

DR JARRAD G. WRIGHT

PhD, MScEng(Elec), PrEng, MIEEE MSAIEE

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CONTACT DETAILS

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PERSONAL DETAILS

Gender: Male
Date of birth: 21 October 1985
Place of birth: Durban, South Africa
Present Citizenship: South African

EDUCATION

- Jan.'12-Dec.'18 **Doctor of Philosophy (PhD)**, University of the Witwatersrand
Thesis title:
*Formulation of a capacity mechanism for the Southern African Power Pool (SAPP)
for sustained long-term system adequacy;*
Supervisor: Dr J.M. Van Coller
- Jan.'08-Nov.'10 **Master of Science in Engineering (Electrical)**, University of the Witwatersrand, Johannesburg, South Africa, *with Distinction*
M.Sc. Dissertation title:
*Development of a Reluctance Synchronous Machine for Traction Vehicle Applications
Using the Finite Element Method;*
Supervisor: Prof. W.A. Cronje
- Jan.'04-Nov.'07 **Bachelor of Science in Engineering (Electrical)**, *Deans List*, University of the Witwatersrand, Johannesburg, South Africa
- Jan.'99-Nov.'03 **Matric**, St Benedict's College, Bedfordview, South Africa

PH.D. THESIS ABSTRACT

Power system adequacy has been historically insufficient in the Southern African Power Pool (SAPP) region with resulting negative effects on economic growth and electrification efforts. Existing domestic regulatory frameworks and opaque long-term bilateral contracting for procuring capacity in the region have been shown to be insufficient in ensuring system adequacy. The concept of an adequacy product in the form of a Capacity Mechanism (CM) introduced into the SAPP region has not yet appeared in the literature. A Capacity Mechanism (CM) for the SAPP region has been proposed and designed as part of this research to address this. A framework has been developed to consider CMs via the combination of a screening assessment, quantitative (model-based) analysis of more favourable CM options and an identification and quantification of key design elements. The developed framework can also be generalised and applied to other jurisdictions where CMs are under consideration. A regional CM which transparently and explicitly values capacity is proposed in the form of a forward-looking annual Capacity Auction that is locationally disaggregated, supplied by all possible supply-side resources with all feasible SAPP market participants included. The CM should be technology agnostic and account for the dual requirement for firm capacity to meet peak demand and firm-energy to meet annual energy requirements considering the dominance of hydro-based capacity in the region when excluding South Africa. There should be a lead-time of 3-4 years with the possibility of long-term auctions for large hydro-based capacity. Strict market monitoring and adherence to performance incentives and penalties will need to be ensured to avoid exercising of market power considering the dominant size of the South African power system. Appropriately mandated institutions to run Capacity Auctions would include the SAPP Co-Ordination Centre as well as a sufficiently mandated regional regulatory body. A further contribution is made in the form of a public domain power system dataset of the SAPP region with sufficient detail to be used in power system operations and planning efforts by future researchers and practitioners.

M.SC. DISSERTATION ABSTRACT

Traction motors, specifically in underground shuttle vehicles, often operate in harsh conditions including steep grades, heavy payloads and high ambient temperatures. These motors require maximum torque density as well as cool and robust operation in order to optimise the overall process and to avoid the current requirement for a duty cycle. The contribution of this research is the design of a new traction motor, a Reluctance Synchronous Machine (RSM), via the 2-D Finite Element Method (FEM) as the primary engineering design tool to replace the commonly used Induction Machine (IM). The electromagnetic and mechanical design of the RSM are performed in commercially available FEM software packages FLUX and ANSYS respectively. The electromagnetic design uses the PyFLUX command language and Python scripting to vary five rotor geometric parameters in a linear progression to find where maximum average torque and minimum torque ripple occurs for each parameter. The mechanical strength of the RSM rotor is defined by two geometric parameters whose final values are chosen via a case study based design in ANSYS. The newly designed RSM runs much cooler than the original IM and develops only 8.4% less torque than the IM. As a result, it should not require a duty cycle and will be capable of a higher rating and thus more torque can be delivered to the end process (up to 42% more) while the motor remains in the same motor frame size. Furthermore, there is a large area of research pertaining to the overall electromagnetic design method used. This includes the use of optimisation algorithms, integrated rotor-stator design, mechanical support placement and grading, various torque ripple reduction techniques and the inclusion of permanent magnets or composite powder metals for the RSM rotor.

PUBLICATIONS AND PUBLIC PROFILE

Website	See https://jarradwright.com
Publications	See ResearchGate
Public profile	See LinkedIn

OTHER TRAINING

Industry: Numerous conferences, seminars and exhibition engagements.

Power system analysis: PSS/E (Advanced), DIgSILENT Powerfactory (Basic, EMT, Harmonics, Intermediate Planning and Stability), ATP/EMTP (Basic), ETAP (Basic), PowerWorld (Intermediate).

Energy modelling and analysis: PLEXOS (Advanced), LEAP (Intermediate), TIMES (Basic), PyPSA (Intermediate), Calliope (Intermediate), OSEMOSYS (Intermediate), System Advisor Model (SAM) (Intermediate)

Finite Element Modelling: ANSYS (Advanced), FLUX (Advanced).

Programming and computational analysis: MATLAB (Advanced), SIMULINK (Advanced), Octave (Advanced), Python (Intermediate), R (Basic), git (Intermediate), C and C++ (Basic), Oracle Crystal Ball (Advanced).

GIS: qGIS (Intermediate).

Project feasibility assessments: Custom Excel based modelling, RETScreen (Basic).

VOLUNTARY ASSOCIATIONS AND INDUSTRY INVOLVEMENT

2010-Present	Member, SA National Committee Representative C5, Working Group contributor: Conseil International des Grands Reseaux Electriques (CIGRE) Member number: 120101037
2010-Present	Professional Engineer (Pr.Eng): Engineering Council of South Africa (ECSA) Member number: 20130705
2007-Present	Member: Institute for Electrical and Electronic Engineers (IEEE) & IEEE Power Engineering Society Member number: 90381317

2010-Present	Member: South African Institute of Electrical Engineers (SAIEE) Member number: 12355
2014-2015	Affiliate Member: South African Energy Agency (SANEA) Member number: AFF219
2015	Most Influential People in African Power 2015 (ESi-Africa.com)
2016	African Power Elites 2016 (ESi-Africa.com)
2016-2019	Advisory Board member for the African Power Elites: Projects & People (ESi-Africa.com)
2020-2021	SAICA-ED Mentorship Programme

COUNTRIES OF WORK EXPERIENCE

Botswana	Ghana
Kenya	Malawi
Mauritius	Mongolia
Namibia	Rwanda
Seychelles	Tanzania
South Africa	Uganda
Zimbabwe	

LANGUAGES

Language	Speaking	Reading	Writing
English	Excellent	Excellent	Excellent
Afrikaans	Good	Good	Good
Portuguese	Functional	Functional	Functional

WORK EXPERIENCE (14 YEARS)

SENIOR ENGINEER - GRID PLANNING AND ANALYSIS (RESEARCHER IV): National Renewable Energy Laboratory (NREL)

Jan.'22.-Ongoing

- Based in the Grid Systems Group of the Grid Planning and Analysis Center (GPAC) in Golden, Colorado (USA).

- Applying advanced modelling and simulation tools to optimally plan for, design, and analyze distribution and bulk power systems to push the boundaries of innovation, integrated analysis, and computational tool development.
- Developing innovative modelling approaches to analyze the impact of specific technologies on the evolving grid, including variable generation, energy storage, hydropower, demand response, and transmission.
- Example types of ongoing research and analysis includes:
 - Grid flexibility and integration studies.
 - 100% RE grids and other high RE penetration studies.
 - Impact of extreme events (system reliability and resiliency).
 - Advance probabilistic methods to assess resource adequacy.
 - Revenue sufficiency and market structures.
- Informing policymakers and utilities by developing and analyzing future grid scenarios that answer big questions about how the electric grid is transforming.

**LECTURER: Long-Term Power Systems Planning
Stellenbosch University**

Jan.'22

- Transmission network expansion planning
- Time horizon and objectives of transmission network expansion planning
- System security criteria (N-1)
- Definition of planning scenarios (deterministic/worst case, market-simulation based etc.), objectives and constraints (incl. system security)
- Heuristic versus automated processes
- Active and reactive power planning
- Load forecasting for transmission expansion planning
- Load flow analysis for system expansion planning
- Transmission line & substation planning
- Transmission grid codes
- HVDC
- Towards integrated planning

CONTRIBUTOR AND ADVISORY TEAM MEMBER: PyPSA meets Africa

Jun.'21.-Ongoing

- [Homepage](#)
- [Documentation](#)
- [GitHub](#)

COMMISSIONER The Presidency: National Planning Commission (NPC) of South Africa

Sep.'15.-Mar. '21

(5.5 years)

- To promote and advance the implementation of the National Development Plan (NDP) 2030 across different sectors of society;
- To undertake detailed planning in a selected number of sectors to be determined from time to time;

- To conduct regular engagements with various sectors of society on all matters pertaining to the long-term development of the country;
- To facilitate stakeholder engagements aimed at forging a social compact towards more effective implementation of the National Development Plan;
- To take a cross-cutting view, undertake research into long-term trends, analyse implementation of short to medium term plans with a view to recommend improvements to Government as well as produce reports to inform policy and planning; and
- To contribute to development of international partnerships and networks on national planning.

