Source:AP Photo/Koji Sasahara (2014)

Evaluating LNG to Power skills in South Africa

The report was aimed at focusing on the skills needed for LNG to Power generation by identifying the current skills internationally and deficits in the South African workforce. The report identified the mid-to-downstream industry skills shortages which have not yet been addressed in South Africa; specifically, evaluating the skills required for LNG to Power.

A document prepared for: SAOGA SOUTH AFRICAN OIL & GAS ALLIANCE

By: Ismaeel Fataar

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API – American Petroleum Institute

BC - British Columbia

CAPCO - Castle Peak Power Co. Ltd.

CCGT – Combined Cycle Gas Turbine

CDC – Coega Development Cooperation

CHIETA - Chemical Industries Education and Training Authority

CIP – Coega Integrated Power Projects

COC - Certificate of Competency

CSIR - The Council for Scientific and Industrial Research

DCS - Distributed Control Systems

DHET - Department of Higher Education and Training

DoL – South African Department of Labour

GDP – Gross Domestic Product

GMDSS - Global Maritime Distress and Safety System

H2S – Hydrogen Sulphide (gas)

HSE – Health, Safety and Environment

HSRC - Human Sciences Research Council

IDZ - Industrial Development Zone

IRP - Integrated Resource Plan

IPP - Independant Power Producer

IGU – International Gas Union

ISO – International Organisation for Standardisation

IUOE – International Union of Operation Engineers

LNG – Liquefied Natural Gas

LMI – Labour Market Intelligence

MTPA – Million Tonne Per Annum (Gas)

NDP – National Development Plan

NDT - Non-Destructive Testing

NEBOSH - National Examination Board in Occupational Safety and Health

OJT – On the Job Training

OPITO - Oil Producer International Training Organisation

PTW – Permit to Work

SAMTRA – South African Maritime Training Academy

SAQA - South African Qualifications Authority

SCBA – Self-Contained Breathing Apparatus

SETA - Sectoral Education and Training Authority

SPE - Society of Petroleum Engineers

SOLAS - International Convention for the Safety of Life at Sea

STCW - The International Convention on Standards of Training, Certification and Watch keeping for Seafarers

TNA - Training Needs Analysis

TVET - Technical Vocational Education and Training

YOY – Year-on-year

1. The background to LNG-to-Power industry

1.1 Introduction to LNG-to-Power

Liquefied Natural Gas (LNG) is the fastest growing sector of the international gas business (BP, 2016). LNG is helping to meet the increasing demand for energy in rapidly growing economies such as China, India and South Korea. It is helping to offset the decline in indigenous gas production in major consuming markets. Many countries are relying on LNG as a cost effective option to conventional oil and gas production. LNG-to-Power also known as Gas-to-Power is the entire process starting from liquefaction all the way to producing electricity for either domestic or commercial use. Power generation comprises of a Combined Cycle Gas Turbine (CCGT) facility that uses gas to drive two turbines which generates electricity.

The skills that are required to explore and harness LNG-to-Power are unique and are essential for the successful implementation of power generation in South Africa.This has not been explored until now and will be highlighted and matched against those present in the current workforce skills in South Africa. The report is aimed at evaluating what skills are required for LNG-to-Power and investigating ways to leverage the current skills pool.

1.2 Background in South Africa

The growing electricity consumption in South Africa has proven to be insufficient and unstable. With electricity supply and costs under heavy pressure it just makes sense to invest in LNG-to-Power. While investing in infrastructure and technology is vital but training and development of skills to perform these complex roles is far more important for South Africa`s progression.

Southern Africa is in the process of catching up on this trend. In recent years we have seen significant gas discoveries in Mozambique and Tanzania with South Africa estimated to have large quantities of shale gas and potential offshore resources (Standard Bank, 2016).

Planning for a liquefied natural gas (LNG) power plant in Port Elizabeth has already begun. The project was first announced 10 years ago and will soon become a reality

with Coega Development Corporation (CDC) announcing that the project will now enter the next stage of development (Fin 24,2015).

Sandisiwe Ncemane, CDC energy sector manager, said the project will support Government's Integrated Resource Plan (IRP) and a 2012 Ministerial Determination allocation of 2 652MW for energy from natural gas between 2021 and 2025(Fin 24, 2015). According to Sandisiwe Ncemane, the LNG-to-power plant at Coega will be one of the most efficient greenfield capacity expansion options for South African energy security.

Human capital development influences all aspects of LNG-to-Power`s success, including its competitiveness. Improving the effectiveness of human capital is crucial to companies and national success.

The South African labour market itself is not ready to undertake LNG activities. However, on a global scale, South Africa has produced highly skilled labour which can be repatriated or adapted to suit the oil and gas industry. Since South Africa has never undertaken energy expansion like LNG-to-Power, it should be understood that this is a new area for development. Although research is fairly limited in the South African context, references from the United States of America, Australia, Oman and the United Kingdom can be readily used.

1.3 Problem statement

In South Africa, the challenges oil and gas companies face are primarily the lack of skills required to explore LNG-to-Power projects. South Africa is an emerging market for LNG-to-Power, so development structures such as dedicated training facilities are not readily available.

Australia and British Columbia are good examples, in terms of preparing for mid-to-downstream energy projects. Their key factors for success are training and development, resulting in the production of highly skilled labour. The shortage of efficient skills in the gas industry can lead to contracts being lost and more importantly, result in hugely negative environmental impacts.

The report will identify the gas industry skills shortages, which have yet to be addressed in South Africa. Significantly, there have been no published studies/reports on the evaluation of the skills required in LNG-to-Power energy.The report will also show similarities between other industries where common skills are found, which can then be leveraged to meet the strict gas industry standards.

1.4 Aim of report

The aim of the report is to evaluate what skills are required for LNG-to-Power expansion projects. The investigation will also identify how the current skills pool can be used as leverage to meet industry standards.

1.5 Objectives of the report

- To determine what skills are required for LNG-to-Power expansion projects.
- To determine the skills deficit of the current workforce in South Africa
- Provide recommendations concerning training and development for LNG-to-Power.

1.6 Significance of LNG-to-Power

There have been no published LNG-to-Power studies on the subject of skills evaluation within the mid-to-downstream gas industry in South Africa.

The report will benefit both corporate business and the Department of Labour (DoL) in South Africa. Human Resources will have clearer information about whether or not the nature of their business requires a new strategy. The report will also provide the necessary background regarding adaptation of suitable or appropriate business to ensure that it becomes beneficial for the market in South Africa.

From an academic perspective, the report will contribute to the body of existing knowledge in human capital management, with a specific focus on training and development in the mid-to-downstream gas industry, which will in turn enhance overall operational effectiveness.

From a professional perspective, the report is significant as an experimental basis for making recommendations on how to develop the skills needed in gas industries.

Moreover, government - in conjunction with training institutions - can develop a training model to suit the LNG-to-Power industry. The report can therefore be considered as a pilot study for South Africa and, depending on the results, may be used for other countries in Sub-Saharan Africa.

The Department of Labour can use the study to evaluate the skills necessary for South Africa and use the research for developing a new skills development strategy.

2. The skills required for the LNG to Power industry

2.1 Introduction

This section provides a broad overview of LNG-to-Power skills in the oil and gas industry. The report starts by introducing the upstream, midstream and downstream energy industry, then gives an overview of South Africa as an LNG-to-Power emerging market. The international employment overview is presented. This is followed by an examination of international skills required in the LNG-to-Power sector.

The report then gives an explanation of the structure of skills required per phase. The latter section of the report is geared to examining the training and development needs in South Africa and providing models or techniques to address the training needs.

2.2 Defining LNG-to-Power in South Africa

According to Royal Dutch Shell (2016:1), LNG is a clear, colourless and non-toxic liquid which forms when natural gas is cooled to -162ºC . The cooling process shrinks the volume of the gas 600 times, making it easier and safer to store and ship. In its liquid state, LNG will not ignite.

When LNG reaches its destination, it is turned back into a gas at regasification plants. It is then piped to homes, businesses and industries where it is burnt for heat or to generate electricity.

Power generation is produced using Combined Cycle Gas Turbine (CCGT) technology. This technology is based on using two turbines i.e. Gas turbine and Steam turbine which drives two generators.

These two generators in turn supply power to an electrical substation. The electrical substations subsequently sends the power to the utility grid (Eskom).

The figure 2.1 below, shows a typical floating regasification layout.

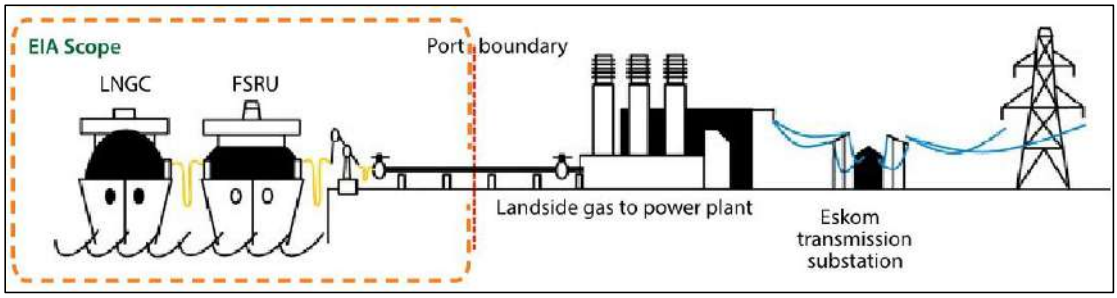


Figure 2.1: FSRU layout

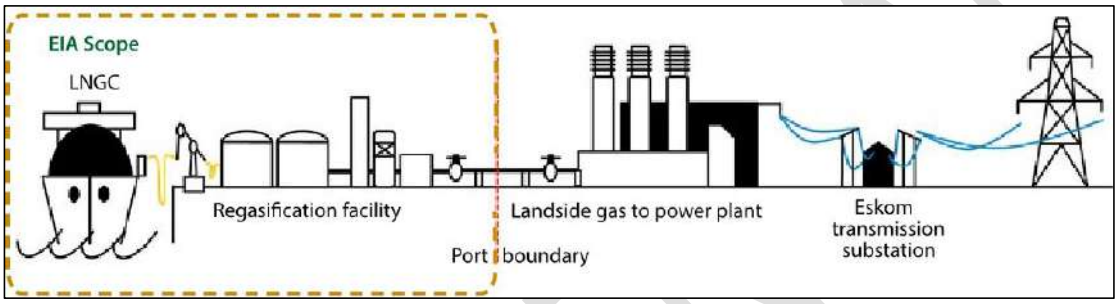


Figure 2.2: Land based regasification layout

(Source: IPP-DoE report, ERM ref:0320839)

The report will concentrate on the mid-to-downstream value chain which is currently topical in South Africa. The type of LNG-to-Power activity which is going to take precedence in South Africa is focused on an receiving terminal and a CCGT plant.

In order to understand the full skills requirement of LNG-to-Power I will have to unravel the basic processes of this greenfield project.

In figure 2.3 below, I have demonstrated the three phases in oil and gas industry in-order to identify LNG-to-Power in the value chain. From figure 2.3, LNG-to-Power is focused on the mid-to-downstream phase.

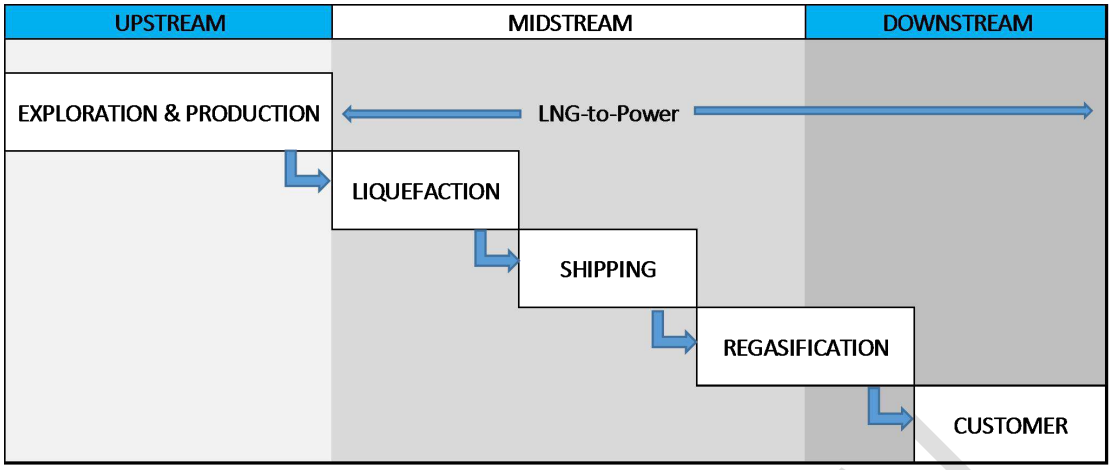


Figure 2.3: An illustration of LNG value chain.

(Adapted Source: www.sempralng.com, 2016).

From Figure 2.3, it can be understood that liquefaction, shipping, regasification and customer represents the LNG process from start to finish. In the South African context it can be noted that South Africa will be a receiving country for LNG. This means that the liquefaction process and part of the shipping process will be done by the LNG exporter.

2.3 An overview of South Africa`s LNG focus.

Delivering his State of the Nation address in Cape Town, President Jacob Zuma said: "The development of petroleum, especially shale gas, will be a game changer for the Karoo region and the South African economy…" (SAnews.gov.za, 2014).

While South Africa has future prospects in shale gas exploration, this is a long-term objective. Shale gas exploration and development takes 10-20 years before it can be used for developing energy. LNG is faster and constitutes a reliable means of addressing the energy crisis in South Africa. According to the International Gas Union (IGU) report (2016:45) in 2015 a total of 7 new regasification terminals were completed worldwide. The current trend of start-up LNG receiving terminals is on a rise. The IGU report (2016:45) shows that the overall total regasification capacity grew by 24 MTPA (+3.3% YOY) in 2015.

According to the Royal Society and the Royal Academy of Engineering (2012:11) recent estimates by the US Department of Energy state that South Africa has the eighth largest shale gas reserves in the world. This opportunity for shale gas exploration can link up once LNG regasification terminals are fully functional, but the focus should first be on LNG-to-Power.

Since South Africa has not started development into LNG-to-Power, it can benefit from developed countries with regards to technology, training, experience and management. Countries such as the United Kingdom (UK), Australia and the United States of America (USA) have a combined wealth of experience and South Africa can learn from these countries.

In figure 2.4 below, I have demonstrated the three phases that would be necessary to identify what skills would be needed.

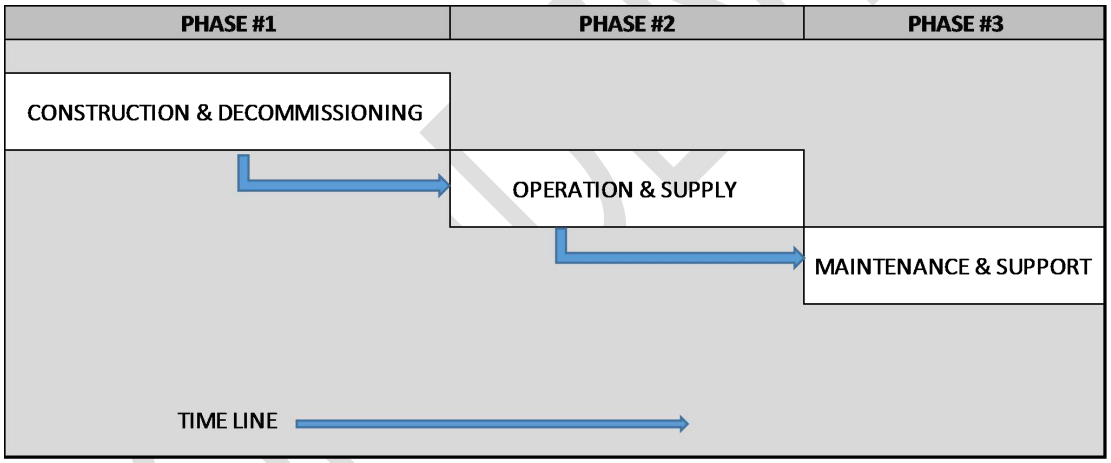


Figure 2.4: South Africa`s LNG-to-Power three phase approach.

(Adapted Source: www.lngcanada.ca, 2016).

Due to the nature of the report its important to note that the Ngqura harbour and Coega IDZ has been identified as the most suitable location for a LNG terminal. From a skills perspective, Port Elizabeth already has a world-class automotive, manufacturing and marine industry. This hub will provide an opportunity to leverage skills in the region.

Figure 2.5 below, demonstrates the Coega Integrated LNG-to-Power project (CIP).

