : 32 MWth
Steam turbine : 10 MWe
–
Availability : 8 150h/year


Biomasse
Dalkia – Biomass power plant in Rennes (France)
Design and build of the electrical power plant of the biomass power plant.
Biomass boiler and exhaust treatment : 35 MWth
Steam turbine : 7,5 MWe
–
Availability : 8 150h/year


Parkes, Griffith, Dubbo, Narromine Solar Plants of 131 MWp - Australie (2017)
Soleq Sukhothai Solar Plant of 30 MWp Thaïlande (2014)
SOLAR MAJOR PROJECTS OF TODAY
Yaita Solar Park of 13,7 MWp, Japon (2017)
Polo Solar Farm, Negros Island 132 MWp, The Philippines (2016)
Noheji Solar Park of 41 MWp, Japon (2016)
Luxey – Ygos-Garein Solar Plants of 30,1 MWp France, (2014)
Whitsundays Solar Plant of 69 MWp, Australie (2017)


Addis Abeba electrification, Ethiopie (2009)
POSTE NORD
Dispatching Nouakchott, Mauritanie (2013)
Interconnexion Ouganda, Rwanda (2015)
Transmission & Distribution MAJOR PROJECTS OF TODAY
HV power line Yllikkala-Visulati, Finlande (2013)
HV power line - Mozambique (2008)
Power distribution network Mozambique (2015)
Power station ENI Congo, République du Congo (2011)

4.3. BCM McAlpine

4.3.1. Description

BCM McAlpine Ltd (“BCM McAlpine”) was formed after BCM, a Bermuda based construction group and Sir Robert McAlpine Ltd (“McAlpine”), a UK based construction group, entered into extensive discussions on joint venturing on major projects in Bermuda. Through these discussions it became clear to both parties that they shared a common approach to business – a commitment to quality products and service, and a determination to build long term relationships.

In early 1996, this relationship was truly cemented when the local management bought out BCM’s share of the Company and the new operation purchased the operating assets from the BCM Group. This created a small but flexible management team with the resources, both physical and human, to position BCM McAlpine to provide the level of service and expertise that Bermuda needs to help enhance its position in the international business arena.

BCM McAlpine operates solely in Bermuda and is mainly involved in general contracting and construction management. We undertake commercial office, hotel, school, residential interior fit out projects and civil engineering projects as well as operating a builders’ supply merchant yard and Bermuda’s largest mill shop which and produces one-off special order millwork for the local market.

4.3.2. References

Civil engineering projects undertaken in Bermuda include the Pembroke Power Station Generators E5 and E6 undertaken for BELCO,, a telecommunications building for 360 Networks and the rebuilding of Somerset Bridge, the world’s smallest drawbridge, Palmetto Road rock stabilization and repairs to Longbird Bridge, all for the Department of Works and Engineering.

BELCO Power Generating Building (1999).

Somerset Bridge (1998)

BCM McAlpine continues to build Bermuda's biggest as most prestigious projects. In 2014 we completed Bermuda's first P3 project, the $250 million New Acute Care Wing at King Edward Memorial Hospital. In 2017 we completed the Cross Island Landfill and Infrastructure for the Event Village for America's Cup 35, hosted in Bermuda.

New Acute Care Wing at KEMH (2014)

Oracle USA Base for America's Cup 35 (2015)

BCM McAlpine is a Bermuda based construction company with a history of over 90 years work in Bermuda. We have successfully performed many contracts covering the full spectrum of work, from residential to commercial office base build and fit out to hotel building and renovation.

To this, through our association with Sir Robert McAlpine Ltd, we have added the necessary expertise and resources to ensure that we can tackle any project in Bermuda with the comfort that we have the right blend of local knowledge and technical expertise to deliver a first-class product to our client's budget and timetable.

4.4. Bermuda Support Companies

4.4.1. ABM Limited

ABM Limited was formed in 2016 by the former senior management team of a large electrical contracting and engineering company. The two principal directors of the company, Terry Barrow and Bryan Adams, have over 60 years combined experience and have executed many large electrical construction projects in Bermuda.

ABM Limited provides electrical and mechanical engineering design, electrical contracting and maintenance to clients in the commercial, industrial and residential markets.

4.4.2. Entech Limited

Entech Ltd. is a Bermuda based company. Entech's consulting services relate primarily to civil and structural design services on various marine, commercial, industrial, institutional, and residential developments. Entech also provides consultancy services in planning and project management.

At Entech, we possess a thorough understanding of local construction processes, codes and guidelines. Entech boasts an extremely experienced compliment of senior engineers who have worked with the country's leading architects.

Our engineers have worked extensively in Bermuda, South America and the Caribbean. Our work covers a wide range, both in size and type, ranging from minor alterations a few thousand dollars in value to new construction and refurbishment projects a few hundred million dollars in value.

Entech has worked with several international firms, as the local engineering representative in support of and as the primary engineer.

At Entech Ltd. we have a great reputation for being problem solvers and creating practical solutions that are understood by our clients and contractors. Our goal is to ensure that we have found the most suitable, cost-effective and buildable engineering design solution.

4.4.3. OBMI International

OBMI is Bermuda's most experienced full service professional design firm. Founded in 1936, OBMI provides Architecture, Interior Design, Landscape Architecture, Master Planning and Project Management services. Over the past 80+ years OBMI's clients range from global corporations such as Bacardi International and AIG, Hotels and tourism products, HM Government House, Bermuda Government institutions and schools, churches and the full range of residential developments. Most recently OBMI participated in Bermuda's first P-3 infrastructure Project, The Acute Care Wing of the King Edward Memorial Hospital.

4.4.4. Bermuda Environmental Consulting Ltd.

Bermuda Environmental Consulting, Ltd., is a professional environmental and land use planning consultancy that operates at the highest level of scientific integrity and commitment. Their clients include the public and private sector, as well as third sector NGOs. Bermuda-based, they are uniquely positioned to offer their expertise in a range of environmental compliance, land use planning, impact assessment, remediation, analytical research and monitoring, natural resource management and sustainability services.

Environmental issues will continue to grow in importance within our community, as they are globally. Environmental degradation and resource limitation will become increasingly important factors in our home and business lives. Resource scarcity and increased environmental regulation are inevitable. Those communities and businesses that effectively adapt to this changing reality will be better positioned to thrive in the future. We believe that applying our extensive environmental and land use planning experience to secure and provide the best available information to assist our clients in achieving sustainable solutions, is the most effective means for us to contribute to our community.

We seek to anticipate our clients' evolving needs by continually enhancing our broad suite of complementary technical and strategic skills through training and best practice experience. We uphold the highest ethical standards, support professional activities that provide a public service, and endeavour to mentor dedicated young Bermudians. We are committed to finding creative, low-cost efficient ways to operate. We look for opportunities to reduce the environmental effects of our own operations, and support activities that promote the protection of community health and a sustainable global environment.