EMPLOYEE Council for Scientific and Industrial Research (CSIR)

Dec.'15-Aug.'21

(5.75 years)

Principal Researcher - Energy Planning and Grid Planning

- Manage projects, research and conduct investigations on grid planning and related topics;
- Provide leadership in formulating research questions and developing study assumptions;
- Provide research direction on power-system planning and energy planning;
- Generate technical reports, articles, conference papers and presentations aimed at the energy industries locally and internationally;
- Provide training on grid and energy planning related topics to CSIR employees and externally;
- Formulate research proposals and develop relationships with potential clients and collaborators in R&D around system operations topics.

- Employment effects, skills requirements and job creation related to the repurposing of former coal-fired power plants in Mpumalanga, South Africa

- **Duration:** April 2021 - October 2021
- **Location:** South Africa
- **Client:** Institute for Advanced Sustainability Studies (IASS)
- **Position:** Steering Committee Member, Researcher
- **Brief description:** The objective of the study is to calculate and quantify the socio-economic costs and benefits of potential renewable and clean energy projects on selected coal power station re-purposing sites in Mpumalanga, South Africa. That is - employment effects, skill development needs and industrial opportunities. The work was split into six work packages and focussed attention is paid to key areas of employment effects, quantification and description of skill gaps and gender-inclusive careers opportunities, green economy growth and quantification of local value creation and final policy recommendations and outlook for further research.
- **Software used:** MS Office, I-JEDI, PLEXOS.

- Impact of delayed power station commissioning on the South African power system (Independent Expert Opinion)

- **Duration:** February 2021 - August 2021
- **Location:** South Africa
- **Client:** Confidential
- **Position:** Independent Expert
- **Brief description:** Medium-term (3-5 year ahead) scenario-based analysis of the system costs, shortages and dispatch of the South African power system as a result of delayed commissioning of an under construction power station.
- **Software used:** PLEXOS, Python, MS Office.

- Support to Operation Vulindlela: Short-term research into appropriate licensing thresholds and related regulatory frameworks for embedded generation in South Africa

- **Duration:** April 2021 - July 2021
- **Location:** South Africa
- **Client:** Operation Vulindlela (via UNU-WIDER)
- **Position:** Researcher
- **Brief description:** In support of Operation Vulindlela, priority reforms in the electricity sector have been identified in order to achieve outcomes of stabilised electricity supply. Operation Vulindlela intends to undertake (1) Monitoring and reporting on progress to identify challenges, sustain momentum and ensure accountability; (2) Facilitating technical support to enable the implementation of reforms and (3) Providing recommendations to the President and Cabinet where a decision or agreement is required. In the support provided, the particular focus was that of recommending an appropriate licensing threshold and related frameworks for embedded generation. The intention of which is to enable increased private sector investment in embedded generation in the country. In the immediate at the time (2021), this would be the only practical way to get additional supply capacity onto the national power system to mitigate the supply-demand imbalance (and risk of loadshedding).
- **Software used:** MS Office.

- Powerfuels and Green Hydrogen in South Africa

- **Duration:** June 2020 - February 2021
- **Location:** South Africa
- **Client:** EU Delegation to South Africa
- **Position:** Policy and Technical Expert
- **Brief description:** Powerfuels (also known as Power-to-X or PtX) are being proposed by many global players as an important option for the future energy system to reduce emissions, particularly in hard-to-abate sectors such as transport and industrial heat. Following initial workshops hosted with CSIR, the European Union - South Africa (EU-SA) Partners for Growth Programme commissioned CSIR to complete and publish a research paper on Powerfuels and Green Hydrogen. The thematic focus areas were the background and context for the the potential of powerfuels in South Africa, an overview of Powerfuels globally and their applicability to South Africa, a legislative and policy overview (including climate change), barriers and recommendations specific to South African industries most likely to benefit from Powerfuels (regulatory, capacity, political, financial and technical) and the potential role for European businesses.

- **Software used:** MS Office.

- Socio-economic Assessment of Supply Chains For Sustainable Aviation Fuel in South Africa

- **Duration:** May 2021 - August 2021
- **Location:** South Africa
- **Client:** World Wildlife Fund (WWF)
- **Position:** Researcher, Reviewer
- **Brief description:** Assessment of the potential socio-economic impact of sustainable aviation fuel value chain, through different technology pathways, through the use of the International Jobs and Economic Development Impact Tool (I-JEDI) model customised to the South African environment. This included the quantitative assessment of potential jobs created during construction and operations, earnings, GDP economic value-add and localisation potential.
- **Software used:** PLEXOS, Python, MS Office.

- Screening for approaches to a coordinated implementation of a Just Transition to a low-carbon and climate resilient economy and society in South Africa

- **Duration:** December 2019 - April 2020
- **Location:** South Africa
- **Client:** Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- **Position:** Energy planner
- **Brief description:** As part of a broader exercise with expected future phases, this brief undertaking aimed to provide quick feedback to GIZ and BMU on the technical and economic (jobs) changes that could be associated with the transition scenarios researched as they relate to a decarbonising South African power system over the next 10 years (to 2030). Within this, three long-term energy planning scenarios were considered Africa including a business-as-usual (IRP 2019), unconstrained least-cost and CO₂ ambition. The power sector impacts on the energy mix, installed capacity, system costs and CO₂ emissions were reported on along with the socio-economic impacts within the power sector of the different expected evolutions of the South African power system decarbonising towards 2030.
- **Software used:** MS Office, PLEXOS, I-JEDI.

- A base-line integrated resource plan (IRP) for electricity for George Municipality

- **Duration:** April 2019 - November 2019
- **Location:** South Africa
- **Client:** George Municipality
- **Position:** Energy planner

- **Brief description:** Considering international megatrends of renewable energy technology cost declines, domestic power system reliability concerns as well as perpetual tariff increases - George Municipality in South Africa requested CSIR to assist in the development of a baseline IRP for the municipality to improve their understanding of their expected role in the future South African power sector. More specifically, municipalities now have an opportunity to take part in the energy supply space, either by themselves, in partnership with the public and/or private sector or through customers in pursuit of low-cost and low-carbon electricity. It is thus important to conduct least-cost electricity optimisation studies which are able to optimally choose and dispatch the most cost effective suite of supply and demand side options that can inform future investment decisions. Hence, CSIR assisted George Municipality to evaluate the role that alternative supply-side options such as wind, solar PV, batteries, gas and biomass/-gas can play, along with electricity imports from Eskom, in managing future electricity costs. In this regard, the CSIR provided modelling expertise to assist George Municipality in developing a least-cost base-line integrated resource plan (IRP) for the long-term horizon (up to 2040).
- **Software used:** MS Office, PLEXOS, qGIS, SAM, WaSP.

- A review of international Adequacy Metrics for the South African power system

- **Duration:** July 2019 - October 2020
- **Location:** South Africa
- **Client:** Eskom Holdings SOC Ltd
- **Position:** Energy planner
- **Brief description:** Eskom commissioned CSIR to undertake a study to enhance the South African Medium-term System Adequacy Outlook (MTSAO) adequacy metrics to ensure they fully capture the operational challenges of the South African power system and meet international best practice standards/guidelines. This included an assessment of the status-quo of adequacy metrics currently being applied in South Africa combined with known challenges being experienced by Eskom with these metrics, an international review of adequacy metrics across most regions as well as recommended adequacy metrics along with initial ranges as to the thresholds for these metrics combined with possible improvements in the MTSAO methodology.
- **Software used:** MS Office, PLEXOS.

- A conceptual study on future alternative energy supply options for Anglo American Platinum's operational complexes in Southern Africa

- **Duration:** May 2019 - December 2020
- **Location:** South Africa, Zimbabwe
- **Client:** Anglo American Platinum
- **Position:** Project Manager, Energy modeller
- **Brief description:** CSIR undertook to understand the alternative energy options across a number of operational sites for Anglo American Platinum in South African and Zimbabwe. As part of this, CSIR undertook to provide the least-cost (and/or alternate) technology options to implement alternate energy rollout at

the operational complexes over the next 5 years with a planning horizon of 20 - 25 years, establish business cases for these, assess and include the impact of a carbon tax, develop alternate scenarios which could further support AAPs strategy as well as market development initiatives for PGMs, provide an assessment of alternate technology options that are likely to evolve and/or mature during this period with the mechanisms to detect, monitor and react to these opportunities, provide an indication of how energy costs across various geographies are likely to evolve and provide an assessment of the regulatory aspects to consider when implementing the recommended alternatives.

- **Software used:** MS Office, PLEXOS, qGIS.

- Integrated Resource Plan for MINTEK

- **Duration:** April 2020 - November 2020
- **Location:** South Africa
- **Client:** MINTEK
- **Position:** Project Manager, Energy modeller
- **Brief description:** To develop an Integrated Resource Plan applying least-cost planning principles across a range of scenarios in line with MINTEK's operational strategy considering EMS targets for annual demand expectations, the carbon tax's impact, future tariff structure and level, local solar resources and spatial availability, as well as the procurement of prospective gas-to-power options.
- **Software used:** MS Office, PLEXOS.

- Systems analysis to support increasingly ambitious CO₂ emissions scenarios in the South African electricity system

- **Duration:** October 2019 - June 2020
- **Location:** South Africa
- **Client:** Meridian Economics
- **Position:** Project Manager, Principal Engineer
- **Brief description:** This projects aimed to explore additional cumulatively more ambitious CO₂ emissions abatement scenarios in the South African power system over the long-term (for the period 2020-2050). Thus, the speed of reducing power sector CO₂ emissions in the power sector is explored from a systems perspective to assess the effects on the energy mix and associated technologies, resulting CO₂ emissions, other emissions (PM, SO_x, NO_x) and total system costs for a range of increasingly ambitious CO₂ scenarios. This systems analysis is intended to inform a detailed techno-financial modelling exercise to assess the viability of clean climate funding to assist ongoing and systemic financial challenges at Eskom.
- **Software used:** MS Office, PLEXOS.