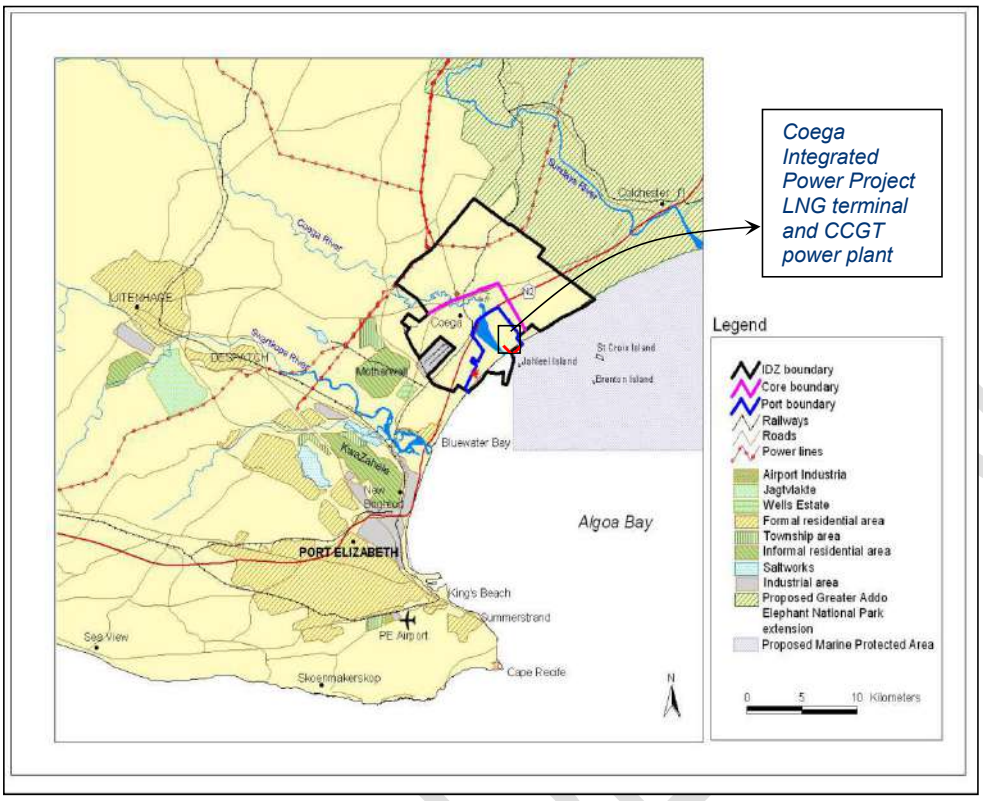


Figure 2.5: South Africa`s, Ngqura harbour and Coega IDZ - LNG-to-Power project.

(Adapted Source: www.fred.csir.co.za , 2006).

The northern section of South Africa is characterised by mining and power generation activities, which will necessarily attract large groups of highly skilled workers. The west coast and east coast of South Africa have a strong marine and offshore history, thus bringing a wealth of skilled labour. This is distinctly advantageous, as multiskilling can provide versatility to the workforce of South Africa.

Another proposed solution is the Port of Richards Bay. The existing Lilly pipeline from Secunda to Durban makes this proposal interesting and could link up with proper pipeline infrastructure. In figure 2.6 the Richards Bay proposed LNG solution can be seen.

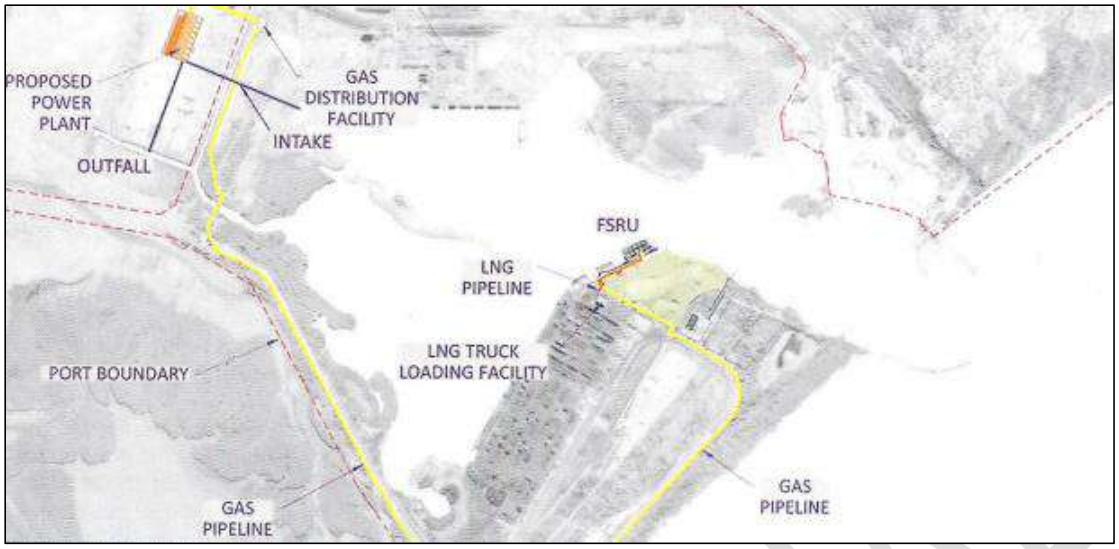


Figure 2.6: South Africa`s, Richards Bay harbour - LNG-to-Power project.

(Source: IPP Preliminary Information Memorandum , 2016)

2.4 International employment overview: LNG-to-Power

South Africa is among the world's highest unequal societies, with high unemployment statistics. Employment opportunities are therefore key to developing South Africa's people and economy. According to an article from the International Union of Operating Engineers (IUOE) Local (2013:1) The enormous potential of LNG is outlined in the "B.C. Natural Gas Workforce Strategy and Action Plan"—as is the significant challenge of finding and training enough skilled workers for a wide variety of jobs needed to succeed. Furthermore, IUOE Local (2013:1) says that 62,000 jobs will be created in the British Columbia during the LNG-to-Power peak. There would be over 21,000 jobs in direct construction created by building the plants and associated pipelines, and another 41,000 jobs in industries supplying goods and services during the construction phase.

Once the LNG projects are fully operational, it is expected 75,000 jobs will be created overall in running the plants and supplying them (IUOE Local, 2013:1). It would be misleading to think that South Africa`s current Coega project will provide such an job output, as in British Columbia. According to Sandisiwe Ncemane the Coega project would create over 1,000 jobs, as well as support the manufacturing hubs of the

province. In my opinion those 1,000 jobs is a fairly low estimate, which will increase appreciably once phase 2 is undertaken.

The table 2.1 below shows comparative LNG-to-Power projects employment outputs:

LNG JOB OPPORTUNITY BREAKDOWN					
LNG COMPANY	GULF COAST	CHEVRON LNG	TEXAS LNG	ENGIE LNG	ANNOVA LNG
SITE	Port Lavca, US	Wheatstone, Australia	Port of Brownsville, US	France (Multiple regions)	Port of Brownsville, US
PERMANENT JOBS	250	880	80	1150	165
TEMPORARY JOBS	3000	11000	600	10000	700

Table 2.1: A job opportunity breakdown with leading industry LNG representatives.

(Source: www.hvllc.com, www.txlng.com, www.rigzone.com, www.annovalng.com , 2016).

Table 2.1 provides an overview of the potential job opportunities in the sector and can be used as a reference when making projections.

Workforce opportunities created by LNG-to-Power in the British Columbia provide a positive outlook for employment. Such workforce opportunities would be particularly advantageous in South Africa. See Appendix 1 for workforce potential figures.

2.5 The skills required for LNG-to-Power

2.5.1 Background

The LNG-to-Power skills environment covers many aspects, from the shipping phase to the final process of selling. In order to display the skills required in the South African context a three phase approach was undertaken.

Details pertaining to shipping, regasification and power generations skills will be displayed in the latter part of this section.

An overview of the three phases (South African, LNG-to-Power context) can be seen in Figure 2.7.

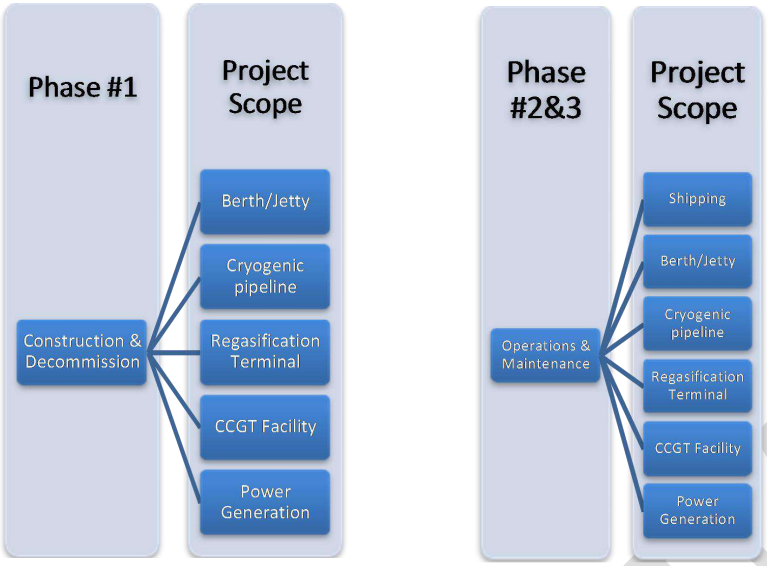


Figure 2.7: South African LNG-to-Power project scope.

(Adapted from source: www.coega.co.za ,www.lngcanada.ca,)

Figure 2.7 clearly demonstrates the various phases of LNG-to-Power within the South African context. Due to the nature of the report, I will put more focus on marine, construction and engineering roles under each of these phases.

2.5.2 Skills required for Construction & Commissioning: Phase #1

Construction activities usually takes 2-3 years and construction will be managed by a main contractor who will in turn hire subcontractors. Contractors and subcontractors will hire workers to help them complete the work. According to the International Gas Union (IGU) report (2016:24) construction comprises 32% of the projects costs, thereby making construction an important and costly phase of an LNG project.

Table 2.2 below shows a job categories for Phase #1 (Construction & Commissioning).

JOB TITLE	*BRIEF JOB DESCRIPTION*	*SKILLS AND QUALIFICATIONS*
Rope Access Technician	Rope access is a form of work positioning, initially developed from techniques used in	IRATA LEVELS 1, 2 & 3

	climbing and caving, which applies practical ropework to allow workers to access difficult-to-reach locations without the use of scaffolding, cradles or an aerial work platform.	
Cryogenic Insulator	Installing an effective insulation system by protecting equipment and personnel, control noise, reduce energy costs and increase process efficiency.	OPITO Application of Non Metallic Insulation Course
Scaffolder	Erecting of scaffolding on a work-site.	Unit Standard No: 263245 NQF Level: 3
Rigger	Knowledge of the rigging principles, general hazards and risks of rigging and lifting operations, an awareness of relevant legislation and regulation.	OPITO stage 1 & 2
Welding Inspector	The inspector conducts basic inspections, to identify welding defects and witness and validate welder qualification tests	International Institute of Welding (IIW) IWIP Standard level inspection diploma or SAIW Level 1
Commissioning Engineer	Commissioning engineers are employed to work at a client's site, where they are responsible for commissioning and overseeing the installation of systems, plants and equipment.	Bachelors Degree in Electrical, mechanical or civil. Achieving chartered (C Eng) status with the Engineering Council engineering

Refrigeration Mechanic	Performs preventative and corrective maintenance on refrigeration facility equipment and systems for multiple facilities.	Journeyman level Refrigeration licence. Gas fitter I & II licence in addition to a refrigeration licence.
Flag Person	Direct and control traffic	Completion of secondary school and traffic control certifications
Labourer	Assist skilled trades-persons and perform labour activities at construction sites	Completion of secondary school and relevant certifications
Forestry Labourer	Perform manual tasks such as attaching choker cables to logs, planting trees, clearing brush – employed by logging companies and contractors	Some secondary school, college or industry courses, combined with on-the-job training
Heavy Duty Equipment Operator	Operate equipment such as backhoes, bulldozers, loaders and graders to excavate, move, load and grade earth, rock gravel and other materials	Some secondary school, college or industry courses in heavy equipment operating combined with on-the-job training
Construction Painter	Apply paint and finishes to interior and exterior surfaces of buildings and other structures	Completion of secondary school, over 3 years of work experience in the trade
Wildlife Monitor	Monitor and control wildlife on-site to ensure worker safety	Completion of secondary school, hunting and outdoor experience, Possession and Acquisition (PAL) licenced
Heavy-Duty Equipment Technician	Repair, troubleshoot, adjust, overhaul and maintain mobile heavy-duty equipment	Completion of secondary school and completion of heavy-duty technician trade certification

Truck Driver	Operate heavy trucks to transport materials	Class 1 licence, Air Brake Endorsement, Transportation of Dangerous Goods certification and completion of a driver training course of up to 3 months through a vocational school or community college
Carpenter	Construct, erect, install, maintain and repair structures made of wood or wood substitutes	Completion of secondary school and a 3 to 4 year apprenticeship program
Concrete Finisher	Smooth and finish freshly poured concrete, and install, maintain and restore masonry structures	Completion of Secondary school and a 2 to 4 year apprenticeship program
Crane Operator	Operate cranes or drag-lines to lift, move, position or place machinery, equipment and other large objects at construction sites	Completion of secondary school and a 1 to 3 year apprenticeship program
Electrician	Lie out, assemble, install, test, troubleshoot and repair electrical wiring, control devices	Completion of secondary school and a 3 to 4 year apprenticeship program
Gas fitter	Install, inspect, repair and maintain gas lines and gas equipment	Completion of secondary school and 2 to 3 year apprenticeship program
Iron-worker	Fabricate, erect, hoist, install, repair and service structural ironwork, precast concrete, concrete reinforcing materials, curtain walls	Completion of secondary school and a 2 to 3 year apprenticeship program

Plumber	Install, repair and maintain pipes, fixtures and other plumbing equipment used for water distribution and waste water disposal	Completion of secondary school and a 4 to 5 year apprenticeship program
Roofer	Install, repair or replace flat roofs and shingles, shakes or other roofing tiles	Completion of secondary school and 2 to 3 year apprenticeship program
Sheet Metal Worker	Fabricate, assemble, install and repair sheet metal products	Completion of secondary school and 3 to 5 year apprenticeship program
Pipe fitter-Steam Fitter & Sprinkler System Installer	Lie out, assemble, fabricate, maintain troubleshot and Repair piping systems carrying water, steam chemicals, and fuel in heating, cooling, lubricated and other process piping systems.	Completion of secondary school and 4 to 5 year apprenticeship program
Welder	Operate welding equipment to weld ferrous and non-ferrous metals	Completion of secondary school and a 3 year apprenticeship program
Occupational Health and Safety Officer (HSE)	Evaluate and monitor health and Safety hazards and develop strategies to control workplace risks	Certification with the Association of Registered Safety Professionals
Biological Technician	Conduct field research and collect data, environmental monitoring for the protection of fish, wildlife and natural resources	A 2 to 3 year college program in agriculture, biology, microbiology, wildlife and resource management
Civil Engineering Technician	Provide technical support and services to scientists, engineers	A 1 or 2 year college program in civil engineering technology

	and other professionals	
Construction Inspector	Inspect the construction and maintenance of new and existing buildings, bridges, highways, and industrial construction to ensure specifications and building codes are observed	Completion of secondary school and college diploma in construction, civil engineering or architectural technology plus several years of related work experience
Soil Inspector	Collecting and analysing soil samples to determine whether they are suitable for development	Completion of secondary school and relevant post-secondary training
Bridge Inspector	Inspect the construction and maintenance of new and existing bridges to ensure specifications and codes are observed	Completion of secondary school plus a college diploma in construction, civil engineering, architectural technology, plus several years of related work experience
Registered Professional Forester	Plan and direct forest surveys and related studies and prepare reports and recommendations, plan and direct woodlands harvesting, silviculture and fire prevention and suppression programs, road building, wildlife management and environmental protection	Certification as a forester or forest engineer by provincially chartered associations
Geological Technician	Provide technical support and services in the field of geophysics, geology, mineralogy	Completion of a 1 to 2 year college program
Geologist	Explore and research to extend knowledge of the structure,	University degree in geology,

	composition and process of the earth to locate, identify and extract hydrocarbon, mineral and groundwater resources to assess and mitigate the effects of development projects on the environment	geochemistry, geophysics
Survey Technologist	Assist survey engineers or professional surveyors to develop methods and procedures for conducting field surveys, conduct field surveys and operate survey instruments	A 2 to 3 year college program in geomatics or land survey technology
Land Surveyor	Direct and conduct surveys to establish the location of contours and other natural or human-made features and prepare drawings, plans pertaining to these surveys	A college diploma in survey science or geomatics technology with additional academic credits and completion of land surveyor examinations.
Non-Destructive Maintenance Technician (NDT)	Operate radiographic, ultrasonic, liquid penetrant, magnetic particle, eddy current and similar testing equipment	Completion of secondary school and 2 years of an approved post-secondary science or engineering
Refrigeration Engineer	Design, test and troubleshoot refrigeration setup.	University degree in Mechanical or Electrical Engineering.
Refrigeration Technician	Lie out, assemble, install, test, troubleshoot and repair refrigeration setup, fixtures, control devices	Completion of secondary school and a 3 to 4 year apprenticeship program

Table 2.2: Job categories for phase #1 (Construction & Commissioning). (Adapted from source: www.lngcanada.ca , 2016).