- Development of a full-sector energy modelling framework for South Africa

- **Duration:** 2020-2021

- **Location:** South Africa
- **Client:** Council for Scientific and Industrial Research (CSIR)
- **Position:** Programme Manager, Principal Engineer
- **Brief description:** There is a distinct need for decision support surrounding accelerated decarbonisation pathways globally. This imperative is further exacerbated in developing economies where it is becoming increasingly cheaper to decarbonize with marginal cost trade-offs supplemented with related co-benefits from decarbonising. These pathways inform institutional decision-making and related detailed planning. Specific drivers that create market pull include policy directives (governments), shareholder sustainability pressure (private sector/enterprise) and mandate fulfilment (public sector institutions - SoEs). More specifically, the distinct filtering down of Paris Agreement commitments and the need to support countries to inform, enable and implement NDCs and related financing. This project is internally funded within CSIR but is actively seeking partners. It relates to the development of long-term full-sector energy pathways for South Africa, hosting of modelling framework platforms (public sector focus) whilst enabling transparency and stakeholder on-boarding for social compacting/accords with general public and particular economic stakeholders. Finally, capacity building/partnering to develop a workforce of the future across South Africa in energy planning whether directly or via partnering is also intended.
- **Software used:** MS Office, GitHub, custom tools

- Implementation partner for South African German Energy Programme 3 (SAGEN-3): Small-Scale Embedded Generation (SSEG) and Municipal Electricity Business Models Support

- **Duration:** May 2018 - November 2021
- **Location:** South Africa
- **Client:** Council for Scientific and Industrial Research (CSIR)
- **Position:** Programme Manager, Principal Engineer
- **Brief description:** As an implementation partner, CSIR completed 4 work packages to support municipalities in South Africa across the topics of SSEG transition topics with Sustainable Energy Africa (SEA), municipal distribution grid impacts of SSEG, municipal electricity master plans (MEMPs) and municipal renewable energy procurement.
- **Software used:** PLEXOS, MS Office, I-JEDI, SAM, qGIS, dGen, custom tools

- Formal comments on South Africa's Integrated Resource Plan (IRP) 2019

- **Duration:** October 2019 - December 2019
- **Location:** South Africa
- **Client:** Council for Scientific and Industrial Research (CSIR)
- **Position:** Project Manager, Principal Engineer
- **Brief description:** CSIR undertook to complete a quick summary and commentary on the IRP 2019 for the benefit of all stakeholders in South Africa. Commentary focussed on the first promulgated IRP in almost 10 years, key decisions put forward in the IRP 2019, the energy mix, costs, emissions and water usage relative

to previous iterations of the IRP. Similarly, commentary on the need for long-term planning (vs only planning to 2030 even though technological disruption makes it difficult to plan beyond 2030, long-term vision is needed). The need for transparent and comprehensive reporting was also highlighted along with remaining key items including new-build limits, unconstrained vs constrained least-cost). Finally, within the analysis - short-term, medium-term and long-term risks and opportunities were highlighted.

- **Software used:** PLEXOS, MS Office, I-JEDI

- Formal comments on South Africa's Draft Integrated Resource Plan (IRP) 2018

- **Duration:** August 2018 - October 2018
- **Location:** South Africa
- **Client:** Council for Scientific and Industrial Research (CSIR)
- **Position:** Project Manager, Principal Engineer
- **Brief description:** The IRP broadly includes input planning assumptions, a modelling process and scenario planning following which a base plan is derived from the least-cost generation investment requirements within the electricity sector. The primary result from the IRP is the identification of the generation capacity required (per technology) and the requisite timing in the long-term based on a set of input assumptions and predefined constraints. As part of the IRP update process, the DoE engages in a multi-stage stakeholder engagement process (including public engagements) to ensure all affected stakeholders are consulted including national and local government, business, organised labour and civil society. This project was led by myself and contained the CSIR's formal comments on the Draft IRP 2018. Key outcomes included a confirmation of previous comments on the Draft IRP 2016 as they relate to least-cost, new-build constraints and technology cost trajectories. Key recommendations included new-build coal and nuclear in South Africa is not least-cost, stationary storage can assist to reduce natural gas import volumes and no system integration issues pre-2030. There is a critical need for improved transparency, an optimised existing South African coal fleet, an understanding of what a just transition looks like in South Africa, sector-coupling opportunities and updating the link between integrated energy plans in South Africa.
- **Software used:** PLEXOS, MS Office, DIgSILENT Powerfactory

- A conceptual study on future alternative energy supply options for Sasol Secunda and Sasolburg operations

- **Duration:** December 2017 - April 2018
- **Location:** South Africa
- **Client:** Sasol Technology (Pty) Ltd
- **Position:** Principal Engineer
- **Brief description:** The CSIR was requested to provide energy planning expertise to assist Sasol in evaluating potential future alternative electricity supply options, using the Secunda SSO operations as a starting point, whilst considering the wheeling of power from other geographical locations in the vicinity. Through a long-term electricity planning approach, the CSIR aims to determine a set of

electricity supply options for Sasol based on least-cost principles. This includes scenarios based on pre-defined input assumptions and boundary conditions. As part of this, a high-level resource assessment was conducted for wind and solar photovoltaic (PV) specifically in order to determine the expected available resource as well as expected profiles for these technologies.

- **Software used:** QGIS, PLEXOS, R, Python, MS Office

- Guidelines for Human Settlements Planning and Design (Energy Chapter)

- **Duration:** February 2018 - March 2018
- **Location:** South Africa
- **Client:** Department of Human Settlements
- **Position:** Principal Engineer
- **Brief description:** Settlements are integrated systems where the various components are interconnected. The contribution made as part of the energy chapter of the Guidelines for Human Settlements Planning and Design. It highlights the role of energy in human settlements and provides information to guide decision-making regarding the provision of an appropriate, context specific electrical energy supply service. Considering developments in the energy sector, the provision of grid-based electricity has historically been the preferred option for energy provision because of its advanced level of development. This is however changing with the introduction of embedded generation and the drive to provide clean energy using distributed generation. When grid options are not feasible, off-grid energy alternatives can be considered. As a result, the provision of electrical energy services can be split into two distinct categories, namely grid-based electricity and off-grid electrical energy services. Although, microgrids are increasing becoming a possible solution, considerations for both grid and off-grid options are applicable.
- **Software used:** MS Office

- Eskom's financial crisis and the viability of coal-fired power in South Africa

- **Duration:** January 2017 - November 2017
- **Location:** South Africa
- **Client:** Institute for Energy Economics & Financial Analysis (IEEFA)
- **Position:** Principal Engineer
- **Brief description:** An independent study into several possible strategies to assist with ameliorating Eskom's critical financial challenges are addressed. Essentially, we have investigated two questions, should Eskom cancel part of its power station construction programme to reduce costs? and should Eskom bring forward the decommissioning of some of its older coal power stations to reduce costs? In this context, the required technical systems analysis was undertaken by the CSIR to determine the "system alternative value" (SAV) of running particular existing or under construction coal-fired power stations (or set of power stations) in South Africa relative to alternative options.
- **Software used:** PLEXOS, R, Python, MS Office

- Value of solar PV revisited: A system-planning view

- **Duration:** August 2017 - October 2017
- **Location:** South Africa
- **Client:** CSIR (internal funding)
- **Position:** Principal Engineer
- **Brief description:** The cost of solar photovoltaics (PV) and wind have dropped considerably over the last decade and are expected to continue to decline and studies have shown that South Africa has significant solar resource across the entire country. Solar PV and wind energy are however variable which makes it difficult to compare to dispatchable power generation options on the basis of its relative cost (LCOE) alone. This research considered the value of solar PV and wind from a central system-planning perspective using South Africa in the year 2050 as a case study. This system value of solar PV and wind was determined relative to a synthetic base supply generator and was found to decrease as the penetration of solar PV and wind in the system increased. The system value was however more for solar PV than a base supply generator below 30% solar PV or wind penetration. In contrast, the value of solar PV dropped sharply at 15% penetration in other studies where the value of solar PV was determined on the electricity market only. Most importantly, the system value for solar PV and wind never falls below 25 EUR/MWh and 12 EUR/MWh of that of a base supply generator, even for very high solar PV and wind penetration levels. The cost of new solar PV and wind in South Africa today is 50-80 EUR/MWh lower than that of new base supply options (coal or nuclear). From a least-cost system planning perspective it can therefore be concluded that a base supply power generator is under no circumstances able to compete with new solar PV or wind power to supply a pre-defined amounts of energy to the power system.
- **Software used:** MS Office, PLEXOS, R.

- Rapid Response Research (3R) Question No. 21: Response and possible solutions to Eskom's REIPPPP concerns

- **Duration:** November 2016
- **Location:** South Africa
- **Client:** Department of Environmental Affairs (DEA)
- **Position:** Principal Engineer
- **Brief description:** Eskom have recently publicly voiced their concerns in relation to renewable energy (RE) Independent Power Producers (IPPs) in South Africa. In the South African electricity industry context, it is essential to understand these concerns as Eskom is the single buyer of energy from RE projects in the REIPPPP. Eskom have a critical enabling role to play in the planned RE rollout in South Africa. The Department of Environmental Affairs (DEA) requested from the Council for Scientific and Industrial Research (CSIR) to assess the validity of Eskom's concerns. This project entailed the response by CSIR to this request from the DEA.
- **Software used:** MS Office

- REMAP 2030 Country Report for South Africa

- **Duration:** November 2016 - April 2018
- **Location:** South Africa
- **Client:** International Renewable Energy Agency (IRENA)
- **Position:** Principal Engineer
- **Brief description:** Develop the IRENA REMAP 2030 country report for South Africa inclusive of recent trends in renewable energy development in South Africa and Africa, a reference case to 2030, renewable energy potential, the REMAP high renewable scenario(s) for South Africa to 2030 as well as an identification of barriers and opportunities for renewable energy development in South Africa.
- **Software used:** PLEXOS, MS Office

- Formal comments on South Africa's Draft Integrated Resource Plan (IRP) 2016

- **Duration:** November 2017 - March 2017
- **Location:** South Africa
- **Client:** Council for Scientific and Industrial Research (CSIR)
- **Position:** Project Manager, Principal Engineer
- **Brief description:** The IRP broadly includes input planning assumptions, a modelling process and scenario planning following which a base plan is derived from the least-cost generation investment requirements within the electricity sector. The primary result from the IRP is the identification of the generation capacity required (per technology) and the requisite timing in the long-term based on a set of input assumptions and predefined constraints. As part of the IRP update process, the DoE engages in a multi-stage stakeholder engagement process (including public engagements) to ensure all affected stakeholders are consulted including national and local government, business, organised labour and civil society. This project contained the CSIR's formal comments on the draft IRP 2016. The CSIR determined the least cost, unconstrained electricity mix by 2050 as input into the IRP 2016 public consultation process.
- **Software used:** PLEXOS, MS Office, DIgSILENT Powerfactory

- Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks

- **Duration:** March 2016 - October 2016
- **Location:** South Africa
- **Client:** Department of Environmental Affairs (DEA), Science and Technology (DST), Council for Scientific and Industrial Research (CSIR)
- **Position:** Integrating Author
- **Brief description:** As part of the broader shale gas Strategic Environmental Assessment (SEA), develop the chapter on energy (*Effects on national energy planning and energy security*). This incorporates special features of South Africa in relation to energy, relevant legislation, regulation and practice as well as key potential impacts the development of shale gas in South Africa would have on energy, a risk assessment and proposed best practice guidelines/monitoring requirements and key identified gaps in the knowledge domestically.

- **Software used:** PLEXOS, MS Office.

- Aspects of nuclear power in South Africa's future electricity mix

- **Duration:** February 2016 - April 2016
- **Location:** South Africa
- **Client:** CSIR (internal funding)
- **Position:** Principal Engineer
- **Brief description:** Without attempting to perform an extensive Integrated Resource Plan (IRP) study - as this is the mandate of the South Africa Department of Energy (DoE), the CSIR investigated aspects of nuclear power in South Africa's future energy mix under the following main topics:
 - A brief history and overview of nuclear power in South Africa
 - Global view of power generation technologies applicable to South Africa
 - Levelised Cost of Electricity (LCOE) assessments
 - Energy planning thought experiment: Planning South Africa's energy mix from scratch.
 - Future energy mix scenario snapshots

Broadly speaking, the objectives of the study can be summarised as:

- Educate and inform industry stakeholders and the general public on power generation global trends relevant to South Africa.
- Objectively inform policy decisions on the future energy mix of South Africa
- Increase the knowledge base and share information on energy planning in South Africa.
- **Software used:** MS Office, Oracle Crystal Ball

- Technical Study on distributed 100% Renewable Energy (RE) systems for African and other developing nations

- **Duration:** January 2016 - March 2016
- **Location:** 5 African countries
- **Client:** South South North (SSN) Project (Africa)
- **Position:** Principal Engineer
- **Brief description:** This pilot study is a starting point that is based on the African Renewable Energy Initiative (AREI) efforts to accelerate and scale up the deployment of Africa's renewables potential. That is, 10 GW of new and additional renewable energy capacity by 2020 (Phase I) and 300 GW by 2030 (Phase II). This study only considers five pilot countries and marginal deployment of renewable energy (RE) in each country. Part 1 and 2 of this pilot study intend to provide a visionary, inspiring and thought-provoking account how African countries with their vast diversity of conditions on the continent may build and/or develop their energy systems towards 100% RE over the coming decades (2015-2050). Part 3 of the study presents a model developed to estimate the direct costs and immediate value of introduction of renewable energy into five different African pilot countries. It provides an estimation of costs, immediate value and financial support needs from international public finance to enable guarantee systems previously proposed for five pilot countries.

- **Software used:** MS Office, Quantum GIS

EMPLOYEE Energy Exemplar (Africa) Pty (Ltd)

Mar.'14-Dec.'15

(1.75 years)

Senior Consultant, Acting Regional Manager, Regional Manager

- Commercialisation of PLEXOS Integrated Energy Model.
- Providing PLEXOS client support to ensure service delivery excellence.
- Consulting on advanced analysis and design of power/energy markets as well as energy planning.
- Training instructor:
 - PLEXOS Beginner Training (2014)
 - Numerous customer specific PLEXOS Intermediate and Advanced Training (2014)
- Development of African energy market datasets:
 - Southern African Power Pool (SAPP)
 - Eastern African Power Pool (EAPP)
 - Western African Power Pool (WAPP)
 - Comité Maghrébin de l'Electricité (COMELEC)

EMPLOYEE Parsons Brinckerhoff Africa (Pty) Ltd

Apr.'10-Feb.'14

(3.75 years)

Engineer in Training, Studies Engineer, Senior Engineer, Proposals Manager

- Total Uganda Associated Gas Integration Study
 - **Duration:** December 2013 - April 2014
 - **Location:** Uganda
 - **Client:** Total Raffinage Marketing Direction EN
 - **Position:** Senior T&D Engineer
 - **Brief description:** Total Raffinage Marketing Direction EN and two of their partners are looking to develop oil fields in the proximity of Lake Albert and Lake Edward in the western part of Uganda. The three partners are investigating the opportunity of developing a gas-fired power plant that will make use of gas arising from the oil field (associated gas). The size of the plant will be dependent on the technology used but will be in the 110-146 MW range (at peak production). Parsons Brinckerhoff (PB) has been engaged to study the connection of the power plant to the electrical transmission network of Uganda Electrical Transmission Company Limited (UETCL).
 - **Contribution:**
 - * Transmission integration studies: Transmission integration studies for two proposed sites and three different generation technologies were performed. Proposed integration options were based upon the vicinity of the two sites to existing or planned UETCL infrastructure. The studies performed included load flow analysis, fault level analysis, transient stability studies, frequency stability studies. Additionally, a high-level cost analysis was performed in order to identify the least-cost integration solution.

- * Conceptual Substation Design: PB provided a conceptual design which consisting of a switching configuration selection, production of a single-line diagram , preliminary general arrangement and section drawings and a functional description of the protection and substation automation functions that will be required.
 - * Conceptual Line Design: The line design consisted of gathering all relevant data pertaining to the line including satellite images, survey data, maps, aerial photography etc, line route selection and optimisation, preliminary investigation of all relevant environmental/climatic conditions including the wind profile along the route, lightning profile, altitude, vegetation, pollution and soil conditions, definition of Client requirements in terms of reliability levels and voltage unbalance for which lines will be designed and requirements in terms of (live line) maintenance, design optimisation of line configuration and major line components such as conductor, ground wires, OPGW, insulation, tower types and families, foundation, earthing system etc, design optimization is based on comprehensive Life Cycle Costing, pilot spotting of entire route using PLS CADD package, with the design check in a 3D environment, production of basic input for bill of quantities.
 - * Environmental Fatal Flaw Analysis: A preliminary assessment of the potential environmental and social impacts of the project (fatal flaw analysis), including an assessment of the input required to ensure compliance to the Ugandan environmental legislation and conformance to Good International Industry Practices (GIIP). This study will consist of a preliminary desktop review of all existing and available biophysical and socio-economic data.
 - **Software used:** MS Excel; MS Word, PLSCAD, Siemens PTI PSS/E 33.0, Quantum GIS
- Kelvin Power Station Review (Phase 1 and 2)
 - **Duration:** September 2013 - December 2013
 - **Location:** South Africa
 - **Client:** City Power and City of Joburg
 - **Position:** Senior Engineer and power system economist
 - **Brief description:** Kelvin Power Station is located in Kempton Park, Johannesburg, South Africa.
The City of Johannesburg (CoJ) in combination with City Power requested a consortium of consultants to provide advisory services on the current state of Kelvin Power Station (KPS) and future options.
Kelvin A was commissioned as a 6 x 30 MW (180 MW) power station. Kelvin B was commissioned as a 7 x 60 MW (420 MW) power station. Thus, the total designed capacity for KPS is 600 MW. Since November 2012, Kelvin A has remained out of service and only Kelvin B is currently in service.
 - **Contribution:**
 - * Technical (transmission):
 - Overall review of existing data and information
 - Brief assessment of transmission substation state (including step-up transformers)

- Development of selected study cases for loadflow studies (existing network/future network)
- Loadflow studies (existing network/future network)
- Steady state fault level analysis
- Reporting on transmission state and network studies
- * Financial and economics:
 - Assistance with the preparation of a financial/economic model of the project using MS Excel used to study various options identified.
 - Dispatch profiles used for the various scenarios to be studied
 - The current and assumed future MegaFlex tariff.
 - Demand forecast for City Power
 - The economic analysis including an assessment of the role that Kelvin Power Station will play in the supply demand balance and economic effects of Kelvin Power Station (job creation/loss, COUE, carbon emissions).
 - The revenue to the project will eventually depend on the agreed tariff with City Power/Eskom (as applicable).
- **Software used:** MS Word, MS Excel, DIgSILENT