The job category overview in Table 2.2 includes many of the common skilled professionals that are necessary in phase #1.

2.5.3 Skills required for Operations & Supply: Phase #2

The skills required for operations & supply form the bases of phase #2. Maintenance will be discussed in the next section as maintenance is an entire structure on its own, however operations and maintenance works hand in hand in the overall plant organogram.

The EcoElectrica LNG-to-Power facilities Organisational structure provides a framework for the South African focus. Figure 2.8 illustrates the basic structure of the different job categories.

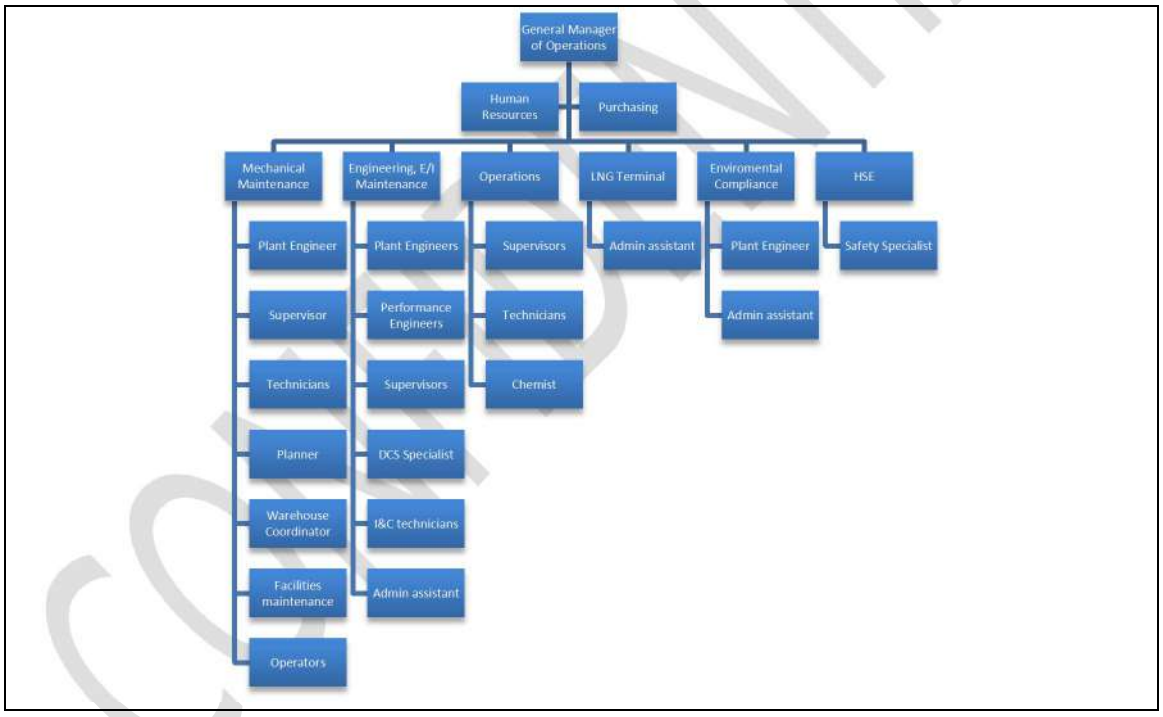


Figure 2.8: EcoElectrica LNG-to-Power project organisation.

(Source: www.ecoelectrica.com)

I have adapted job categories from KPMG`s BC workforce forecast report (2014) in Table 2.3 below, considering operational and supply roles in a typical LNG regasification terminal.

JOB TITLE	*BRIEF JOB DESCRIPTION*	*SKILLS AND QUALIFICATIONS*
Managers in natural resources production	Manage petroleum production and provides technical support to other professionals	University degree or College diploma with Production experience.
Supervisors, petroleum, gas and chemical processing and utilities	Manage petroleum utilities and processes. Provides technical support to other professionals	University degree or College diploma with Plant Operations experience.
Machinists and machining and tooling inspectors	Fabricates steel components for the LNG plant.	Completion of secondary school and a 4 to 5 year apprenticeship program
Petroleum engineers	Manage petroleum plant processes and provide technical support to other professionals.	University degree in Petroleum Engineering
Facility operation managers	Manage facilities and provide technical support to other professionals.	University degree or College diploma with Plant Operations experience.
Geoscientists and oceanographers	Explore and research to extend knowledge of the structure, composition and process of the earth and sea.	University degree in geology, geochemistry, geophysics,oceanography
Geological and mineral technologists and technicians	Provide technical support and services in the field of geophysics, geology, mineralogy	Completion of a 1 to 2 year college program
Power engineers	Manage power plant processes and provide technical support to other professionals.	University degree in Electrical / Power Engineering
Senior managers -	Manage overall plant processes	Completion of secondary school

construction, transportation, production and utilities	and provide technical support to other professionals.	and college diploma in construction, transportation engineering or architectural technology plus several years of related work experience
Electrical and electronics engineering technologists and technicians	Provide technical support and services to scientists, engineers and other professionals	A 1 or 2 year college program in electrical engineering technology
Power systems operators	Assist skilled trades-persons and perform labour activities on power systems.	Some secondary school and industry courses in heavy power equipment operating combined with on-the-job training.
Chemical technologists and technicians	Provide technical support and services to scientists, engineers and other professionals	A 1 or 2 year college program in chemical engineering technology
Chemical engineers	Manage plant processes and provide technical support to other professionals.	University degree in Chemical Engineering
Material handlers	Provide material support and inventory control.	Completion of secondary school and relevant certifications
Mechanical engineering technologists and technicians	Provide technical support and services to scientists, engineers and other professionals	A 1 or 2 year college program in Mechanical engineering technology
Drafting technologists and technicians	Provide technical support and services to scientists, engineers and other professionals	A 1 or 2 year college program in Design engineering technology
Production logistics co-ordinators	Provide logistical support for LNG operations	A 1 or 2 year college program in Supply & Logistics
Industrial engineering and	Provide technical support and	A 1 or 2 year college program in

manufacturing technologists and technicians	services to scientists, engineers and other professionals	Industrial engineering technology
Plant Health and Safety Officer (HSE)	Evaluate and monitor health and Safety hazards and develop strategies to control workplace risks	Certification with the Association of Registered Safety Professionals

Table 2.3: Job categories for phase #2 (Operations & Supply). (Adapted from source: KPMG, British Columbia LNG Workforce Occupation Forecast, 2014).

2.5.4 Skills required for Shipping/Marine operations Phase #2

I have adapted the job categories from Marine jobs (2016) in Table 2.4, considering Shipping & Marine professions in a typical LNG terminal.

JOB TITLE	***BRIEF JOB DESCRIPTION***	***SKILLS AND QUALIFICATIONS***
LNG Carrier, Master/Captain	Responsible for the LNG carriers efficient operation and all crew and equipment on-board the vessel.	Captains Licence.
LNG Carrier, Chief Engineer	Responsible to the Master for the efficient operation and maintenance of all machinery and equipment on-board.	Unlimited COC as per STCW 2010
LNG Carrier, Gas Engineer	Supervise all LNG operations on the vessel.	University degree in Chemical Engineering and relevant LNG experience.
LNG Carrier, Operator	Assist Supervisor and perform labour activities on LNG carrier.	Completion of secondary school and relevant certifications

Mooring Supervisor	Supervise and liaise with all necessary parties during port LNG operations.	Completion of secondary school and relevant mooring certificate.
LNG Terminal Supervisor	Supervise and liaise with all necessary parties during unloading.	Completion of secondary school and relevant marine certifications
LNG Terminal Operator	Assist Supervisor and perform labour activities on LNG terminal.	Completion of secondary school and relevant certifications
LNG Terminal control room operator	Monitor and liaise with LNG supervisor, Jetty and LNG carrier radio operators. Provide the direction to the day to day activities of the outside shift operators. Responsible for interfacing with the other DCS control room operators to ensure the safe and efficient operation of the facility	High School Graduate or GED equivalent and in process of acquiring Process Technology Degree or 10+ years' experience
Offshore Jetty Supervisor	Supervise and liaise with LNG supervisor, Jetty and LNG carrier radio operators.	Completion of secondary school and relevant STCW 95
Offshore Jetty operator	Assist Supervisor and perform labour activities on Jetty.	Completion of secondary school and relevant marine training
Tug boat Captain	Responsible for positioning of the LNG carrier into the jetty.	Captains Licence, STCW 95
Tug boat operator	Assist Tugboat crew and perform labour activities.	Marine related training or Able seaman certificate

Radio Operator	Responsible for communication between all parties during LNG terminal operations.	Completion of secondary school and relevant radio operators certifications

Table 2.4: Shipping & Marine professions for phase #2 (Operations & Supply). (Source: www.maritimejobs.com , 2016).

2.5.5 Skills required for Maintenance & Support: Phase #3

CAPCO Corporation was the platform in demonstrating a basic LNG receiving terminal organogram. Figure 2.9 illustrates the basic structure of the different job categories.

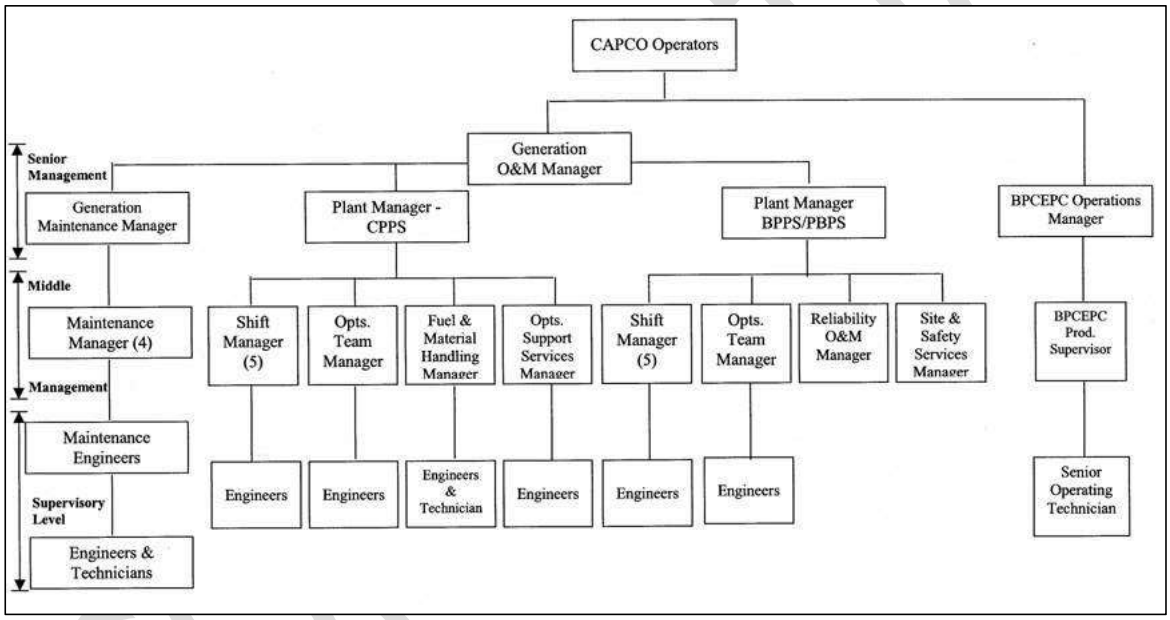


Figure 2.9: LNG receiving terminal (CAPCO) organogram.

Source:(www.edp.gov.hk).

From figure 2.9, it is clear that LNG operations and maintenance makes up two important tiers and are both vital to the LNG terminal`s overall effectiveness.

The CAPCO organogram also has four important divisions:

1. Generations Maintenance Manager.
2. Plant Manager - LNG Terminal.

3. Plant Manager - CCGT Power.

4. Operations Manager.

In Figure 2.9, we can see that the career path for a engineer or technician can progress to the position of a Plant Manager. However, this path depends on the training and development plan from the LNG facility.

I have adapted the job categories from EcoElectrica`s lean workforce (2014) in Table 2.5, considering maintenance and support roles in a typical LNG terminal.

JOB TITLE	***BRIEF JOB DESCRIPTION***	***SKILLS AND QUALIFICATIONS***
Facility maintenance managers	Manage plants electrical, mechanical and CCGT processes and provide technical support to other professionals.	University degree in Mechanical/Electrical/Chemical Engineering
Maintenance Engineers (Mechanical)	Manage plants mechanical processes and provide technical support to other professionals.	University degree in Mechanical Engineering
Maintenance Engineers (Electrical)	Manage plants electrical processes and provide technical support to other professionals.	University degree in Electrical Engineering
Maintenance Engineers (Turbine)	Manage plants turbine processes and provide technical support to other professionals.	University degree in Mechanical Engineering
Waterworks and gas maintenance workers	Assist skilled trades persons and perform labour activities at sites	Completion of secondary school and relevant certifications
Maintenance Technicians (Mechanical)	Provide technical support and services to scientists, engineers and other professionals	A 1 or 2 year college program in mechanical engineering technology

Maintenance Technicians (Electrical)	Provide technical support and services to scientists, engineers and other professionals	A 1 or 2 year college program in electrical engineering technology
Maintenance Technicians (Turbine)	Provide technical support and services to scientists, engineers and other professionals	A 1 or 2 year college program in mechanical engineering technology
Maintenance Technicians (Control Systems)	Provide technical support and services to scientists, engineers and other professionals	A 1 or 2 year college program in electrical engineering technology
Plant Electrician	Lie out, assemble, install, test, troubleshoot and repair electrical wiring, fixtures, control devices	Completion of secondary school and a 3 to 4 year apprenticeship program
Plant Welder	Operate welding equipment to weld ferrous and non-ferrous metals	Completion of secondary school and a 3 year apprenticeship program
Non Destructive Maintenance Technician (NDT)	Operate radiographic, ultrasonic, liquid penetrant, magnetic particle, eddy current and similar testing equipment	Completion of secondary school and 2 years of an approved post-secondary science or engineering
Maintenance Mechanic	Provide technical support and services to scientists, engineers and other professionals	Automotive Mechanic`s trade tested artisan.
Maintenance Operator	Assist skilled trades-persons and perform maintenance activities.	Relevant industry OJT
Gas Testing Technician	Use portable gas detection equipment to determine the presence of potentially harmful atmospheres in the workplace. Tasked with maintenance and	Gas Detection Certification Or MSA, Draeger certificate of competence

	calibration of the devices.	
Water Waste Disposal Technician	Technicians work in water treatment plants, wastewater treatment plants, environmental laboratories and in the environmental industry.	College Diploma in Water Waste Technology
Water Waste Disposal Operator	Assist skilled trades-persons and perform maintenance activities.	Relevant industry OJT

Table 2.5: EcoElectrica LNG-to-Power project scope;phase #3(Maintenance & Support).

(Source: www.ecoelectrica.com)

2.6 The domestic skills shortage in South Africa`s energy sector

According to the Mediterranean Journal of Social Sciences, Mateus, Allen-Ile and Iwu (2014:64) state that the shortage of skills in South Africa is a source of aggravation to firms and, when severe, it is likely to hamper the quality and quantity of industrial development outputs. Mateus *et al*. (2014: 64) state, "…skills shortage was long identified as one of the critical constraints to economic growth and employment creation by the South African government".

The Human Sciences Research Council (HSRC) and the South African Department of Labour (DoL) contributed towards a skills shortage case study, wherein scarce skills and critical skills were identified. From HSRC and DoL, Erasmus and Breier (2009:75) state that the skills shortage in engineering within South Africa is significantly high. As proof of the dilemma Erasmus and Breier (2009:75) mention, South Africa has approximately 437 engineers per million citizens, while Japan has 3306 engineers per million citizens. Erasmus and Breier (2009:221) also say that the shortage of skills in key technical fields has been fuelled by a drastic decline in the number of artisans trained in the last decade. The defunct apprenticeship training programme has been reactivated and can possibly lead to considerable skills development across industry. Current apprenticeship programmes provide companies

with sizeable tax saving incentives and, if well managed, can benefit both employer and apprentice.

The Government Gazette of South Africa (2014:14) shows the top 100 scarce skills list which includes all engineering disciplines. The energy sector in South Africa is lacking skills in critically important fields. LNG-to-Power is highly technical and, as a base for domestic skills development, government will need to increase its engineering graduate output to meet the future demand.

2.8 Training & Development: Mid-to-Downstream Industry

Training and development are pertinent in all companies. All oil and gas companies, regardless of their size, have training and development programmes. Additionally, some companies work with tertiary institutions to provide their employees with adequate training.

A large number of oil and gas companies provide on-the-job training (OJT) and in addition to that, basic modules can be completed online (www.petroskills.com).

2.8.1 Training Providers & Costs

Each career path requires specific training. Training providers in this section covers critical careers associated with LNG-to-Power. Most of the training providers are not found locally and is therefore expensive for the local engineer, technician and artisan.

International training providers:

- Petroskills (Online) - Various courses
- SAIT Polytechnic (Online)
- Maritime Research Institute (Netherlands)
- Energy Institute (UK)
- IPF Training (Online)
- The Oxford Princeton Program (Online)
- SGS Training Services (Online)
- Society of Petroleum Engineers (SPE) (Online, members only)

- The University of Western Australia (2-day workshop training) - AUS
- The University of Texas at Austin (2.5-day workshop training) - US
- Government of Western Australia (5-day workshop training) - AUS
- Warsash Maritime Academy (Classroom led training) - UK

Cost of courses:

The average cost of a 1 $^{1}/_{2}$ - 2-day course/workshop in LNG is **$2000** per person

The average cost of a 2-3day course/workshop in LNG is **$3000** per person

The average cost of a 4-day course/workshop in LNG is **$4000 - $5500** per person

Specialized courses in LNG can range from **$5900 - $7000** per person

Domestic training providers:

SAMTRA in partnership with Stavanger Offshore Technical College (SOTS):

· Norwegian Petroleum Directorate (NPD)
· Petroleum Safety Authority Norway (PTIL)
· Climate and Pollution Agency (KLIF)
· PETRAD

Courses will be administered by SAMTRA and conducted at its premises in Simon's Town, near Cape Town.

Marine, Engineering and offshore services training providers locally:

Universities, Universities of Technology &Colleges:

Africa Skills TVET College
The University of the Western Cape
University of the Witwatersrand, Johannesburg
West Coast College
Northlink College
Cape Peninsula University of Technology (CPUT)
College of Cape Town
University of Cape Town (UCT)

Private Training providers:

Amandla Offshore Oil & Gas Education and Training

Atlas Amplo
Intertek Consulting & Training
Offshore Africa Training Centre (OATC)
Training Force
The domestic training providers has not implemented any specific LNG programs into their curriculum but covers basic training for engineers, technicians and artisans. More information can be found on www.moga.saoga.org.za.

2.8.2 Health, Safety and Environment (HSE)

Safety is regarded as one of the most important considerations in the oil and gas industry. The HSE representative in each company provides in-house HSE training. Furthermore, each installation whether it be a plant or LNG vessel, has a safety officer.

The safety officer will provide basics training for all personnel on the plant. Some of the basics included would be:

- Permit-to-work (PTW) training
- Confined space entry training
- Fall protection safety training
- Electrical lock-out training
- Incident reporting, STOP card system.

Depending on the environment and gas concentrations, personnel will receive specific training. For example, some specific training includes high hydrogen sulphide (H2S) training, where personnel require to use Self-Contained Breathing Apparatus (SCBA).

3. The current skills that can be supplied to industry

The information gathered from this section will be addressing the research question of what skills (local capacity) with the same unique characteristics, could be leveraged for LNG to Power projects.

Universities, Universities of Technology and TVET colleges are producing top quality engineering skills, thus giving South Africa a good platform to work from in-order to supply LNG-to-Power skills. The LNG-to-Power industry is unique but shares some common ground with traditional artisan roles such as electricians, mechanics, welders and machinist. Specialist roles such as Turbine technician, DCS technician and I&C technicians requires more training but comes from a core of either electrical engineering or mechanical engineering offered by Universities of Technology and TVET colleges.

It is very common in the oil and gas industry for companies to recruit straight from colleges and universities.

Most companies train their engineers, technicians and artisans to industry standards with in-house training which includes on-the-job training, e-learning and independent industry courses.

The focus was the identification of local South African skills that fit into the following classifications of international LNG required skills.

In-order to simply classifications, the use of colour-coded tabs were chosen, as seen below:

Class 1	Green	Capacity matches opportunity directly.
Class 2	Yellow	Potential exists but matches other industry or sector (possible capacity).
Class 3	Red	Skills not available or accessible locally; only international.

I have adapted the job categories from the various sources to show the international skills required for LNG-to-Power and what the South African equivalents are, shown in Table 3.1, considering phase #1 roles in a typical LNG-to-Power setup.

3.1 Skills required for Construction & Commissioning: Phase #1

Table 3.1 below provides a comparison between international careers and local careers. The table also identifies the international skills and qualifications in comparison to South Africa`s skills and qualifications. The equivalent industry column demonstrates where such potential candidates will be located in industry.

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Rope Access Technician	IRATA LEVELS 1, 2 & 3	***Rope Access Technician***	IRATA LEVELS 1, 2 & 3	Construction, Engineering, Marine, Power, Mining.	Technician
Cryogenic Insulator	OPITO Application of Non Metallic Insulation Course	***Insulator/ Cladding operator***	Insulation / cladding course	Construction, Engineering, Marine, Power, Mining, Oil & Gas.	Trade tested artisan
Scaffolder	OSHA Scaffolds Compliance	***Scaffolder***	Unit Standard No: 263245	Construction, Engineering, Marine, Power, Mining and	Trade tested artisan

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
	Training certification		NQF Level: 3	Agriculture.	
Rigger	OPITO stage 1 & 2	***Rigger***	OPITO stage 1 & 2	Construction, Engineering, Marine, Power, Mining.	Trade tested artisan
Welding Inspector	International Institute of Welding (IIW) IWIP Standard level inspection diploma	***Welding Inspector***	International Institute of Welding (IIW) IWIP Standard level inspection diploma or SAIW Level 1	Construction, Engineering, Marine, Power, Mining and Nuclear.	Trade tested artisan
Commissioning Engineer	Bachelors Degree in Electrical, mechanical or civil. Achieving chartered (C Eng) status with the Engineering Council engineering	***Commissioning Engineer***	Bachelors Degree in Electrical, mechanical or civil. Achieving chartered (PR Eng) status with ECSA or GCC.	Construction, Engineering, Marine, Power, Mining and Nuclear.	Engineer

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Refrigeration Mechanic	Journeyman level Refrigeration licence. Gas fitter I & II licence in addition to a refrigeration licence, an asset.	***Refrigeration Mechanic***	SAQCC/SARACCA Authorised Refrigeration Practitioner Course. Trade Tested.	Construction, Engineering, Marine, Power, Mining and Shipping.	Trade tested artisan
Flag Person	Completion of secondary school and traffic control certifications	***Flag Person, Traffic controller***	Completion of high school and signal training certificate with on-the-job training.	Construction, Engineering, Marine, Power, Mining and Aviation.	Associate Artisan/Operator
Labourer	Completion of secondary school and relevant certifications	***Labourers:*** • ***Unskilled*** • ***Semi-skilled***	Completion of primary school and relevant on-the-job experience	Construction, Engineering, Marine, Power, Mining and Agriculture.	Associate Artisan/Operator
Forestry Labourer	Some secondary school, college or industry courses, combined with on-the-job	***Forestry Labourer***	Completion of primary school and relevant on-the-job experience	Wildlife & Forestry, Power, Mining and Agriculture.	Associate Artisan/Operator

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
	training				
Heavy Duty Equipment Operator	Some secondary school, college or industry courses in heavy equipment operating combined with on-the-job training	***Heavy Duty Equipment Operator***	Completion of primary school and relevant on-the-job experience	Construction, Engineering, Marine, Power, Mining and Agriculture.	Associate Artisan/Operator
Construction Painter	Completion of secondary school, over 3 years of work experience in the trade	***Painter***	Completion of primary or high school, over 3 years of work experience in the trade.	Construction, Engineering, Marine, Power, Mining and Agriculture.	Associate Artisan/Operator
Wildlife Monitor	Completion of secondary school, hunting and outdoor experience, Possession and Acquisition (PAL) licenced	• ***Wildlife Monitor,*** • ***Field Ranger,*** • ***Patrol Leader***	Completion of primary or high school. Completing a industry recognised course.[1]	Wildlife & Forestry, Power, Mining and Agriculture.	Managers and Researchers

[1] Southern African Wildlife College: http://www.wildlifecollege.org.za

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Heavy-Duty Equipment Technician	Completion of secondary school and completion of heavy-duty technician trade certification	***Heavy-Duty Equipment Technician***	Completion of primary or high school. Completing a industry recognised course.	Construction, Engineering, Marine, Power, Mining and Agriculture.	Associate Artisan/Operator
Truck Driver	Class 1 Licence, Air Brake Endorsement, Transportation of Dangerous Goods certification and completion of a driver training course of up to 3 months through a vocational school or community college	***Truck Driver***	Completion of primary or high school. Codes B, EB, C1, C and EC1. Transportation of Dangerous Goods certification. 5-10 years of experience.	Construction, Engineering, Marine, Power, Mining and Agriculture.	Trade tested artisan
Carpenter	Completion of secondary school and a 3 to 4 year apprenticeship program	***Carpenter***	Completion of an apprenticeship program. Trade test certificate.	Construction, Engineering, Marine, Power, Mining.	Trade tested artisan

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Concrete Finisher	Completion of Secondary school and a 2 to 4 year apprenticeship program	***Plasterer***	Completion of primary or high school, over 3 years of work experience in the trade.	Construction industry.	Trade tested artisan
Crane Operator	Completion of secondary school and a 1 to 3 year apprenticeship program	***Crane Operator:*** • ***Mobile crane*** • ***Tower crane***	Completion of primary or high school, over 3 years of work experience in the trade. Cert : C32- C36; C39; C40.[2]	Construction, Engineering, Marine, Power, Mining.	Trade tested artisan
Electrician	Completion of secondary school and a 3 to 4 year apprenticeship program	***Electrician:*** • ***Master Installation Electrician (Construction, Mining, Engineering)***	Completion of an apprenticeship program. Trade test certificate.[3]	Construction, Engineering, Marine, Power, Mining and Agriculture.	Trade tested artisan
Gas fitter	Completion of secondary school and 2 to 3 year apprenticeship program	***Gas Installer***	This qualification follows on the National Certificate: Gas Installations NQF Level 2. With over 3	Construction, Engineering, Marine, Power, Mining.	Trade tested artisan

[2] AA Technical Institute: www.liftingequipmenttraining.co.za
[3] Electrical Contractors Association South Africa: www.ecasa.co.za

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
			years of work experience in the trade.[4]		
Iron-worker	Completion of secondary school and a 2 to 3 year apprenticeship program	***Boiler Maker***	Completion of an apprenticeship program. Trade test certificate.	Manufacturing, Engineering, Marine, Power, Mining and Agriculture.	Trade tested artisan
Plumber	Completion of secondary school and a 4 to 5 year apprenticeship program	***Plumber***	Completion of an apprenticeship program. Trade test certificate.	Construction, Engineering, Marine, Power, Mining and Agriculture.	Trade tested artisan
Roofer	Completion of secondary school and 2 to 3 year apprenticeship program	***Roofing installer***	Completion of primary or high school, over 3 years of work experience in the trade. Roof trust certificate.	Construction, Engineering, Marine, Power, Mining.	Trade tested artisan
Sheet Metal Worker	Completion of secondary school and 3 to 5 year apprenticeship	***Sheet Metal Worker***	National Certificate: Metal and Engineering Manufacturing Processes Comp	Construction, Engineering, Marine, Power, Mining.	Trade tested artisan

[4] SAQA: National Certificate: Gas Installations (58950)

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
	program		letion of an apprenticeship program. Trade test certificate. [5]		
Pipe fitter-Steam Fitter & Sprinkler System Installer	Completion of secondary school and 4 to 5 year apprenticeship program	• ***Pipe fitter-Steam Fitter*** • ***Sprinkler System Installer***	Completion of an apprenticeship program. Trade test certificate. Certificate: Mechanical Engineering: Pipe-Fitting [6]	Construction, Engineering, Marine, Power, Mining and Agriculture.	Trade tested artisan
Welder	Completion of secondary school and a 3 year apprenticeship program	***Welder***	Completion of an apprenticeship program. Trade test certificate.	Construction, Engineering, Marine, Power, Mining and Agriculture.	Trade tested artisan
Occupational Health and Safety Officer (HSE)	Certification with the Association for Canadian Registered Safety Professionals	***Occupational Health and Safety Officer (HSE)***	Certification (NEBOSH)[7] with the Association for South African Registered Safety Professionals	Construction, Engineering, Marine, Power, Mining and Agriculture.	Managers and Researchers

[5] SAQA: National Certificate: Metal and Engineering Manufacturing Processes (79686)
[6] SAQA: National Certificate: Mechanical Engineering: Pipe-Fitting (59750)
[7] NEBOSH Certification: www.smtsgroup.com

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Biological Technician	A 2 to 3 year college program in agriculture, biology, microbiology, wildlife and resource management	***Biological Technician*** ***Bio-medical Technologists***	Completion of National Diploma: Biomedical Technology[8]	Wildlife & Forestry, Power, Mining and Agriculture.	Technician
Civil Engineering Technician	A 1 or 2 year college program in civil engineering technology	***Civil Engineering Technician***	Completion of National Diploma / BTech or N6 equivalent in Civil engineering	Construction, Engineering, Marine, Power, Mining and Agriculture.	Technician
Construction Inspector	Completion of secondary school and college diploma in construction, civil engineering or architectural technology plus several years of related work experience	***Construction Inspector***	Completion of secondary school and college diploma in construction, civil engineering or architectural technology plus several years of related work experience	Construction, Engineering,	Managers and Researchers

[8] Biomedical Technology: www.cut.ac.za

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Soil Inspector	Completion of secondary school and relevant post-secondary training	***Soil Inspector*** ***Soil Scientist***	National Diploma in Construction Materials Technology[9] BSc Agric with Soil Science and Chemistry[10] With several years of related work experience.	Forestry, Power, Mining and Agriculture.	Managers and Researchers
Bridge Inspector	Completion of secondary school plus a college diploma in construction, civil engineering, architectural technology, plus several years of related work experience	***Bridge Inspector***	Completion of National Diploma / BTech or N6 equivalent in Civil engineering With several years of related work experience.	Construction, Engineering,	Managers and Researchers

[9] SAQA: National Certificate: Construction Materials Testing (49058) * Currently no accredited providers for this qualification.
[10] Soil Sciences offered by: Department of Plant Production and Soil Science, University of Pretoria Department of Soil Science, Stellenbosch University & School of Agriculture, Earth and Environmental Science, UKZN

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Registered Professional Forester	Certification as a forester or forest engineer by provincially chartered associations	***Registered Professional Forester***	N.H.Dip./B.Tech. or B.Sc. Honours degree Professional Natural Scientist – "Pr.Sci.Nat."[11]	Forestry, Power, Mining and Agriculture.	Managers and Researchers
Geological Technician	Completion of a 1 to 2 year college program	***Geological Technician***	University degree in Geology or N5-N6 Mining/Exploration Geology. [12]	Forestry, Power, Mining and Agriculture.	Technician
Geologist	University degree in geology, geochemistry, geophysics	***Geologist***	University degree in geology, geochemistry, geophysics	Forestry, Power, Mining and Agriculture.	Managers and Researchers
Survey Technologist	A 2 to 3 year college program in geomatics or land survey technology	• ***Survey Technologist*** • ***Quantity Surveyor***	Degree / BTech (Survey) Degree / Survey Diploma	Forestry, Power, Construction, Mining and Agriculture.	Technician

[11] South African Council for Natural Scientific Professions: www.sarnap.org.za
[12] SAQA: http://regqs.saqa.org.za/showQualification.php?id=77963

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Land Surveyor	A college diploma in survey science or geomatics technology with additional academic credits and completion of land surveyor examinations.	• ***Land Surveyor*** • ***Registered Surveyor*** • ***Survey Technician***	BSc (Land Surveying) Degree / BTech (Survey) Degree / Survey Diploma	Forestry, Power, Construction, Mining and Agriculture.	Technician
Non-Destructive Maintenance Technician (NDT)	Completion of secondary school and 2 years of an approved post-secondary science or engineering	***Non-Destructive Maintenance Technician (NDT)***	National Certificate: Welding Application and Practice. PCN or SAQCC Qualifications. With 4 years of experience in electronics or technical field	Construction, Engineering, Marine, Power, Mining.	Technician
Refrigeration Engineer	University degree in Mechanical or Electrical Engineering.	***Refrigeration, Electro - Mechanical Engineers / Technologist.***	University degree in Mechanical Engineering or University of Technology.	Construction, Engineering, Marine, Power, Mining and Agriculture.	Engineer
Refrigeration Technician	Completion of secondary	***Air-conditioning***	Completion of an	Construction, Engineering,	Technician

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
	school and a 3 to 4 year apprenticeship program	***Refrigeration Technician***	apprenticeship program. Trade test certificate.	Marine, Power, Mining and Agriculture.	