- Independent Engineer: RustMo1 PV solar farm

- **Duration:** July 2013 - February 2014
- **Location:** South Africa
- **Client:** Momentous Energy
- **Position:** Project Manager, T & D Engineer
- **Brief description:** Parsons Brinckerhoff Africa (Pty) Ltd was appointed by Momentous Operations Services (Pty) Ltd as the Independent Engineer (IE) for the 7 MW RustMo1 Photovoltaic (PV) facility around Rustenburg, North West Province, South Africa.
The IE role is a formal role included under South Africa's Department of Energy's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). From a high level, the following tasks are required of the IE:
 - * Determination on commencement and continued construction of the facility
 - * Act as Independent Expert in the case of fast track dispute resolution
 - * Conduct inspections and/or non-intrusive tests to check maintenance of the facility
 - * Make determinations and confirmations on Deemed Energy Payments
 - * Certify mechanical and electrical completion via Facility Completion Form (constructed, commissioned, achieved capacity, commercial operation readiness, pyranometer/temperature sensors)
- **Contribution:**
 - * Data collection
 - * Site visits
 - * General project management
 - * Determination on commencement and continued construction of the facility
 - * Act as Independent Expert in the case of fast track dispute resolution

- * Conduct inspections and/or non-intrusive tests to check maintenance of the facility
 - * Make determinations and confirmations on Deemed Energy Payments
 - * Certify mechanical and electrical completion via Facility Completion Form (constructed, commissioned, achieved capacity, commercial operation readiness, pyranometer/temperature sensors)
 - **Software used:** MS Word, MS Excel, DIGSILENT
- RustMo1 Grid Code Compliance Review
 - **Duration:** June 2013
 - **Location:** South Africa
 - **Client:** Momentous Energy
 - **Position:** T & D Engineer
 - **Brief description:** Parsons Brinckerhoff Africa (Pty) Ltd was appointed by Momentous Operations Services (Pty) Ltd to conduct a grid compliance study review for a 7 MW Photovoltaic (PV) facility around Rustenburg, North West Province, South Africa.
The grid code compliance study was performed in order to ensure compliance with the latest version of the South African Renewables Grid Code.
 - **Contribution:**
 - * Significant inputs into Grid Code compliance review process
 - * Report review
 - **Software used:** MS Word, MS Excel
 - Interim Feasibility Study: Pamodzi Coal Fired Power Station (Malawi)
 - **Duration:** April 2013 - August 2013
 - **Location:** Malawi
 - **Client:** Intra Energy Corporation
 - **Position:** T & D Engineer
 - **Brief description:** Intra Energy commissioned Parsons Brinckerhoff Africa to perform a site selection study for their proposed Pamodzi 120 MW coal fired power plant in the Chipoka area of Malawi. Areas which could affect the power plant location (source of water and coal) and general transmission line and substations were considered. Based on the site assessment findings, a preferred site location was chosen and an indicative access and supply of bulk materials such as coal limestone, water, etc. configurations as they apply to the preferred site location were developed. An Environmental project Brief was required to be submitted for the project.
A desktop review of the current progress of Carbon Capture and Storage/Sequestration via algae growth including the scale and current status of the technology, the companies involved in developing this technology and consideration of some aspects of the feasibility of this technology in relation to Project Pamodzi were developed.
 - **Contribution:**
 - * Development and assistance with GIS maps for transmission infrastructure
 - * Report compilation and integration of the various components of the study from team members Internal Quality Control (Report review process)

- **Software used:** qGIS, MS Word, MS Excel
- Interim Feasibility Study: Ngaka Coal Fired Power Station (Tanzania)
 - **Duration:** April 2013 - August 2013
 - **Location:** Tanzania
 - **Client:** Intra Energy Corporation
 - **Position:** Project Manager, T & D Engineer
 - **Brief description:** Intra Energy Corporation Limited wished to develop a 200 MW coal fired power station in Tanzania known as Project Ngaka. The proposed development area is located about 85 km north west of the town of Songea, in the Ruvuma Region of South Western Tanzania. Intra Energy approached Parsons Brinckerhoff (PB) to provide assistance on a Pre-Feasibility Study (PFS) for Project Ngaka which was completed in March 2013. The Pre-Feasibility Study focussed on an environmental fatal flaw analysis, generation technology assessment and a grid connection study. Following the completion of the PFS, Intra Energy approached PB to complete an Interim Feasibility Study (IFS) with specific focus on:
 - * Water Resource Assessment
 - * Power Plant Cooling Technology
 - * Environmental Project Brief
 - * Grid Connection Study
 - **Contribution:**
 - * Determination of the network integration solution for Ngaka via steady state network load flow analysis considering existing and future transmission network topologies, generation capacity development in Tanzania and expected electrical demand forecast for Tanzania
 - * Perform transient stability analysis for the study cases considered to ensure grid code compliance
 - * Perform frequency stability analysis (for maximum unit sizing) to ensure acceptable system frequency performance in line with the grid code
 - * Ensure steady state fault levels before and after the integration of Project Ngaka are in line with grid code requirements
 - * Costing of the required transmission infrastructure to integrate Project Ngaka
 - * Report compilation and integration of the various components of the study from team members
 - * Internal Quality Control (Report review process)
 - **Software used:** qGIS, MS Word, DIgSILENT, MS Excel
- Renewable Energy IPP Strategic GIS Planning Study
 - **Duration:** February 2013 - October 2013
 - **Location:** South Africa
 - **Client:** Eskom Grid Planning
 - **Position:** T & D Engineer
 - **Brief description:** Studies have been done in South Africa for Independent Power Producer (IPP) integration at transmission and sub- transmission level within a Grid Connection Capacity Assessment (GCCA) for 2012 and

2016. These indicate the capacity limits of the network in 2012 and 2016 when adding additional generation to the transmission networks.

Following from the above, a strategic network study is required to determine transmission strengthening required to enable grid access for IPPs based on areas of high renewable IPP potential. Such areas are identified through the high renewable energy resource availability and high number of applications for grid integration in those areas. The plant type, size and location of IPPs are, among others, the key factors that determine the transmission infrastructure required for integrating RE IPPs into the grid.

The primary study areas of this project are the Northern Cape, Free State, Western Cape and Eastern Cape. These have been identified to have a high renewable energy resource potential and high number of applications.

– **Contribution:**

- * Assistance with planning study: Identification of least-cost connection options (for associated areas under study) including assessment of existing GIS data (environmental layers, existing Tx/Dx infrastructure, land topology and elevation etc) as well as power system studies (as required)
- * Assistance with Revision of GIS maps to incorporate planning solution
- * Review of Report on solutions for IPP integration

– **Software used:** qGIS, MS Word, PSS/E, MS Excel

• ABB Venus Capacitor Switching Study

– **Duration:** February 2013 - July 2013

– **Location:** South Africa

– **Client:** ABB South Africa

– **Position:** T & D Engineer

– **Brief description:** Parsons Brinckerhoff Africa (Pty) Ltd (the Consultant) was approached by ABB South Africa (ABB) to perform an insulation co-ordination, equipment rating and protection study for the harmonic filter bank at Venus Substation in Kwazulu-Natal, South Africa.

In light of the recent failure of the protection scheme system protecting the harmonic filter bank at Venus Substation, ABB requires a study to be conducted investigating the adequacy of the selected surge arrestor. EMT studies were conducted for the following:

- * Switching conditions
- * Fault conditions on the feeder busbars
- * Lightning conditions

– **Contribution:**

- * Development and assistance with case studies required
- * Provision of guidance on EMT studies required in DIgSILENT
- * Internal Quality Control (Report review process)

– **Software used:** DIgSILENT, MS Word, MS Excel

• FSBWSA Interconnection Study

– **Duration:** February 2013 - May 2013

– **Location:** South Africa

– **Client:** First Solar Blue Wave Capital SolAfrica (FSBWSA)

- **Position:** T & D Engineer
- **Brief description:** An interconnection study for Photovoltaic (PV) facilities up to 400 MW around Aggeneys, Northern Cape, South Africa. It is envisaged that these facilities will be bid as part of South Africa's Department of Energy (DoE) Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). The client has tasked the consultant to develop an interconnection strategy to determine the least cost, technically viable and least regret interconnection solution for each of the possible FSBWSA PV plants. Furthermore, the client has requested that an estimate of the associated duration for each of the interconnection solutions is investigated.
- **Contribution:**
 - * Assistance with power system studies to assess the least-cost (including only capital expenditure (capex)), technically feasible and least regret solution for the integration of the PV plants for a number of PV facility size scenarios.
 - * The optimum solution for each of the scenarios considered the various voltage levels available at the surrounding substation, thermal ratings of lines and transformers, voltage assessments, impact on fault current levels and reliability assessments including (N-1) contingencies. A budget level estimation (85% accuracy) for the capex for each option was made to assess least-cost solutions.
 - * Perform high level review of the options presented in the supplied Cost Estimate Letters (CELs) from the utility.
 - * Review connection schedule estimates
 - * Review Report
- **Software used:** MS Word, DIgSILENT, MS Excel

- Grid Collapse Protection Studies and CEB/IPP Islanding

- **Duration:** February 2013 - August 2013
- **Location:** Mauritius
- **Client:** Central Electricity Board (CEB)
- **Position:** Project Manager, T & D Engineer, Protection Engineer
- **Brief description:** The Central Electricity Board (CEB) is the main electrical utility in Mauritius. CEB provides generation, transmission and distribution services to the main island of Mauritius. A number of Independent Power Producers (IPPs) provide generation services only. During a general breakdown of the Central Electricity Board (CEB) system, CEB has experienced difficulty in restoration of supply as a result of generating units shutting down (not operating in island mode). Following a major system breakdown on 13 December 2011, a meeting was held between CEB and all IPPs whereby it was agreed that IPPs would appoint a consultant to review protection relay settings on the CEB transmission system and at IPPs (if deemed required) so that in the case of a fault on the grid requiring generator disconnection that IPP units would go into islanding mode rather than shutting down. Following the conclusion of the above study performed by the consultant, Parsons Brinckerhoff (PB) was appointed by CEB to:
 - * Supplement existing network model with applicable main and backup protection relays and instrumentation (VTs, CTs, impedance, OC & EF, reverse power, underfrequency/overfrequency, overvoltage/undervoltage).