Table 3.1: Skills required for Construction & Commissioning: Phase #1

3.2 Skills required for Operations & Supply: Phase #2

Table 3.2 below shows the typical skills required for phase #2 with a particular emphasis on the operational stage of a completed LNG terminal, regasification plant and CCGT facility.

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Managers in natural resources production	University degree or College diploma with Production experience.	***Managers:*** • ***Chemical Engineer*** • ***Production Engineer*** • ***Reservoir Engineer***	University degree with Production experience.	Petrochemical , Oil & Gas industry.	Managers and Researchers

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Supervisors, petroleum, gas and chemical processing and utilities	University degree or College diploma with Plant Operations experience.	***Supervisors:*** • ***Chemical Engineer*** • ***Production Engineer*** • ***Reservoir Engineer***	University degree with Petroleum experience.	Petrochemical, Oil & Gas industry.	Managers and Researchers
Machinists and machining and tooling inspectors	Completion of secondary school and a 4 to 5 year apprenticeship program	• ***Fitter & Turner*** • ***CNC machinist*** • ***Tool-maker*** • ***Tooling inspector***	Completion of high school and a 4 to 5 year apprenticeship program with N3-N6.[13] With several years of related work experience.	Manufacturing, Engineering, Marine, Power, Mining.	Trade tested artisan
Petroleum engineers	University degree in Petroleum Engineering	***Petroleum engineers***	University degree with Petroleum experience.[14]	Oil & Gas industry.	Engineer
Facility operation managers	University degree or College diploma with Plant Operations	***Operation managers:*** • ***Chemical Engineer*** • ***Production***	University degree with Operations / Production experience.	Construction, Engineering, Marine, Power, Mining and	Managers and Researchers

[13] SAQA: National Certificate: Mechanical Engineering: Fitting and Machining (23254). Offered at TVET colleges and private accredited institutions in South Africa. Toolmaker (91796).
[14] Petroleum / Reservoir Engineering degree programs currently not offered in South Africa.

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
	experience.	***Engineer*** • ***Mech/Elec Engineer***		Oil & Gas.	
Geoscientists	University degree in geology, geochemistry, geophysics.	***Geo-scientists***	University degree in geology, geochemistry, geophysics,oceanography	Engineering, Marine, Mining.	Managers and Researchers
Oceanographer	University degree in oceanography	***Oceanographic technicians***	Completion of National Diploma / BTech in Marine Sciences[15] Or BSc Degree	Marine	Managers and Researchers
Geological and mineral technologists and technicians	Completion of a 1 to 2 year college program	***Geological and mineral technologists and technicians***	University degree in Geology or N5-N6 Mining/Exploration Geology. [16]	Oil & Gas, Mining.	Technician
Power engineers	University degree in Electrical /	•***Electrical Engineer*** •***Electro - Mech***	University degree in Electrical /	Construction, Engineering, Marine,	Engineer

[15] Tertiary Institutions included: UCT & CPUT in the Western Cape.
[16] SAQA: Further Education and Training Certificate: Mining/Exploration Geology: http://regqs.saqa.org.za/showQualification.php?id=77963

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
	Power Engineering	***Engineer.***	Power Engineering	Power, Mining. Renewable energy.	
Senior managers - construction, transportation, production and utilities	Completion of secondary school and college diploma in construction, transportation engineering or architectural technology plus several years of related work experience	***Senior managers: Construction, Transportation, Production.***	Completion of National Diploma or N6 equivalent in construction, transportation engineering or architectural technology plus several years of related work experience	Construction, Engineering, Marine, Power, Mining. Renewable energy.	Managers and Researchers
Electrical and electronics engineering technologists and technicians	A 1 or 2 year college program in electrical engineering technology	***Electrical and electronics technologists and technicians***	Completion of National Diploma / BTech or N6 equivalent in Electrical, electronic engineering	Construction, Engineering, Marine, Power, Mining. Renewable energy.	Technician
Power systems operators	Some secondary school and industry courses in heavy power equipment operating combined with	***Power systems operators***	High school with industry courses in heavy power equipment operating combined with	Construction, Engineering, Marine, Power, Mining. Renewable energy.	Associate Artisan/Operator

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
	on-the-job training.		on-the-job training.		
Chemical technologists and technicians	A 1 or 2 year college program in chemical engineering technology	***Chemical technologists and technicians***	Completion of National Diploma / BTech or N6 equivalent in Chemical engineering	Pharmaceutical, Engineering, Marine, Power, Mining. Renewable energy.	Technician
Chemical engineers	University degree in Chemical Engineering	***Chemical engineers***	University degree in Chemical Engineering	Pharmaceutical, Engineering, Marine, Power, Mining. Renewable energy.	Engineer
Material handlers	Completion of secondary school and relevant certifications	***Material/store man***	On-the-Job training and relevant store/material certifications.	Construction, Engineering, Marine, Power, Mining.	
Mechanical engineering technologists and technicians	A 1 or 2 year college program in Mechanical engineering technology	***Mechanical engineering technologists and technicians***	Completion of National Diploma / BTech or N6 equivalent in Mechanical	Construction, Engineering, Marine, Power, Mining. Renewable	Technician

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
			engineering	energy.	
Drafting technologists and technicians	A 1 or 2 year college program in Design engineering technology	***Drafting technologists and technicians***	Completion of National Diploma or N6 equivalent in Mechanical engineering.	Construction, Engineering, Marine, Power, Mining.	Technician
Production logistics co-ordinators	A 1- or 2-year college program in Supply & Logistics	***Production logistics co-ordinators***	Completion of National Diploma or N4-N6 equivalent in Procurement & Logistics	Construction, Engineering, Marine, Power, Mining.	Managers and Researchers
Industrial engineering and manufacturing technologists and technicians	A 1- or 2-year college program in Industrial engineering technology	***Industrial engineering technologists and technicians***	Completion of National Diploma / BTech or N6 equivalent in Industrial engineering	Construction, Engineering, Marine, Power, Mining. Renewable energy.	Technician
Plant Health and Safety Officer (HSE)	Certification with the Association for Registered Safety Professionals	***Plant Health and Safety Officer (HSE)***	Certification (NEBOSH)with the Association for South African Registered Safety Professionals	Construction, Engineering, Marine, Power, Mining. Renewable energy.	Managers and Researchers

Table 3.2: Skills required for Operations & Supply: Phase #2

3.3 Skills required for Shipping/Marine operations Phase #2

Table 3.3 below shows the typical skills required for shipping and marine operations which is a critical component of phase #2. The focus of this table 3.3 is looking at roles that are critical in unloading LNG and port operations.

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
LNG Carrier, Master/Captain	Captains Licence.	***Master/ Captain***	S4 (Higher Diploma in Maritime Studies) at either Durban University or Cape Peninsula University of Technology[17] With 10-years experience in Petroleum Tankers and LNG Carriers, as well as operating tank terminals.	Marine, Shipping & Offshore.	Managers and Researchers

[17] SAMSA: www.samsa.org.za

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
LNG Carrier, Chief Engineer	Unlimited COC as per STCW 2010	***Chief Engineer***	S4 (Higher Diploma in Maritime Studies) at either Durban University or Cape Peninsula University of Technology[18] With 10 years experience in Petroleum Tankers and LNG Carriers, as well as owning and operating tank terminals and offshore floating facilities.	Marine, Shipping & Offshore.	Engineer
LNG Carrier, Gas Engineer	University degree in Chemical Engineering and relevant LNG experience. Class 4 Second Engineer Unlimited CoC	Ship Engineer	University degree in Chemical Engineering OR 4th Engineer with relevant LNG experience. With 10 years experience in Petroleum Tankers and LNG Carriers, as well as owning and operating tank terminals and	Marine, Shipping & Offshore.	Engineer

[18] SAMSA: www.samsa.org.za

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
			offshore floating facilities.		
LNG Carrier, Operator	Completion of secondary school and relevant certifications	***First Assistant Engineer*** ***Deck officer***	Complete S1 and S2, the student will have to join a shipping company to complete a 12-month sea service training period.[19]	Marine, Shipping & Offshore.	Technician
Mooring Supervisor	Completion of secondary school and relevant mooring certificate.	***Mooring Master / Supervisor***	STCWCode, Tables A-II/1 & A-II/2, the SAMSA Code, as well as the US Coast Guard Code of Federal Regulations 46 CFR 10.205 and 10.209.	Marine, Shipping & Offshore.	Managers and Researchers
LNG Terminal Supervisor	Completion of secondary school and relevant Engineering / marine certifications LNG regulations including Federal DOT LNG CFR	***Terminal Supervisor***	Bachelor's degree in engineering and up to 5 years of related experience, or committed to 'on the job' training programs with practical experience of methods,	Marine & Offshore.	Managers and Researchers

[19] SAMSA: www.samsa.org.za

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
	193 and NFPA 59A		processes and techniques relevant to area or discipline		
LNG Terminal Operator	Completion of secondary school and relevant certifications	***Plant Operator***	Completion of National Diploma / BTech in Engineering Relevant OJT in process plant or energy generation.	Power Plant, Marine & Offshore.	Technician
LNG Terminal control room operator	High School Graduate or GED equivalent and in process of acquiring Process Technology Degree or 10+ years' experience	***Control Room Operator***	Provide the direction to the day to day activities of the outside shift operators. Responsible for interfacing with the other DCS control room operators to ensure the safe and efficient operation of the facility	Nuclear, Marine, Power, Mining and Aviation.	Technician
Offshore Jetty Supervisor	Completion of secondary school and relevant STCW 95	***Marine Pilot***	National Certificate in Marine Pilotage With several years of experience in guiding ships in and out of ports	Marine, Fishing & Offshore.	Managers and Researchers

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
			with LNG movements.		
Offshore Jetty operator	Completion of secondary school and relevant marine training	***Jetty operator***	Certificate of Competence: Able Seafarer - Deck Navigational Watch experience	Marine, Fishing & Offshore.	Associate Artisan/Operator
Tug boat Captain	Captains licence, STCW 95 Captains of tugs are responsible for ships towing other vessels/barges when they are in trouble at sea.	***Tug Master***	Skipper Port Operations or Master Port Operations. This course qualifies you to skipper a vessel up to 200 tonnes. A structured Tug Master 12-month training program[20]	Marine & Offshore.	Technician
Tug boat operator	Marine related training or Able seaman certificate	***Able Seaman***	Certificate of Competence: Able Seafarer With a minimum of 12 month of	Marine & Offshore.	Associate Artisan/Operator

[20] Transnet careers: Tug Master- www.transnet.net

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
			service at sea.[21]		
Radio Operator	Completion of secondary school and relevant radio operators certifications	***Radio Operator***	GMDSS First class Radio Electronic Certificate[22] Or Short Range Certificate (SRC) depending for Non-SOLAS vessels	Aviation, Marine, Power, Mining.	Associate Artisan/Operator

Table 3.3: Skills required for Shipping/Marine operations phase #2

3.4 Skills required for Maintenance & Support: Phase #3

Table 3.4 below shows the typical skills required for maintenance operations aligned with phase #3. The importance of displaying the careers that form part of the ongoing operations in the LNG-to-Power facility.

[21] See Appendix 3: Able Seaman
[22] SAMSA: www.samsa.org.za

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Facility maintenance managers	University degree in Mechanical/Electrical/Chemical Engineering	***Maintenance managers***	University degree in Mechanical Engineering	Construction, Engineering, Marine, Power, Mining and Agriculture.	Managers and Researchers
Maintenance Engineers (Mechanical)	University degree in Mechanical Engineering	***Maintenance Engineers (Mechanical)***	University degree in Mechanical Engineering	Construction, Engineering, Marine, Power, Mining and Agriculture.	Engineer
Maintenance Engineers (Electrical)	University degree in Electrical Engineering	***Maintenance Engineers (Electrical)***	University degree in Electrical Engineering	Construction, Engineering, Marine, Power, Mining and Agriculture.	Engineer
Maintenance Engineers (Turbine)	University degree in Mechanical Engineering	***Mechanical Engineers***	University degree in Mechanical Engineering.[23]	Power, Mining. Renewable energy.	Engineer
Waterworks maintenance workers	Completion of secondary school and relevant certifications	***Utility plant maintenance worker*** ***Waterworks maintenance worker***	St 8/ Grade 10 (or NTC 1) plus Maintenance Workers Certificate; or St 8/ Grade 10 (or NTC 1) plus Water and Wastewater	Construction, Engineering, Marine, Power, Mining and Agriculture.	Trade tested artisan

[23] No dedicated CCGT tertiary training facilities in South Africa, besides private sector i.e. Siemens.

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
			Treatment[24]		
Gas maintenance workers	Completion of secondary school and relevant certifications	***Gas maintenance workers***	The Transnet School of Pipelines. (Currently, the School is only open to Transnet employees) or Registered with SAQCC LP Gas Safety Association of Southern Africa	Construction, Engineering, Marine, Power, Mining and Agriculture.	Technician
Maintenance Technicians (Mechanical)	A 1 or 2 year college program in mechanical engineering technology	***Mechanical Maintenance Technicians***	Completion of National Diploma / BTech or N6 equivalent in Mechanical engineering	Construction, Engineering, Marine, Power, Mining and Agriculture.	Technician
Maintenance Technicians (Electrical)	A 1 or 2 year college program in electrical	***Electrical Maintenance Technicians***	Completion of National Diploma / BTech or N6	Construction, Engineering, Marine, Power, Mining and Agriculture.	Technician

[24] No. 36958:GOVERNMENT GAZETTE, 23 OCTOBER 2013

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
	engineering technology		equivalent in Electrical, electronic engineering		
Maintenance Technicians (Turbine)	A 1 or 2 year college program in mechanical engineering technology Professional Certificate of Competency in Gas Turbine Engineering	• ***Turbine Technicians*** • ***Senior Technician (Turbine)*** • ***Aircraft Mechanic*** • ***Aircraft Technician***	• South African Airways Technical Training apprentice program • Eskom Technical Training program	Aviation, Marine, Power Generation, Renewable Energy.	Technician
Maintenance Technicians (DSC:Distributed Control Systems)	A 1 or 2 year college program in electrical engineering technology	***Maintenance Technicians (DCS)***	Completion of National Diploma / BTech or N6 equivalent in Electrical, electronic engineering.[25]	Power, Mining. Renewable energy.	Technician
Plant Electrician	Completion of secondary school and a 3- to 4-year	***Plant Electrician:*** • ***Master***	Completion of an apprenticeship program. Trade	Construction, Engineering, Marine, Power, Mining and	Trade tested artisan

[25] A distributed control system (DCS) is a platform for automated control and operation of a plant or industrial process.

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
	apprenticeship program	***Installation Electrician (Oil & Gas, Production, Mining)***	test certificate With 5 year`s experience in plant operations .	Agriculture.	
Plant Welder	Completion of secondary school and a 3-year apprenticeship program	***Plant Welder***	Completion of an apprenticeship program. Trade test certificate. With 5 year`s experience in plant operations .	Construction, Engineering, Marine, Power, Mining and Agriculture.	Trade tested artisan
Non-Destructive Maintenance Technician (NDT)	Completion of secondary school and 2 years of an approved post-secondary science or engineering	***Plant Non-Destructive Maintenance Technician (NDT)***	National Certificate: Welding Application and Practice. PCN or SAQCC Qualifications. With 4 years of experience in electronics or technical field	Engineering, Marine, Power, Mining and Oil & Gas.	Technician
Maintenance Mechanic	Automotive Mechanic`s trade tested artisan.	***-Maintenance Mechanic*** ***- Millwright***	Completion of an apprenticeship program. Trade test certificate.	Engineering, Marine, Power, Mining and Automotive	Trade tested artisan

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
Maintenance Operator	High School with Relevant industry OJT	***Maintenance Operator***	Completion of High school and relevant on-the-job experience	Engineering, Marine, Power, Mining and Automotive	Associate Artisan/Operator
Gas Testing Technician	Gas Detection Certification Or MSA, Draeger certificate of competence	***Gas Testing Technician***	SANS Gas Detection Certification or MSA, Draeger certificate of competence	Engineering, Marine, Power, Mining and Oil & Gas.	Technician
Water Waste Disposal Technician	College Diploma in Water Waste Technology	***Water Waste Disposal Technician***	- National Certificate: Water and Wastewater Treatment Process Operations (NQF Level 2) - National Certificate: Water and Wastewater Process Control	Engineering, Marine, Power, Mining and Nuclear.	Technician

INTERNATIONAL JOB TITLE	*SKILLS AND QUALIFICATION*	*SOUTH AFRICAN JOB TITLE*	*SKILLS & QUALIFICATION*	*EQUIVALENT INDUSTRY*	*OCCUPATIONAL LEVEL*
			(NQF Level 3) - Further Education and Training Certificate: Water and Wastewater Treatment Process Control Supervision (NQF Level 4)[26]		
Water Waste Disposal Operator	High School with Relevant industry OJT	***Water Waste Disposal Operator***	Completion of High school and relevant on-the-job experience	Engineering, Marine, Power, Mining and Nuclear.	Associate Artisan/Operator

Table 3.4: Skills required for Maintenance & Support: Phase #3

3.5 Local industry skills relationships to LNG

From tables 3.1-3.4 an equivalent industry column demonstrated the linkages with our local industry. Key industries areas:

- **Construction** (Construction of power plants: Dedisa)
- **Nuclear** (Koeberg Power Station & Avon Peaking)
- **Oil & Gas** (Upstream, Midstream & Downstream)
- **Manufacturing**
- **General Engineering**

[26] CPUT: Certificate in Water and Wastewater Treatment

- **Marine / Shipping** (Large carriers & Mooring services)
- **Power** (See Appendix 4)
- **Mining** (See Appendix 4)
- **Renewable energy**
- **Aviation** (Aircraft turbines)

In my opinion areas of particular interest with regards to operations and maintenance would be in:

Nuclear/Power - Power plants employs highly skilled individuals and common skills exist in comparison to LNG. This aligns with the power generation industry professionals, thus providing the building blocks for LNG to Power

Oil & Gas - Onshore or offshore rigs and production platforms employs highly skilled individuals and common skills exist in comparison to LNG. The oil and gas industry employs a wide range of engineers, technicians and artisans which all have been highly trained to meet industry standards.

Marine / Shipping - The marine industry employs highly skilled individuals and common skills exist in comparison to LNG.

Mining - Onshore or offshore mining employs highly skilled individuals and common skills exist in comparison to LNG. The mining industry employs a wide range of engineers, technicians and artisans which all have been highly trained to meet industry standards. South Africa is very fortunate to have a developed mining industry and can cross-train these professionals to work in the LNG industry.

Aviation - The aviation industry provides an important link to CCGT. Gas turbines and air craft turbines are regarded as a specialized field. The aviation industry employs highly skilled individuals and common turbine skills exist in comparison to LNG to Power. The aviation industry employs a wide range of engineers, technicians and artisans which all have been highly trained to meet industry standards.

4. Discussion of findings

4.1 Introduction

The information gathered from the skills required in all three phase will be discussed in this section. In addressing the research question of what is needed to raise the game in terms of coaching, training and management for local engineers, technicians and artisans, it was imperative to compare and classify local skills.

4.5 Discussion of findings

In figure 4.1 below, the skills required for construction and commissioning were displayed for phase # 1.

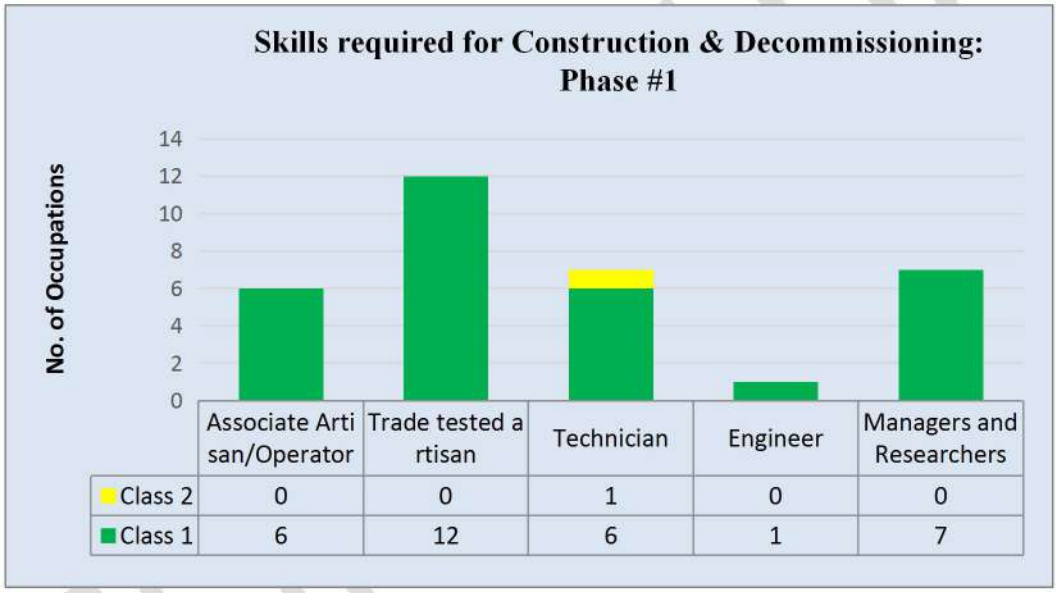


Figure 4.1: Skills required for Construction & Commissioning: Phase #1

From figure 4.1 it is evident that local capacity is met with the construction stage of the project. However development in the technician career was noted as classification 2.

Development areas, Figure 4.2:

- Refrigeration Engineer
- Refrigeration Technician
- Biological Technician

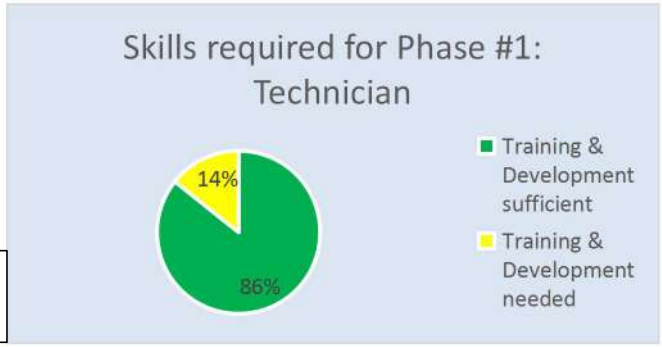


Figure 4.2

In figure 4.3 below, the skills required for Operations & Supply & Shipping/Marine: Phase #2

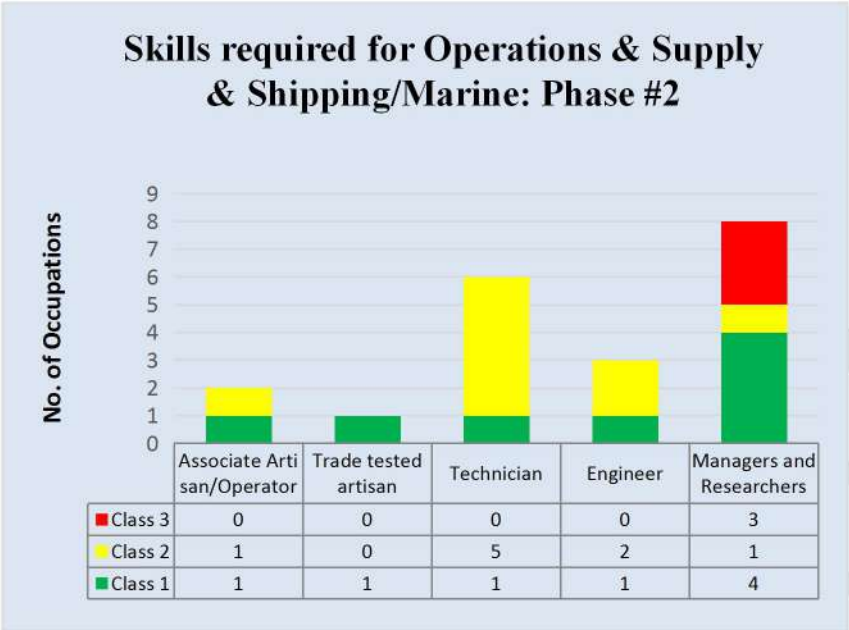


Figure 4.3: Skills required for Operations & Supply & Shipping/Marine: Phase #2

Figure 4.4

Critical Development areas Figure 4.4:

- Geo-scientists
- Geological and mineral technologists
- Electrical and electronics engineering technologists and technicians
- Power systems operators
- Chemical technologists and technicians

- Chemical engineers
- Mechanical engineering technologists and technicians
- Industrial engineering and manufacturing technologists and technicians
- LNG Carrier, Operator
- Mooring Supervisor
- Offshore Jetty Supervisor
- Offshore Jetty operator
- Managers in natural resources production
- Supervisors, petroleum, gas and chemical processing and utilities
- Petroleum engineers
- Facility operation managers
- LNG Carrier, Master/Captain
- LNG Carrier, Chief Engineer
- LNG Carrier, Gas Engineer
- LNG Terminal Supervisor
- LNG Terminal Operator
- LNG Terminal control room operator

In figure 4.5 below, the skills required for Maintenance & Support: Phase #3

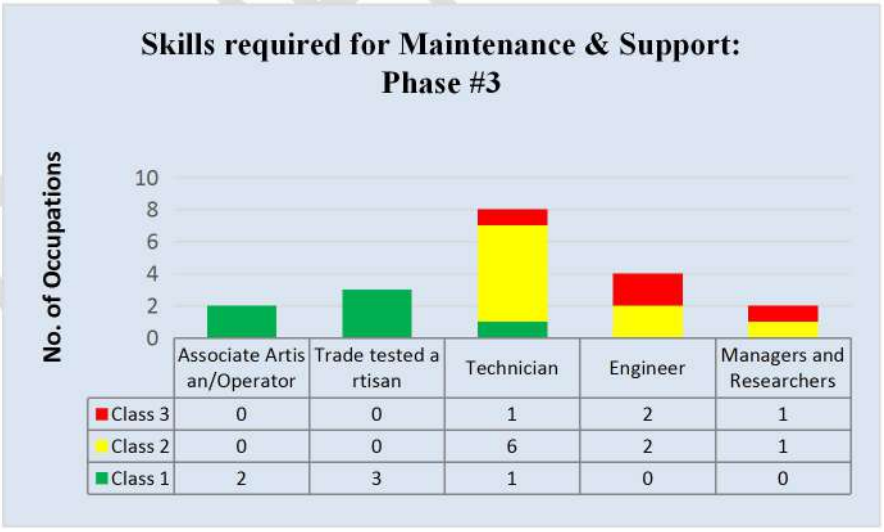


Figure 4.5: Skills required for Maintenance & Support: Phase #3

Critical Development areas Figure 4.6 (A,B,C):

- Facility maintenance managers
- Maintenance Engineers (Mechanical)
- Maintenance Engineers (Electrical)
- Waterworks maintenance workers
- Gas maintenance workers
- Maintenance Technicians (Mechanical)
- Maintenance Technicians (Electrical)
- Maintenance Technicians (DCS)
- Maintenance Engineers (Turbine)
- Maintenance Technicians (NDT)

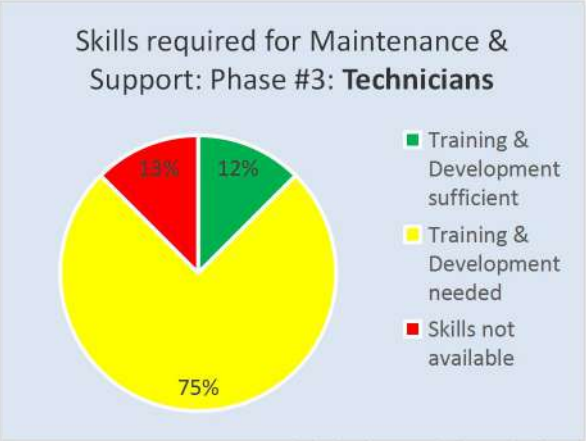


Figure 4.6 A

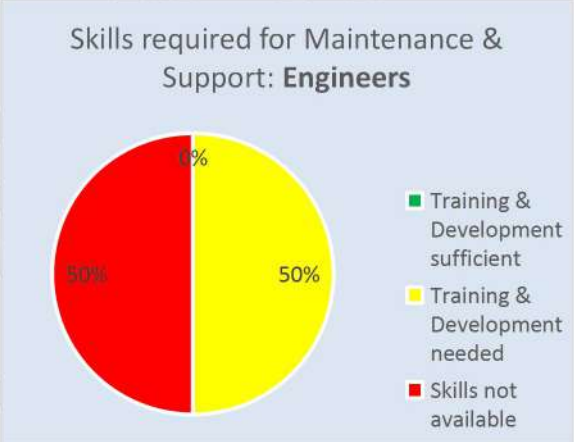


Figure 4.6 B

Figure 4.6 C

4.5.1 An evaluation of the skills needed for LNG-to-Power.

The findings obtained from Table 4.1 - 4.6 show that skills needed are covering areas from phase #1 to phase #3. The findings further reveals that technical skills are broken down into three classifications where you would find training and development is sufficient, training and development needed or skills not available. Classification 3 (Red) are vital to LNG to Power operations. It is understood that LNG training is not offered in South Africa. Careers in these fields are impossible to pursue, as only a handful of South Africans are trained in these roles.

Findings have shown that many artisans fall into the classification 1 (Green). This enables South Africans to make transitions comfortably into the LNG industry. However basic training is required to leverage these artisans.

Classification 2 (Yellow) shows that certain training and development is needed in a large array of careers in phase #2 & #3. From figure 4.6 (A,B,C) it is clear that much-needed training and development is needed to leverage the training gap - and some occupations are not offered in South Africa.

4.5.2 Identifying the training gap in LNG-to-Power.

In order to identify the training gap a training needs assessment (TNA) has to be completed for each occupation. However this was not the scope of the report and would require extensive in-depth analysis with DOL, DHET & SETA for information regarding [relevant] skills as the oil and gas industry straddles several SETA`s.

The needs assessment requirement for the skills prerequisite in LNG to Power within Southern Africa aligns with National and sectoral needs assessments, but the focus will also be on individual needs assessment of engineers, technicians and artisans.

The process to uncover the training gap was focused on the basis of the Phakisa occupational learning framework, where five categories where identified, displayed previously in figure 3.1, namely: Managers and Researchers, Engineers, Technicians, Trade Tested artisan and Associate Artisan/Operator.

Table 4.1 shows the how local capacity can be leveraged to meet industry standards. The mode of training is specific to the LNG industry, training and development for all

three phases of LNG requires classroom training (In-house), Industry specific courses, Simulation training, On-the-Job training, HSE and Fire protection training.

Training required LNG-to-Power Coaching, Training and Development						
Occupational Levels	**Classroom training**	**Industry courses**	**Pilot/Simulation training**	**OJT**	**Health, Safety & Enviroment**	**Fire Protection**
Associate Artisan/Operator	*In-house classroom training:* - Basic Plant overview - Risk awareness	Industry related course where applicable to operator. Should always be acting under supervision	N/A	YES	♦Permit-to-work (PTW) training ♦Fatigue management ♦Confined space entry training ♦Fall protection safety training ♦Electrical lock-out training ♦Incident reporting, STOP card system.	YES
Trade tested artisan	*In-house classroom training:* - Basic LNG concept - Basic Terminal operations - Plant overview - Risk awareness	Industry related course where applicable to artisan.	Only applicable for Crane operators and bridge operators	YES		YES
Technician	*In-house classroom training:* - Intermediate LNG concept - Intermediate Terminal operations - Intermediate Plant overview - Risk awareness - Equipment principles - Maintenance of equipment	Industry related course where applicable to technician. *Online platforms available* (SAMTRA, PetroSkills, SPE, SAIT).	YES, Only specific careers: - LNG Control Room Operator - Plant Technicians - Refrigeration Technician - CCGT Technician	YES		YES
Engineer	*In-house classroom training:* - Advance LNG concept - Advance Terminal operations - Advance Plant overview - Risk awareness - Equipment principles - ERP Training - Maintenance of equipment	*Industry related course:* - Liquefaction, - LNG *Online platforms available* (SAMTRA, PetroSkills, SPE, SAIT).	YES, Only specific careers: - LNG Carrier Master & Engineer - Chemical Engineer - Refrigeration Engineer - Power Utility Engineer - CCGT Engineer	YES		YES
Managers and Researchers	*In-house classroom training:* - Advance LNG concept - Advance Terminal operations - Advance Plant overview - Risk awareness - Plant Management - ERP Management	*Industry related course:* - Inspector certification - Building certification - Management certifications *Online platforms available* (SAMTRA, PetroSkills, SPE, SAIT).	Only applicable for Plant/Operations managers	YES	Basic safety training	YES, where applicable

Table 4.1: LNG Training required (Training & Development)

4.6 Conclusion from findings

The findings presented important focal areas in the South African labour market. Some skills were well-developed and can easily be leveraged to meet LNG industry needs. The findings also highlighted some areas that need training and development but has the potential to meet industry standards.

Phase #2 & #3 has identified skills domain which is not available or accessible locally. In terms of prioritising the skills needs in South Africa, it would be imperative that we focus on classifications 2 & 3.

The findings could also identify the training gap in LNG-to-Power. This was displayed in table 4.1 where each occupational level was given a criteria to leverage the training gap.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The report focused on the skills needed for LNG to Power and identified the current skills deficits of the South African workforce. The findings clearly provided conclusive evidence of the skills required for LNG to Power, thereby succeeding in pinpointing the critical skills needed.

The report revealed that the current skills deficits will contribute negatively to the LNG to Power industry. However, certain job categories such as unskilled workers (Operators) only require basic training in order to bridge the gap.