- * Review the analysis performed by the IPP Consultant (as the analysis challenged existing protection settings)
 - * Review PCC settings for CEB and IPP generation
 - * Investigate general cause of the network breakdown on 13 December 2011 initiated by a line disturbance and circuit breaker (CB) fail incident.
 - **Contribution:**
 - * Commenting on IPP Consultant Report
 - * Briefly review/discuss DIgSILENT zero sequence impedances (transformers)
 - * Present a typical CB fail protection scheme (redline of an existing CEB main substation protection scheme)
 - * Undertake transient DIgSILENT network modelling to simulate the dynamic decay of the CEB and IPP generation systems
 - * Installation of main and backup relays in network model
 - * Develop revised CEB protection settings to address the long duration fault issues
 - * Develop revised IPP and CEB PCC settings
 - * Undertake dynamic network studies to evaluate the operation of the revised protection settings
 - * Reporting
 - * Workshop with CEB and the IPPs to discuss the proposals
 - **Software used:** MS Word, DIgSILENT, MS Excel
- Hodges Resources Coal Concept Power Station Studies
 - **Duration:** October 2012 - December 2012
 - **Location:** Botswana
 - **Client:** Hodges Resources Limited
 - **Position:** T & D Engineer
 - **Brief description:** PB was approached by Hodges Resources Limited to undertake studies to determine the best techno-financial solution for the integration of a 300 MW, 600 MW, 900 MW, 1200 and 1800 MW coal-fired power station near Morupule in Botswana.
 - **Contribution:**
 - * Options analysis
 - * Loadflow analysis including 400kV AC
 - * Fault analysis
 - * Reactive Power Analysis
 - * High level costing estimates for options
 - * Report contributions
 - **Software used:** DIgSILENT, MS Word, MS Excel
 - Lender Technical Advisor for solar Photovoltaic projects
 - **Duration:** 2012
 - **Location:** South Africa
 - **Client:** Industrial Development Corporation (IDC)
 - **Position:** T & D Engineer, Regulatory analyst

- **Brief description:** Provision of technical advice to the lender (IDC) for two solar photovoltaic projects in the Northern Cape of South Africa (Aries and Konkoosies). This includes inter alia:
 - * Technical due diligence (construction and operation to the required technical and environmental standards, with the projected performance estimations; within the budgeted costs and proposed schedules and in accordance with prudent utility practice within the budget)
 - * Reviews of PPA, transmission interconnection agreement, EPC and O & M agreements, land agreements, implementation agreements, salient governmental permits/applications, financial model audit
 - * Required reporting back to the client
- **Contribution:**
 - * Technical review and assessment of Grid code Compliance Studies for both solar photovoltaic projects (Aries and Konkoosies)
- **Software used:** MS Word, DIgSILENT, MS Excel

- Diaz Wind Energy Facility Technical Advisor

- **Duration:** 2012 - 2014
- **Location:** Namibia
- **Client:** Diaz Wind Power (Pty) Ltd
- **Position:** T & D Engineer, Regulatory analyst
- **Brief description:** Diaz Wind Power (Pty) Ltd (the client) is developing the Diaz Wind Energy Facility (WEF) near the town of Luderitz in Namibia. The project is likely to be the first to be developed in the area and as such it will be key to the success of Namibia's renewable energy strategy as well as contributing to the promotion of the wind industry in the region. The Services consist in two packages of core and optional services:
 - * Core services - Technical Assistance regarding EPC Tendering, including specification preparation and tendering process for EPC and O & M contractors on behalf of the Client, technical optimization and Project documentation review.
 - * Optional Services such as PPA negotiations and Technical Advisor regarding the review of project key documents such as EIA, project financing support, geotechnical investigation and grid connection study.
 Ad-hoc services may be required and in addition some assistance regarding early works for the construction phase may be requested in addition to those services noted in the clients RfP.
- **Contribution:**
 - * Steady state and dynamic studies (focusing on reactive power) for grid integration of WEF (grid connection study component of Optional Services above)
 - * Report compilation
 - * Preliminary assessment of bidders replying to Invitation to Bid on behalf of the developer (with focus on grid connection issues and grid code compliance)
 - * Selected technical and regulatory inputs into the Transmission Use of System (TUSA) and Power Purchase Agreement
- **Software used:** MS Word, DIgSILENT, MS Excel

- Pre-feasibility Study for Power Plants in Eastern Africa
 - **Duration:** September 2012 - January 2013
 - **Location:** Malawi and Tanzania
 - **Client:** Intra Energy Corporation
 - **Position:** T & D Engineer
 - **Brief description:** Intra Energy Corporation Limited is actively developing three coal fired power stations in Tanzania and Malawi.
For the realisation of these projects, Intra Energy approached Parsons Brinckerhoff (PB) to provide assistance on the conceptual design and pre-feasibility assessment of the projects with regards to environmental, grid integration and generation technology assessment.
The purpose of this Pre-Feasibility Study is to evaluate whether the suggested power plants have economic potential which warrants further investigation and to highlight any risks and potential fatal flaws.
 - **Contribution:**
 - * Grid integration studies (loadflow and contingency)
 - * Unit sizing (frequency stability)
 - * Transient stability (preliminary)
 - * Fault levels
 - * Contributions to substation designs
 - * Indicative line routing
 - * Budget capex costing of transmission infrastructure
 - * Report compilation
 - **Software used:** MS Word, DIgSILENT, MS Excel

- System Study of the Kenyan Electricity Supply System (Kenya Transmission Masterplan)
 - **Duration:** 2012
 - **Location:** Kenya
 - **Client:** Energy Regulatory Commission (Kenya)
 - **Position:** T & D Engineer
 - **Brief description:** Perform detailed system analyses to identify steady state and dynamic problems that are affecting the existing system (2011-2012) and propose and specify immediate reinforcements or operational protection / control solutions needed to maintain/improve the security and reliability of the power system.
Perform system analyses to identify medium term (2013-2016) and long term (2017-2030) reinforcements needed to suit the existing developments in Kenya stated in the LCPDP.
Recommend improvements in the current transmission planning functions used in the electricity sector, including the process, the security and reliability principles, and the tools used to assist the technical planning function. Other objectives include capacity building activities and other institutional adjustments that should be undertaken, as well as knowledge transfer and training of the ERC, KPLC, KETRACO, KenGen and MoE staff that are involved in the study.
 - **Contribution:**
 - * Transient stability studies

- * Report compilation (for transient stability studies)
- **Software used:** MS Word, PSS/E, MS Excel

- Waterberg integration transient stability studies (New Coal)

- **Duration:** September 2012 - December 2012
- **Location:** South Africa
- **Client:** Eskom Grid Planning
- **Position:** Project Manager, T & D Engineer
- **Brief description:** Eskom Grid Planning approached Parsons Brinckerhoff Africa (Pty) Ltd (PBA) to investigate which phases of the existing Limpopo West Corridor (LWC) framework developed by Eskom Grid Planning are required for the expected 2022 Waterberg generation capacity (in the region of 15 000 MW) including various updated assumptions on transmission system topologies. The LWC framework includes 400 kV and 765 kV transmission strengthening as well as two HVDC bipoles (Central and Eastern) to transfer 8000 MW (4000 MW per bipole line).

The investigations focus on transient stability aspects. In addition to the proposed phases of the LWC framework, additional options are suggested in an attempt to delay or completely remove significant transmission network investments deemed required previously.

The studies essentially attempt to answer the question of how much transmission infrastructure defined in the LWC framework is required to evacuate a pre-defined amount of generation capacity from the Waterberg area. It also suggests possible other technology options e.g. series compensation and power re-routing.

- **Contribution:**
 - * General project management
 - * Data collection
 - * Primary client interface
 - * Numerous loadflow and contingency options analysis
 - * Transient stability studies in PSS/E and transient stability performance improvement
 - * Report compilation
 - * Presentation to client
- **Software used:** MS Word, PSS/E, MS Excel

- Commenting on Wind and Renewable Energy Grid Codes of South Africa

- **Duration:** June 2012 - July 2012
- **Location:** South Africa
- **Client:** Grid Code Secretariat
- **Position:** T & D Engineer, Regulatory analyst
- **Brief description:** Parsons Brinckerhoff Africa (Pty) Ltd (PB) was invited to attend industry expert meetings and contacted on a number of occasions to comment on the various draft versions of the Wind Grid Code and Renewable Energy (RE) Grid Code by the Grid Code Secretariat.
- **Contribution:**
 - * Attendance at industry expert meetings

- * Provision of comments on the various draft versions of the Wind Grid Code and Renewable Energy (RE) Grid Code by the Grid Code Secretariat.
 - **Software used:** MS Word
- Resources to Assist Eskom Grid Planning
 - **Duration:** September 2012 - April 2013
 - **Location:** South Africa
 - **Client:** Eskom Grid Planning
 - **Position:** T & D Engineer
 - **Brief description:** Parsons Brinckerhoff Africa Pty (Ltd) was contracted by Eskom Grid Planning to assist Transmission Grid Planning with the handling of IPP applications as part of the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP).
The scope was included developing alternative integration options based on the position of the IPP with regards to the Eskom grid, modelling the integration options, technical evaluation of the options (loadflow analysis under system healthy and emergency conditions at both Time of System Peak (TOSP) and light loading conditions, Fault level analysis, transient stability studies.
 - Identification of necessary network upgrades to accommodate the integration of the IPP
 - Costing and selection of a least cost preferred option
 - **Contribution:**
 - * Numerous technical and financial inputs into studies
 - * Assistance and mentoring of engineers in the planning process applicable to Eskom
 - * General inputs into overall integration solutions for IPPs
 - * Internal Report Quality Control (review process)
 - **Software used:** PSS/E, MS Word, MS Excel
- Development of a Transmission Pricing and Ancillary Services Model.
 - **Duration:** January 2012 - June 2012
 - **Location:** Ghana
 - **Client:** Ghana Grid Company (GRIDCo)
 - **Position:** Project Manager, T & D Engineer, Market analyst, Regulatory analyst
 - **Brief description:** Parsons Brinckerhoff Africa (Pty) Ltd (PBA) was awarded the contract to develop a transmission tariff and ancillary services model for the Ghana Grid Company (GRIDCo), the Ghanaian Transmission Owner and System Operator. The model was an Excel based tariff model inclusive of Ancillary Services requirements.
PBA also gave training to client counterpart staff in Johannesburg, South Africa for an extended period (3 months) focusing on the newly procured power system tool (DIGSILENT Powerfactory) and selected power system regulatory, economic and financial topics as well as ancillary services in the Ghanaian context. Attendance at selected workshops, lectures and technical tours was also arranged during the training period.