The report also uncovered some shortcomings in the industry. It established that certain factors, such as training providers and costs of courses. However, some factors can be turned into positives if planning is done well, these factors being: improving infrastructure, increasing engineer, technician and artisan output and providing technical courses at universities & colleges.

Numbers of areas are seen to be positive, as South Africa can leverage its skills to meet industry standards. The opportunities indicated from the report show that South Africa can develop the capacity to upskill the current workforce.

From the report, the researcher identified a number of areas that create scope for further research. The limitations of the research actually provide opportunities for further research, since the skills deficit in the Coega and Richards Bay region was not investigated and will definitely be a contributing factor in further studies.

More research can be carried out in the key technical skills categories, as well as into models for LNG skills development in South Africa's workforce, programme design and development and quality assurance in LNG development.

The report recommended that intensive training and development programmes should be implemented before the Independent Power Producer (IPP) goes ahead with development. An action plan was recommended to allow stakeholders to focus on key developmental areas. By identifying the necessary skills needed, South Africa can be

one step ahead, with a view to providing substantial economic relief in today's frantic markets.

5.2 Recommendations

It is highly recommended that the South African DoL, DHET, as well as tertiary academic institutions and all relevant financial and commercial organisations, take cognisance of the fact that intensive training and development programmes need to be implemented before entering into the LNG market. An immediate action plan is vital, one which defines the skills needed and diagnoses the current skills deficiencies, if a workable training and development strategy is to be arrived at and implemented.

The following recommendations can be made, based on the conclusions of the report:

- Technical courses (University and Colleges) focusing on engineering studies that are not available in Southern Africa remain at the forefront of consideration. Programmes in petroleum, liquefaction, regasification, production and gas power generation should be offered by SA universities and colleges. The obstacles to upskilling South Africa's engineers and technicians are real and obvious, so we urgently need our academic institutions to be able to provide relevant oil and gas technical programmes and courses;
- Basic technical knowledge is also important to operators and artisans, as the technical language should be mutually understood. As well as communication between field personnel and management.
- Since universities and colleges do not have the expertise to present this topic, which prevents the discipline spreading to upcoming engineers, technicians and artisans, they must therefore partner up with overseas institutions to create awareness and promote knowledge sharing in the gas industry.
- Internships and field work or site visits are invaluable in addressing the skills deficiency.
- Bringing experienced SA expats home to work could enhance knowledge sharing and provide a cost-effective short-term solution.
- Lucrative remunerations packages (Incentives and benefits) are recommended in order to attract prospective graduates, experienced engineers, technicians and artisans to the LNG industry.

5.2.1 Action Plan

Table 5.1: Action Plan for Training and Development

Action Plan	Level	Action / Responsibility	Outcomes	Time frame
Government (DoL)	Macro	• Provide funding for LNG-to-Power training & development • Include LNG-to-Power careers in the scarce skills list • Create awareness of the LNG-to-Power industry • Provide tax incentives for organisations and training institutions • Invest in infrastructure to promote LNG development	• Skills development in South Africa to develop engineers, technicians and artisans in the gas industry • LNG-to-Power conferences	• Once funds become available, immediate action is needed
Organisations	Meso	• Provide technical knowledge and skills (Hands-on-training) • Opportunities for further employment • Remuneration	• In-house oil & gas certifications. • Employment • Industry knowledge transfer	12 -24 months
Universities & Universities of Technology	Macro	• Providing accredited oil & gas programs • Knowledge sharing with scholarship programs • Increasing LNG gas awareness • Linking / partnering with overseas universities	• Meeting industry experts & alumni • Bachelor Degrees and Advanced certificates • Masters & Doctoral Degrees	4-6 years
Technical Colleges	Macro	• Linking / partnering with overseas colleges • Providing accredited oil & gas programs • Aligning trade programs with oil & gas needs	• Trade test certification • National Higher certificates	1-3 years
Individuals	Micro	• Individuals should enquire about the different courses and careers in the oil & gas industry • Applying for internships and field work • Enrol in online oil & gas training	• Preparing for potential job opportunities • Internships and field work enhances job applications • Online certification	3-6 months

BIBLIOGRAPHY

American Association of Petroleum Geologists, Energy Minerals Division. (2009). *Natural Resources Research.* Unconventional Energy Resources: 2007–2008 Review. USA: Tulsa. DOI: 10.1007/s11053-009-9094-0.

Bairi, J., Manohar, B. M. and Kundu, G. K. (2013). *Knowledge acquisition by outsourced service providers from aging workforce of oil and gas industry*. 43(1), p. 39 -56.

British Petroleum (2016). A Natural Gas Partner*:* Gas Marketing and Communications (Brochure), Middlesex, UK .

Energy Institute, Norman Broadbent and Deloitte. (2008). *Skills needs in the Energy Industry:* A report on the initial findings of three surveys conducted by the Energy Institute, Deloitte and Norman Broadbent. UK: London.

Erasmus, B.J., Loedolff, P.V.Z., Mda, T.V. and Nel, P.S. (2013) *Managing Training and Development.* 6th ed. Cape Town: Oxford University Press.

Erasmus, J. and Breier, M. (2009*) Skills Shortages in South Africa: Case Study of key professions, Human Sciences Research Council and South African Department of Labour.* South Africa: Cape Town.

Ernst and Young LLP (2014). *Getting ready for UK shale gas: Supply chain and skills requirements and opportunities*. UK: London.

Mansor, A. (2012) *Training Needs Analysis 350*. ABM Consultation. http://www.slideshare.net/abmconsult/350-training-needs-abm [Accessed 4 August 2015]

Mateus, A. D., Allen-Ile, C. and Iwu, C.G. (2014) *Skills Shortage in South Africa:* Interrogating the Repertoire of Discussions, *Mediterranean Journal of Social Sciences***,** 5(6): 63-73, April.

SAnews.gov.za (2014) *Government*: Shale gas exploration 'to be game-changer for SA'.http://www.southafrica.info/about/government/stateofnation2014f.htm# [Accessed 4 April 2015].

South Africa (2014) *National Scarce Skills List: Top 100 Occupations in Demand*. (Government notice no. 380). *Government Gazette*, 37678: 3, 23 May.

Vasa-Sideris, S. (2011). *Advantages and Disadvantages of energy sources. United States*: Southern Polytechnic State University. (Student notes).http://homepages.spa.umn.edu/~larry/ADVANTAGE_DIS_ENERGY.pdf [Accessed 07 October 2015]

Standard Bank (2016). I*ssues in Financing of Gas Projects:* Presented at Gas 101 Event, Cape Town, 28 September 2016.

Fin24.com (2015). Coega announces LNG-to-power plant. http://www.fin24.com/Companies/Industrial/Coega-announces-LNG-to-power-plant-20150811 [Accessed October 2016].

Royal Dutch Shell (2016). *Gas Market Development in South Africa:* Presented at Gas 101 Event, Cape Town, 28 September 2016.

The Royal Society and The Royal Academy of Engineering. (2012). Shale gas extraction in the UK: a review of hydraulic fracturing. DES2597. UK: London.

Department of Energy (2015). Independant Power Producer Programme: *EIA for Floating Power Plant and EIA for LNG Import Facilities, Port of Richards Bay.* South Africa: Environmental Resources Management Southern Africa (ERM ref:0320839).

International Gas Union (2016). *IGU: World Gas LNG Report - 2016 Edition*, Norway: IGU.

LNGCanada (2016). LNG Canada Opportunties. http://lngcanada.ca/category/opportunities [Accessed October 2016].

Department of Energy (2016). Independant Power Producer Preliminary Information Memorandum: *Liquefied Natural Gas (LNG) to Power IPP Procurement Programme.* South Africa: Independant Power Producer Office.

International Union of Operating Engineers Local (2013). *LNG job creation presents opportunities and challenges in construction*, Originally published in The OE News, Fall 2013 Edition, 7 Oct, 2013.

KPMG (2014). *British Columbia LNG Workforce Occupation Forecast:* Prepared for the British Columbia Ministry of Jobs, Tourism and Skills Training, Canada, May 21, 2014.

INTERNET RESOURCES

Society of Petroleum Engineers (SPE): www.spe.com

PetroSkills Training: www.petroskills.com

South African Oil and Gas Alliance: www.moga.saoga.org.za.

South African Maritime Safety Authority: www.samsa.org.za

Haddington Ventures: www.hvllc.com

Texas LNG: www.txlng.com

Rigzone online resources: www.rigzone.com

Annova LNG Brownsville: www.annovalng.com

Electrical Contractors Association South Africa: www.ecasa.co.za

South African Council for Natural Scientific Professions: www.sarnap.org.za

South African Qualifications Authority (SAQA): www.saqa.org.za

Southern African Wildlife College: http://www.wildlifecollege.org.za

AA Technical Institute: www.liftingequipmenttraining.co.za

Transnet careers: www.transnet.net

NEBOSH Certification: www.smtsgroup.com

Central University of Technology, Biomedical Technology: www.cut.ac.za

University of Pretoria, Department of Plant Production and Soil Science: www.up.ac.za

Stellenbosch University, Department of Soil Science: www.sun.ac.za

University of KwaZulu-Natal, School of Agriculture, Earth and Environmental Science: www.ukzn.ac.za

University of Cape Town: www.uct.ac.za

Cape Peninsula University of Technology: www.cput.ac.za

The Council for Scientific and Industrial Research (CSIR): www.csir.co.za

University of Witwatersrand: www.wits.ac.za

Maritime Jobs Online: www.maritimejobs.com

Coega Development Corporation: www.coega.co.za

EcoElectrica LNG: www.ecoelectrica.com

CAPCO Organisational Structure: http://www.epd.gov.hk/eia/register/report/eiareport/eia_1252006/html/eiareport/Part3/Section13/Sec3_Annex13B_Appendix1.htm

Sempra LNG: www.sempralng.com

APPENDICES:

Appendix 1:

Appendix 4 Estimated Direct Workforce Demand Over Time – Medium Scenario

Medium Scenario Direct	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Construction	0	2,260	9,280	19,380	25,720	19,010	10,720	5,360	0	0
Operations	0	0	0	0	480	950	1,700	2,450	3,190	3,470
Total Direct - Medium	0	2,260	9,280	19,380	26,200	19,960	12,420	7,810	3,190	3,470

Medium Scenario Construction	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Facility	0	1,100	4,340	9,070	13,790	9,870	5,960	2,980	0	0
Pipeline	0	470	2,150	4,620	7,090	5,140	3,190	1,590	0	0
Upstream	0	690	2,800	5,700	4,850	4,000	1,580	790	0	0
Total Construction - Medium	0	2,260	9,290	19,390	25,730	19,010	10,730	5,360	0	0

Medium Scenario Operations	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Facility	0	0	0	0	80	160	300	440	580	640
Pipeline	0	0	0	0	10	20	40	50	70	70
Upstream	0	0	0	0	380	770	1,360	1,950	2,540	2,750
Total Operations - Medium	0	0	0	0	470	950	1,700	2,440	3,190	3,460

Appendix 2:

The following qualifications are within the primary focus of the CHIETA (Chemical Industries Education and Training Authority) and registered with SAQA (South African Qualifications Authority) - www.saqa.org.za

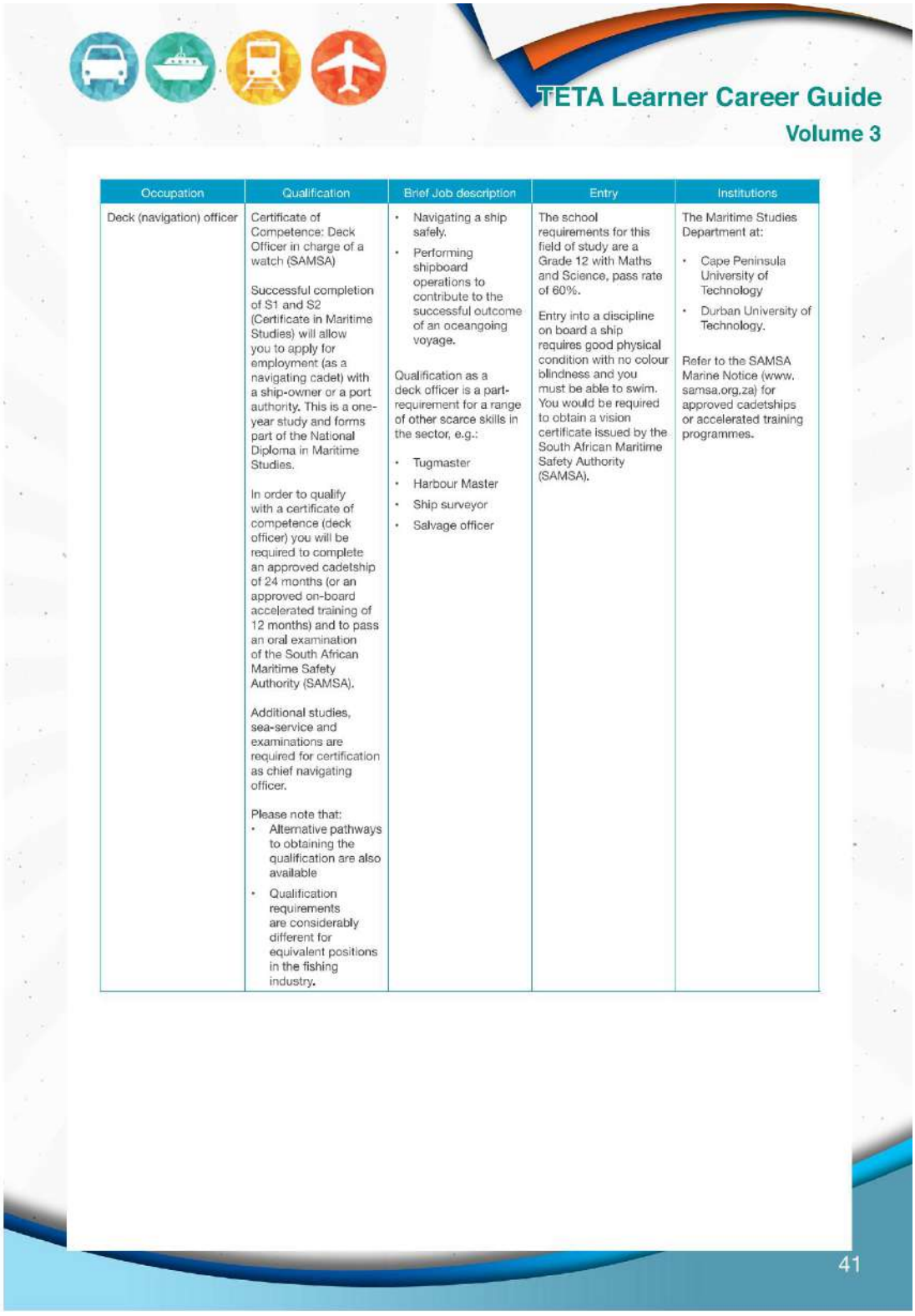
SAQA NLRD ID	Learning Program ID	NQF Level	Qualification Title	OFO CODES	Learnership Registration Number
63349		NQF Level 3	National Certificate: Molten Glass Production	**718102**	03Q030095281203
64950	**78386**	NQF Level 4	Further Education and Training Certificate: Laboratory Analysis: Chemical	**311101**	03Q030091521404
66029	**58514**	NQF Level 1	General Education and Training Certificate: Chemical Operations	**313301**	03Q030075411201
78527	**58515**	NQF Level 2	National Certificate: Chemical Operations	**313301**	03Q03007641352
78528	**66209**	NQF Level 3	National Certificate: Chemical Operations		03Q030077321203
78529	**58538**	NQF Level 4	Further Education and Training Certificate: Chemical Operations	**313301**	03Q030088291404
58955		NQF Level 2	National Certificate: Chemical Manufacturing	**313301**	03Q030096631202
49555		NQF Level 3	National Certificate: Operations of Mobile Explosives Manufacturing Units	**734209**	03Q030065191203
57828		NQF Level 3	National Chemical: Glass Forming	**718102**	03Q030072201203
57881	**59178**	NQF Level 2	National Certificate: Welding Application and Practice	**651202**	03Q030069301582
57886	**59179**	NQF Level 3	National Certificate: Welding Application and Practice: Chemical Welding	**651202**	03Q030070361513
57887	**59180**	NQF Level 4	Further Education and Training Certificate: Welding Application and Practice: Chemical Welding	**651202**	
58722	**63809**	NQF Level 2	National Certificate: Engineering Fabrication	**615302**	03Q030081331482