At the end of the project, PBA presented the model and project findings to GRIDCo Tema, Ghana and held a Workshop to familiarise all stakeholders in the Ghanaian ESI with the work performed.

– **Contribution:**

- * General project management
- * High level assessment and review of existing Ghanaian Electricity Supply Industry documents
- * Formal review of Ghana energy policies and regulations
- * Review of Existing financial models and technical system operations data
- * Formulation of a transmission pricing and ancillary services pricing model for the next 20 years
- * Determination of required ancillary services
- * Appropriate pricing of ancillary services
- * Determination and pricing of losses in the power system
- * Determination of the require pro-forma financial statements for the next 20 years including Balance Sheet, Income Statement, Cash Flow Statement
- * Extensive training of four GRIDCo staff for 3 full months in PB's Johannesburg offices on various topics including DIgSILENT Powerfactory training, power system stability theory, utility revenue requirements, asset valuations and Regulatory asset base considerations, return on investments, cost reflective charges to customers, Ancillary Services, Depreciation, marginal costing of transmission
- * Various site visits, public lectures and technical tours in South Africa

– **Software used:** DIgSILENT, PSS/E, MS Word, MS Excel

• Erdenes Tavan Tolgoi Power Plant Integration Study

– **Duration:** June 2012 - July 2012

– **Location:** Mongolia

– **Client:** Erdenes TT

– **Position:** Project Manager, T & D Engineer

– **Brief description:** Parsons Brinckerhoff (PB) conducted a PP integration study to determine if the proposed initial 300 MW Erdenes Tavan Tolgoi Power Plant (ETTPP) as well as future expansions of ETTPP to up to 750 MW can be successfully integrated into the Mongolian power network along with other power plant options in the region. In this study the following analysis was performed:

- * Steady state studies including loadflow studies, steady state fault level studies, contingency analysis (reliability study), voltage stability
- * Dynamic stability studies including transient stability

– **Contribution:**

- * Primary client interface
- * General project management
- * Remote data collection from client
- * Steady state studies including loadflow studies, steady state fault level studies, contingency analysis (reliability study), voltage stability
- * Dynamic stability studies including transient stability
- * Compiling of Report to client

- **Software used:** PSS/E, Python, MS Word, MS Excel
- Suzlon S97 Turbines Connection Compliance Studies
 - **Duration:** January 2012 - February 2012
 - **Location:** South Africa
 - **Client:** ACED Bedford Wind Farm (Pty) Ltd, ACED Great Fish River Wind Farm (Pty) Ltd
 - **Position:** Project Manager, T & D Engineer
 - **Brief description:** Parsons Brinckerhoff Africa (Pty) Ltd (PB) was approached by ACED Renewables (Pty) Ltd (ACED) to provide to perform a wind farm grid code compliance and Eskom network integration study. ACED and its partners intend to develop Great Fish River and Bedford Wind Farms in the Eastern Cape of South Africa. The wind farm must comply to the requirements laid out in the latest Grid Code Requirements for Wind Turbines Connected to Distribution or Transmission Systems in South Africa document.

In addition to the Grid Code requirements, a study is also required to prove that the technology and chosen supplier (Suzlon S97 Type wind turbines) can be successfully integrated at Eskom's Poseidon substation. The Great Fish River and Bedford Wind Farms will have a MEC of 140 MW and 50.4 MW at 132kV and 66kV respectively.
 - **Contribution:**
 - * General project management
 - * Primary client interface
 - * Data collection (inter alia SLDs, schematics, Suzlon wind turbine models etc)
 - * Load Flow
 - * Steady state fault levels
 - * Contingency analysis
 - * Grid Code compliance including frequency stability, transient stability, Low Voltage Ridethrough (LVRT) assessment, Voltage step change
 - * Compiling of Report to client
 - **Software used:** DIGSILENT, Python, MS Word, MS Excel
 - Macquarie PV Farm Connection Studies
 - **Duration:** October 2011 - February 2012
 - **Location:** South Africa
 - **Client:** ACED Renewables (Pty) Ltd
 - **Position:** T & D Engineer
 - **Brief description:** Parsons Brinckerhoff Africa (Pty) Ltd (PB) was approached by ACED Renewables (Pty) Ltd (ACED) to undertake PV farm interconnection studies at Hydra MTS Substation in the Northern Cape. Hydra SS is the main 765kV/400kV/220kV/132kV SS connecting the Southern and Eastern Cape to the Northern part of the country. The PV farms will be in five phases of 75MW.

Connection possibilities are mainly at 132kV due to the greater level of complexity of integrating at transmission voltages.
 - **Contribution:**

- * Primary client interface
- * Connection option analysis including lines into SSs, line turn-ins and various voltage connections
- * Load Flow (including steady state voltage stability and VAR analysis)
- * Steady state fault levels Contingency and reliability analysis (LVRT) assessment
- * Voltage step change
- * Compiling of Report to client
- **Software used:** DIgSILENT, MS Word, MS Excel

- Consultancy Services for the Development of the National Electricity Grid Code (Rwanda)

- **Duration:** June 2011 - September 2011
- **Location:** South Africa
- **Client:** Ministry of Infrastructure (MININFRA)
- **Position:** T & D Engineer. Electricity Policy and Tariffs analyst, Electricity Market and System Operations analyst
- **Brief description:** Parsons Brinckerhoff Africa (Pty) Ltd (PBA) was approached by the Ministry of Infrastructure (MININFRA) to develop a National Electricity Grid Code.

The Grid Code incorporated both the Transmission and Distribution aspects of the electricity Supply Industry (ESI). The various "sub-codes" developed which deal with specific aspects of the ESI were as follows:

- * Preamble
- * Governance Code
- * System Operations Code
- * Network Code
- * Metering Code
- * Information Exchange Code
- * Network Tariff Code

PBA also gave training to client counterpart staff in Johannesburg, South Africa and held a Workshop in Kigali, Rwanda to allow for knowledge exchange and appropriate training on various aspects of Grid Code development, promulgation, methodologies, standardisation and future amendment processes.

- **Contribution:**
 - * Primary client interface
 - * Collection of applicable data in Kigali, Rwanda.
 - * Development of Network Code and Preamble.
 - * Assistance and selected inputs on Governance Code, System operations Code, metering Code, Information Exchange Code and Network Tariff Code
 - * Training of counterpart staff via formal training and a Workshop on various aspects of Grid Code development
 - * Integration of all inputs from team members for various sub-documents to form complete integrated Grid Code.
- **Software used:** MS Word, MS Excel

- Zambia EMCO IPP Transmission Integration Study

- **Duration:** May-August 2011
- **Location:** Zambia
- **Client:** Sinazongwe Energy Corporation (SEC)
- **Position:** Power systems engineer
- **Brief description:** Parsons Brinckerhoff Africa (PB) was contracted by Sinazongwe Energy Corporation (SEC) to perform a high level study on the integration of 6x150 MW coal-fired generators into the ZESCO (Zambian utility) grid at the Muzuma substation. At the time of project execution, 98% of Zambia's electricity was generated with hydro-electrical power stations and ZESCO was trying to diversify their generation mix by introducing thermal generation by independent power producers (IPPs).
- **Software used:** DIgSILENT, MS Word, MS Excel, Python

- Macquarie Suzlon Wind Farm Grid Code Compliance Studies (S88)

- **Duration:** June 2011 - September 2011
- **Location:** South Africa
- **Client:** ACED Renewables Cookhouse (Pty) Ltd
- **Position:** T & D Engineer
- **Brief description:** Parsons Brinckerhoff Africa (Pty) Ltd (PB) was approached by ACED Renewables (Pty) Ltd (ACED) to perform a wind farm grid code compliance and Eskom network integration study. ACED and its partners intend to develop a wind farm in the Eastern Cape of South Africa and as such the wind farm must comply to the requirements laid out in the latest Grid Code Requirements for Wind Turbines Connected to Distribution or Transmission Systems in South Africa document.