SAQA NLRD ID	Learning Program ID	NQF Level	Qualification Title	OFO CODES	Learnership Registration Number
58720	**63810**	NQF Level 3	National Certificate: Engineering Fabrication: Chemical Boiler Making	**615302**	03Q030073361383
58721	**63829**	NQF Level 4	Further Education and Training Certificate: Engineering Fabrication: Chemical Boiler Making	**615302**	03Q030074221414
59689	**63475**	NQF Level 2	National Certificate: Mechanical Engineering: Pipe-Fitting	**642607**	03Q030082351302
59750	**63330**	NQF Level 3	National Certificate: Mechanical Engineering: Pipe-Fitting: Chemical	**642607**	03Q030083281213
59769	**63332**	NQF Level 4	Further Education and Training Certificate: Mechanical Engineering: Pipe-Fitting: Chemical	**642607**	03Q030084271234
58975	**79946**	NQF Level 3	National Certificate: Automated Packaging	**718304**	03Q030102241203
59689	**63474**	NQF Level 2	National Certificate: Mechanical Engineering: Fitting	**653303**	03Q030085311302
59669	**63470**	NQF Level 3	National Certificate: Mechanical Engineering: Fitting: Chemical	**653303**	03Q030086241203
59709	**63480**	NQF Level 4	Further Education and Training Certificate: Mechanical Engineering: Fitting: Chemical	**653303**	03Q030087221204
59729	**63484**	NQF Level 2	National Certificate: Mechanical Handling (Rigging)	**651501**	03Q030078301272
59730	**63487**	NQF Level 3	National Certificate: Mechanical Handling: Rigging: Chemical	**651501**	03Q030079241213
59731	**63491**	NQF Level 4	Further Education and Training Certificate: Mechanical Handling: Rigging: Chemical	**651501**	03Q030080271364
59015		NQF Level 2	National Certificate: Gas Installations	**642603**	03Q030089381202
58950		NQF Level 3	National Certificate: Gas Installations	**642603**	03Q030090351203
57879		NQF Level 3	National Certificate: Manufacturing of Surface Coating	**211301**	03Q030071311223
74530	**78383**	NQF	National Certificate:	**672105**	03Q030098271332

SAQA NLRD ID	Learning Program ID	NQF Level	Qualification Title	OFO CODES	Learnership Registration Number
		Level 2	Measurement ,Control and Instrumentation: Chemical		
74532	**78385**	NQF Level 3	National Certificate: Measurement, Control and Instrumentation: Chemical	**672105**	03Q030101201203
74531	**78384**	NQF Level 4	Further Education and Training Certificate: Measurement, Control and Instrumentation: Chemical	**672105**	03Q030097201344
63969		NQF Level 5	National Certificate: Pharmaceutical Sales Representation	**243302**	03Q030022001225
13678		NQF Level 2	Mechanics: Chemical Boiler making: Technology	**651302**	03Q030010251582
13675		NQF Level 3	Mechanics: Chemical Boiler making	**651302**	03Q030023001203
13674		NQF Level 4	Mechanics: Chemical Boiler making	**651302**	03Q030024001204
13653		NQF Level 2	Electrics: Chemical Electrical	**671101**	03Q030011251832
13640		NQF Level 3	Electrics: Chemical Electrical	**671101**	03Q030028001203
13639		NQF Level 4	Electrics: Chemical Electrical	**671101**	03Q030029001204
13676		NQF Level 2	Mechanics: Chemical Fitting	**653303**	03Q030015391982
13672		NQF Level 3	Mechanics: Chemical Fitting	**653303**	03Q030025001203
13656		NQF Level 4	Mechanics: Chemical Fitting	**653303**	03Q030028001204
13692		NQF Level 2	Mechanics: Chemical Turning	**652301**	03Q030012261972
13680		NQF Level 3	Mechanics: Chemical Turning	**652301**	03Q030035001203
13679		NQF	Mechanics: Chemical Turning	**652301**	03Q030036001204

SAQA NLRD ID	Learning Program ID	NQF Level	Qualification Title	OFO CODES	Learnership Registration Number
		Level 4			
23613		NQF Level 2	Mechanics: Chemical Welding	**651202**	03Q030021241362
13633		NQF Level 3	Mechanics: Chemical Welding	**651202**	03Q030031001203
13632		NQF Level 4	Mechanics: Chemical Welding	**651202**	03Q030032001204
13698		NQF Level 3	Electrics: Chemical Instrumentation	**672105**	03Q030027001203
13697		NQF Level 4	Electrics: Chemical Instrumentation	**672105**	03Q030037001204

Appendix 3:



TETA Learner Career Guide
Volume 3

Occupation	Qualification	Brief Job description	Entry	Institutions
Deck (navigation) officer	Certificate of Competence: Deck Officer in charge of a watch (SAMSA) Successful completion of S1 and S2 (Certificate in Maritime Studies) will allow you to apply for employment (as a navigating cadet) with a ship-owner or a port authority. This is a one-year study and forms part of the National Diploma in Maritime Studies. In order to qualify with a certificate of competence (deck officer) you will be required to complete an approved cadetship of 24 months (or an approved on-board accelerated training of 12 months) and to pass an oral examination of the South African Maritime Safety Authority (SAMSA). Additional studies, sea-service and examinations are required for certification as chief navigating officer. Please note that: • Alternative pathways to obtaining the qualification are also available • Qualification requirements are considerably different for equivalent positions in the fishing industry.	• Navigating a ship safely. • Performing shipboard operations to contribute to the successful outcome of an oceangoing voyage. Qualification as a deck officer is a part-requirement for a range of other scarce skills in the sector, e.g.: • Tugmaster • Harbour Master • Ship surveyor • Salvage officer	The school requirements for this field of study are a Grade 12 with Maths and Science, pass rate of 60%. Entry into a discipline on board a ship requires good physical condition with no colour blindness and you must be able to swim. You would be required to obtain a vision certificate issued by the South African Maritime Safety Authority (SAMSA).	The Maritime Studies Department at: • Cape Peninsula University of Technology • Durban University of Technology. Refer to the SAMSA Marine Notice (www.samsa.org.za) for approved cadetships or accelerated training programmes.

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Occupation	Qualification	Brief Job description	Entry	Institutions
Engineering officer	Certificate of Competence: Engineering Officer in charge of a watch (SAMSA) Successful completion of S1 and S2 (Certificate in Marine Engineering) will allow you to apply for employment (as a engineering cadet) with a ship-owner or a port authority. This is a one-year study and forms part of the National Diploma in Mechanical Engineering In order to qualify with a certificate of competence (engineering officer) you will be required to complete an approved cadetship of 30 months (or an approved on-board accelerated training of 18 months) , which comprises practical workshop training and theoretical education (3 additional maritime subjects. You will also be required to pass an oral examination of the South African Maritime Safety Authority (SAMSA) Please note that: • Alternative pathways (e.g. N4 mechanical engineering) to obtaining the qualification are also available • Qualification requirements are considerably different for equivalent positions in the fishing industry.	• Maintenance of the engine of a ship. • Performing a range of engineering requirements that will contribute to a successful oceangoing voyage Qualification as a engineering officer is a part-requirement for a range of other scarce skills in the sector, e.g.: • Tug engineer • Ship surveyors • Naval architect • Salvage engineer	The school requirements for this field of study are a Grade 12 with Maths and Science, pass rate of 60%. Entry into a discipline on board a ship requires good physical condition with no colour blindness and you must be able to swim. You would be required to obtain a vision certificate issued by the South African Maritime Safety Authority (SAMSA).	The Engineering Faculty at: • Cape Peninsula University of Technology • Durban University of Technology Refer to the SAMSA Marine Notice (www.samsa.org.za) for approved cadetships or accelerated training programmes.

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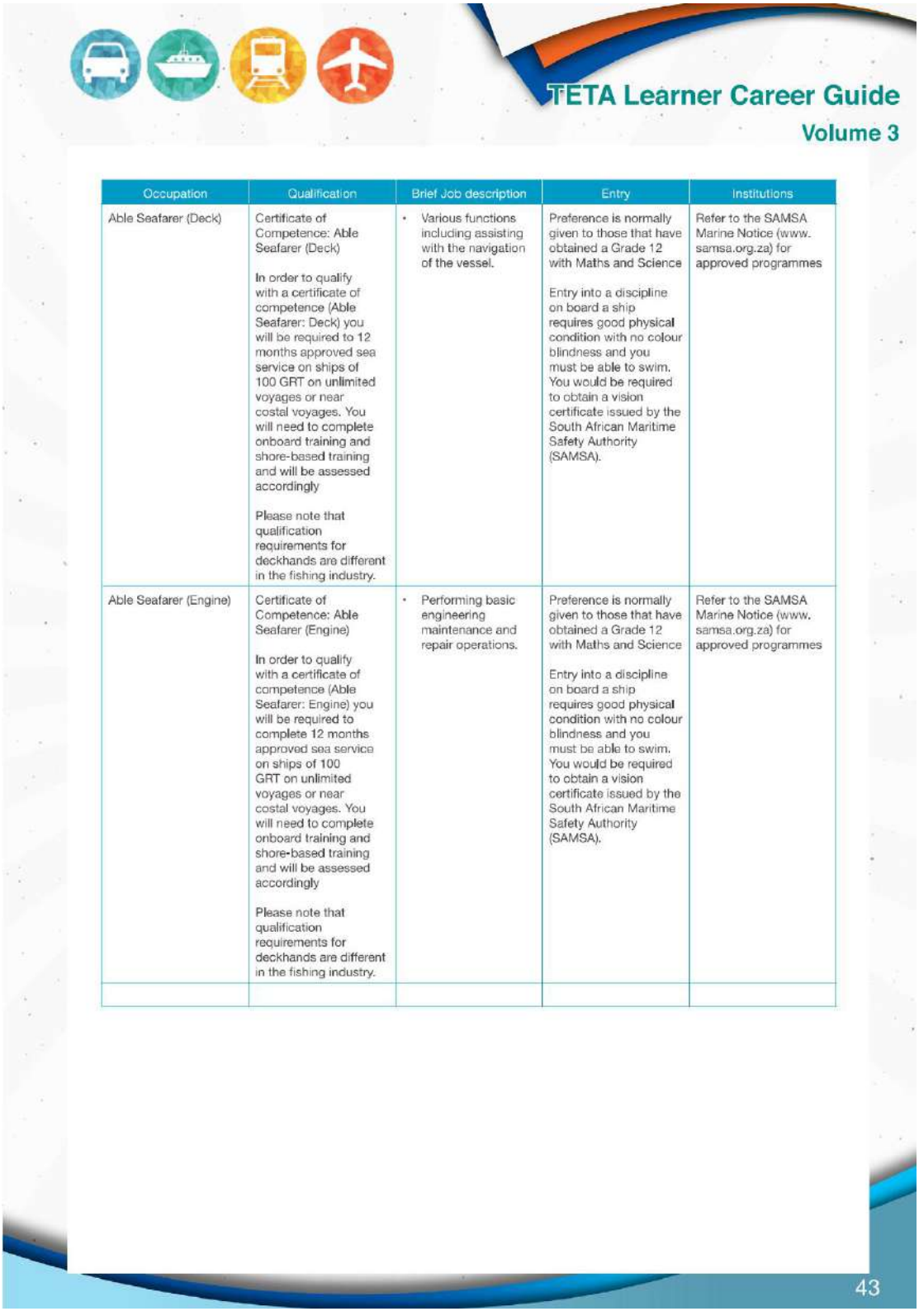

Occupation	Qualification	Brief Job description	Entry	Institutions
Able Seafarer (Deck)	Certificate of Competence: Able Seafarer (Deck) In order to qualify with a certificate of competence (Able Seafarer: Deck) you will be required to 12 months approved sea service on ships of 100 GRT on unlimited voyages or near costal voyages. You will need to complete onboard training and shore-based training and will be assessed accordingly Please note that qualification requirements for deckhands are different in the fishing industry.	• Various functions including assisting with the navigation of the vessel.	Preference is normally given to those that have obtained a Grade 12 with Maths and Science Entry into a discipline on board a ship requires good physical condition with no colour blindness and you must be able to swim. You would be required to obtain a vision certificate issued by the South African Maritime Safety Authority (SAMSA).	Refer to the SAMSA Marine Notice (www.samsa.org.za) for approved programmes
Able Seafarer (Engine)	Certificate of Competence: Able Seafarer (Engine) In order to qualify with a certificate of competence (Able Seafarer: Engine) you will be required to complete 12 months approved sea service on ships of 100 GRT on unlimited voyages or near costal voyages. You will need to complete onboard training and shore-based training and will be assessed accordingly Please note that qualification requirements for deckhands are different in the fishing industry.	• Performing basic engineering maintenance and repair operations.	Preference is normally given to those that have obtained a Grade 12 with Maths and Science Entry into a discipline on board a ship requires good physical condition with no colour blindness and you must be able to swim. You would be required to obtain a vision certificate issued by the South African Maritime Safety Authority (SAMSA).	Refer to the SAMSA Marine Notice (www.samsa.org.za) for approved programmes

Occupation	Qualification	Brief Job description	Entry	Institutions
Marine Pilot	National Certificate in Marine Pilotage	• Pilotage is a specialist function required to safely handle the movement of all vessels within the harbour. • Guiding ships when entering the harbour/port, as the Master of the ship may not be well versed with the geography of the port.	Certificate of Competence: Deck Officer in charge of a watch (SAMSA). The learner should satisfy the competent pilotage authority's requirements for medical fitness. In particular this entails meeting the eyesight, hearing and physical fitness standards required for certification of officers in charge of a navigational watch under STCW 1995.	Transnet School of Ports

*Image supplied courtesy of SAMSA

Appendix 4:

CCGT Plants in South Africa

Ankerlig
Location: Western Cape
Operator: Eskom
Configuration: 4 X 150 MW SGT5-2000E combustion turbines
Operation: 2007
Fuel: diesel oil, kerosene
T/G supplier: Siemens
EPC: Siemens, Eskom
Quick facts: Construction at the Ankerlig site (aka Atlantis) began on 17 Jan 2006. The fourth unit was released for commercial operation on 25 Jun 2007. The 7 GTs comprising the first phases at Ankerlig and Gourikwa cost R3.5bn. The 400kV substations and transmission lines at both sites were built in eight and a half months, against the norm of 13 to 16 months. Four more 150-MW gas turbines were added in 2009.

Photograph courtesy of Eskom
Posted 17 Aug 2008

Athlone
Location: Western Cape
Operator: Cape Town Electricity Dept
Configuration: 1 X 57 MW combustion turbine
Operation: 1972
Fuel: diesel oil
T/G supplier: Curtiss-Wright, Brush
Quick facts: The original controls on the Athlone gas turbine have been changed out by Turbine Controls Ltd. There is a possibility that this machine will be modified for biogas consumption.

Photograph courtesy of Merz and McLellan (Pty) Ltd
Posted 2 Jan 2004

Avon Peaking
Location: KwaZulu-Natal
Operator: Avon Peaking Power (Pty) Ltd
Configuration: 4 X 167.5-MW AE94.2 gas turbines
Operation: 2016
Fuel: diesel oil
T/G supplier: Ansaldo
EPC: Ansaldo, Fata SpA
Quick facts: Avon Peaking Power is JV of Engie (38%), Legend Power Solutions (27%), Mitsui & Co (25%), and The Peaker Trust (10%), representing the local community. Avon construction began in Aug 2014 and the project completed in Jul 2016. Peak construction employment was around 1,500. Avon is near Shakaskraal, 45km northeast of Durban. It has a 15yr PPA with Eskom and connects to the 275kV grid.

Photograph courtesy of Engie
Re-posted 27 Jul 2016

Dedisa
Location: Eastern Cape
Operator: Avon Peaking Power (Pty) Ltd
Configuration: 2 X 167.5-MW AE94.2 gas turbines
Operation: 2015
Fuel: diesel oil
T/G supplier: Ansaldo
EPC: Ansaldo, Fata SpA
Quick facts: The GT plant is in Port Elizabeth's Coega Industrial Development Zone. Construction began in Sep 2013 and Dedisa went commercial on 30 Sep 2015. Peak construction employment was 1,400. Dedisa has a 15yr PPA with Eskom. It connects to the 400kV grid.

Photograph courtesy of Engie
Posted 9 Oct 2015

Gourikwa
Location: Western Cape
Operator: Eskom
Configuration: 3 X 150 MW SGT5-2000E combustion turbines
Operation: 2007
Fuel: diesel oil, kerosene
T/G supplier: Siemens
EPC: Siemens, Eskom
Quick facts: Construction at the Gourikwa site in Mossel Bay began on 24 Jan 2006. The third unit was released for commercial operation on 22 Jun 2007. Two more machines were added in 2009.

Photograph courtesy of Eskom
Posted 17 Aug 2008

Newcastle
Location: KwaZulu-Natal
Operator: IPSA Group plc
Configuration: 18-MW, 2+1 CCGT with Tornado gas turbines CHP
Operation: 2007
Fuel: diesel oil
HRSG supplier: Aalborg
T/G supplier: Ruston, Siemens
Quick facts: In June 2005, IPSA Group began development of South Africa's first privately financed IPP, this small CHP plant in Newcastle. The main plant equipment was relocated from the former Scottish & Southern East Lancashire Mill CHP in Scotland and was re-constructed in 14mos. In addition to electricity, the plant can deliver just