In addition to the Grid Code requirements, a study is also required to prove that the technology and chosen supplier (Suzlon S88 Type wind turbines) can be successfully integrated at Eskom's Poseidon substation up to a total generation capacity of 420 MW at various voltage levels (66 kV, 132 kV, 220 kV).
- **Contribution:**
 - * Primary client interface
 - * Data collection (inter alia SLDs, schematics, Suzlon wind turbine models etc)
 - * Steady state (N-1) compliance loadflow studies up to full 420 MW integration level of Cookhouse Wind Energy Facility (WEF)
 - * Steady state fault current level analysis at Poseidon Main Transmission Substation (MTS)
 - * Verification of Suzlon S88 user defined model in PSS/E
 - * Grid Code compliance studies of Suzlon S88 wind turbine to ensure frequency response requirements, voltage requirements, power factor control requirements, active power curtailment, low voltage ride through (LVRT) requirements, transient and frequency stability are in accordance with Grid Code requirements
 - * A small Sub-Synchronous Resonance (SSR) investigation was performed to check whether any SSR problems (primarily Induction Generator Effect (IGE)) will be present especially considering the series compensated lines going to the Western Grid of the Eskom transmission network

- * Compiling of Report to client
 - **Software used:** PSS/E 32, Fortran, Python, MS Word, MS Excel
- - Public Utilities Corporation (PUC): Consulting Services to Conduct a Feasibility Study for Praslin Power Supply Options Project in Seychelles
 - **Duration:** February 2011 - June 2012
 - **Location:** Seychelles
 - **Client:** Public Utilities Company (PUC)
 - **Position:** T & D Engineer
 - **Brief description:** Public electricity supply on the Seychelles was provided to customers on the Island of Praslin by developing the generation, transmission and distribution facilities in the year 1981. Electrification project to provide electricity supply to the island of La Digue from Praslin through an undersea cable was completed in 1986. The demand for electricity has grown on an average at more than 13.2% from 240 kW in 1981 to 6,050 kW in 2009. All the generating set prime movers were configured to operate on Gas Oil since Fuel Oil storage and handling facilities were not available in the country when the power station was constructed in the year 1980. The projected load growth rate on Praslin is estimated in between 3 and 5 percent per year. Additional power for the island of Praslin will be required to cater for this load growth. The Baie Ste Anne Power Station site (on Praslin) is developed to its potential and there is insufficient space for expansion to meet future needs. A feasibility study was required to be undertaken to determine the most cost effective solution for power supply options to the island of Praslin. The two broad project objectives are to define the power supply options for Praslin island and recommend the: best power supply option in the long term with regard to techno-financial and environmental issues. The available options that were evaluated are undersea cable system between Mahe and Praslin (Option 1) and New Power Station (PS) on Praslin (Option 2).
 - **Contribution:**
 - * On-site data collection at various PSs and substations (including transformer, generator, AVR and governor data)
 - * Demand forecasting
 - * Budget capital and O & M pricing of options
 - * Building of techno-financial model to assess the feasibility of both options and variants thereof
 - * Loadflow and fault studies (including contingencies)
 - * Voltage stability studies
 - * Switching studies
 - * Stability studies
 - * Presentation of techno-financial results to client
 - * Report compilation
 - * Preparation of functional technical specifications for chosen option
 - **Software used:** DlgSILENT PowerFactory, MSExcel, MSWord
- Tanzania Electric Supply Company (TANESCO): Overall System Operations Study including Reactive Power Compensation and Transmission System Protection
 - **Duration:** August 2010 - November 2010

- **Location:** Tanzania
 - **Client:** Tanzania Electricity Supply Corporation (TANESCO)
 - **Position:** T & D Engineer
 - **Brief description:** Tanesco has been experiencing system blackouts and poor system performance over the recent past. In addition, Tanesco intends overlaying its 220kV and 132kV transmission grid with a more suitable 400kV transmission voltage.
Tanesco required their system assessed and modelled in detail and operational recommendations made to improve the operation of the system for the present and into the future.
The brief scope of works included brief scope of work was:
 - * Power station and sub-station visits and data collection
 - * Generator, exciter, AVR and governor modelling
 - * Transmission line, transformer, VAR and FACTS devices modelling
 - * Protection philosophy assessment and improvement
 - * Loadflow studies including (N-0) and (N-1) studies for present and future years
 - * Fault studies (Steady state) for present and future years
 - * Transient Stability studies for present and future years
 - * Frequency stability studies for present and future years
 - * Protection settings studies
 - * Reactive power compensation recommendations (strategic placement of additional VAR devices, FACTS devices and operational philosophy changes)
 - **Contribution:**
 - * Building of present and future Tanesco Transmission network base case files - digSILENT
 - * Building of present enhanced Tanesco Transmission network with short term suggestions - digSILENT
 - * Deriving future Tanesco transmission network base case files from original DigSilent files and Tanesco Power System Master Plan (PSMP)
 - * Steady state (n-0) and (n-1) voltage/thermal analysis of developed Tanesco transmission network - digSILENT
 - * Reactive power compensation recommendations (strategic placement of additional VAR devices, FACTS devices and operational philosophy changes)
 - * Transient stability analysis of Tanesco transmission network imposing various large signal disturbances and verifying system stability for 2010 and 2015
 - * Presentation to client
 - * Training given to Tanesco personnel on digSILENT basics, modelling of Tanesco transmission network and transient stability
 - * Draft and Final Report compilation
 - **Software used:** digSILENT PowerFactory, Python, MSExcel, MSWord
- Eskom: Renewable Energy Integration (Wind and CSP): A Techno/Enviro Study (used as input into the published *Grid Connection Capacity Assessment of the 2012 Transmission Network (GCCA-2012)* in December 2010)
 - **Duration:** April 2010 - November 2010
 - **Location:** South Africa
 - **Client:** Eskom Grid Planning

- **Position:** T & D Engineer
- **Brief description:** The primary goal of this study was to develop a transmission level geographical GIS map with supplementary information superimposed onto it that allows for easy identification of candidate substations for the integration of renewable energy (RE) generation in the near future (2012). Availability of electrical and spatial capacity at a substation is a primary limiting factor in determining the amount of generation to be integrated. The candidate substation's eligibility for integration will be based on load flow studies verifying voltage and thermal compliance as well as fault levels before and after the integration of the new RE generation. The transmission backbone limitation was based on both the normal (n-0) and emergency (n-1) condition at each sub-station. Restricted environmental areas surrounding a substation will count negatively. Historical voltage dip classifications at each sub-station according to NRS 048-2:2003 incorporated with low-voltage ride through (LVRT) capability according to the draft South African Wind Grid Code was analysed. Savings in network losses as a result of newly integrated RE generation will count positively towards a substation's suitability for integration.
- **Contribution:**
 - * Modelling and integration of new generation at each substation exclusively
 - * System wide integration of new generation (Transmission and sub-transmission levels)
 - * Zonal integration for each zone (Zone East, Zone West and Zone North)
 - * Pre and post integration of new generation fault level analysis
 - * Extraction of network losses deferred as a result of new renewable energy generation
 - * Low Voltage Ride-Through (LVRT) compatibility of each substation with NRS 048-2:2003
 - * Assigning of an overall score to each substation based on determining factors (amount of new generation integrated, network losses deferred, LVRT characteristics)
 - * Compilation of transmission maps graphically showing more/less favourable substations for future generation integration
 - * Compilation of Draft and final Reports
- **Software used:** PSS/E, Octave, MSExcel, MSWord, AutoCAD

EMPLOYEE: University of the Witwatersrand

Jan.'09-Mar.'09

(0.25 years)

Measurement & Verification team member

Eskom Corporate Services Division Assurance and Forensic Department

University of the Witwatersrand were contracted by Eskom Corporate Services Division Assurance and Forensic Department to perform the required measurement and verification of selected energy efficiency and Demand-Side Management (DSM) projects. The work entailed site visits, collection of the relevant data from site, meetings with the various stakeholders (Eskom, Energy Services Company (ESCO), client and measurement and verification teams) and the compilation of the various required reports depending on the relevant phase of the project.

EMPLOYEE: Dowding Reynard and Associates (Pty) Ltd

Various periods

(1 year) Dec.'05-Jan.'06, Jun.'06-Jul.'06 Dec.'06-Feb.'07, Jun.'07-Jul.'07, Nov.'07 - Dec.'07

Student Engineer

Dowding Reynard And Associates (Pty) Ltd

Sunninghill

Gauteng

South Africa

Minority of work completed at DRA head office in Sunninghill handling the necessary documentation required for Marula Platinum Mine Off-Reef Conversion Project in Limpopo Province. Majority of work completed on Marula Platinum Mine involved in electrical aspects pertaining to the project

EMPLOYEE: Current Electric

Jun.'05-Jul.'05

(0.25 years)

Student Engineer

Current Electric (Pty) Ltd

Germiston

Gauteng

Routine tests according to IEC 44-1 specification, primarily involving:

- Magnetisation Curves - knee point voltage of class X CT's
- Ratio Error - verification of accuracy of metering class CT's.
- Verification of composite error on protection CT's
- Final assembly - labeling, marking of terminals and polarity prior to despatch

PROFESSIONAL INTERESTS

Power systems operations, control and dynamics

Energy systems and network planning

Energy markets and regulation

Power system economics

Utility and energy project finance

GENERAL INTERESTS

Sport (Rowing, Football (Soccer), Baseball, Rugby, Cricket, Motorsport, Tennis)

Music

Percussion (Drums)

REFERENCES

The following persons are familiar with my professional qualifications and character:

Dr Clinton Carter-Brown (Energy Centre: Head)

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Dr Brian North (Research Group Leader: Energy Systems)

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Mr Paul Tuson (Studies Team Leader)

Mentor while at Parsons Brinckerhoff Africa (Pty) Ltd

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Prof. Willem Cronje (Head of the machines and drives research programme)

Supervisor of M.Sc.

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CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes myself, my qualifications, and my experience. I understand that any wilful misstatement described herein may lead to my disqualification or dismissal, if engaged.

January 26, 2022

Jarrad G. Wright

Date

Johannesburg, South Africa