Australian Government
Submission to Australian Government House of Representatives
Standing Committee on the Environment and Energy Inquiry into dispatchable energy generation and storage capability in Australia

PIONEERING THE NEW ENERGY GRID THROUGH THE POWER OF BIG DATA

As Australia moves towards the **carbon-neutral energy grid**, there is a critical need to change how power performance is monitored and managed. Advances in Big Data technology make that possible now.

AUSTRALIAN REGIONAL ENERGY PRICES (2012 - 2021)

Prices falling to a nine-year low is an outstanding result and demonstrates how effective the government actions have been.”

Angus Taylor
FEDERAL ENERGY MINISTER

Source: Australian Energy Market Operator

The advantages of reduced CO2 emission and falling electricity prices are counter-balanced by investments necessary to ensure the stability and resilience of the national grids..

Executive Summary

Our submission addresses the complex technical issues related to generation, transmission and distribution networks including significant distributed generation, as the electricity sector transitions to increasing penetration by renewable sources.

The provision of alternating current energy in a landscape of increasing asynchronous generation from renewable sources requires new approaches to the reliable, stable, and resilient operation of the grid.

At the heart of the technical issues that are developing at a seemingly accelerating rate, is the current lack of a live, contiguous, comprehensive system performance database. Succinctly, one must control fast moving events by means of information updates at an even faster rate.

Secondly, the concept of a dynamic system requires that control and information gathering cover all of the system, not only some selected parts based on historical experience. Our submission is based on a new, homogeneous, contiguous, live system performance database accessing thousands of monitoring points in the national grid that will also enable the development of markets for system strength, new forms of frequency support and inertia, etc.

Given Australia's vanguard position in the adoption of renewables, the technological developments in relation to monitoring and control of a dynamic grid, will provide a unique technology and knowledge export potential.

CT LAB specialises in power grid management and control technology. For details regarding the organisation and its technology, please refer to **Appendix A**.

Appendix B provides basic electrical engineering concepts relating to the submission.

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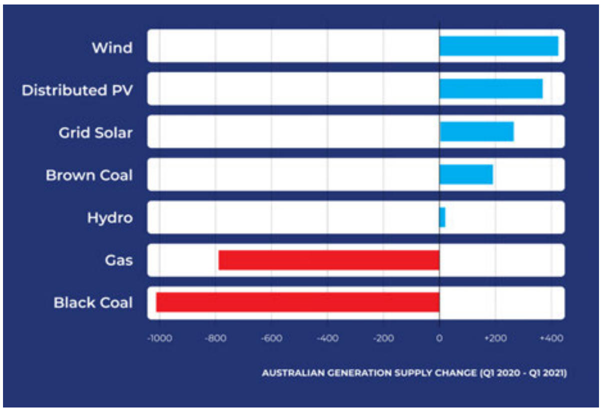
The tsunami of change brought about by renewables requires a new management and control paradigm based on Big Data

The growth in distributed energy resources (DER) and the transition from traditional thermal generation to variable renewable energy (VRE) by major energy generation industries, causing welcomed falling electricity wholesale prices, is at the same time challenging system strength. The advantages of reduced CO2 emission and falling electricity prices are counter-balanced by investments necessary to ensure the stability and resilience of the national grids. Currently, synchronous condensers and the construction of interconnecting transmission lines, as well as gas turbines are being installed and contemplated to meet reliability requirements.

Optimal planning and operation of emerging national grids with renewables of 50% and higher penetration of electricity demand, require a contiguous, national electricity market (NEM) grid-wide, synchronous data analysis and Big Data system in order to control as well regulate the connection of current and future VRE and to integrate the seemingly unstoppable growth in DER. The monitoring, analysis and Big Data system forming the substance of our submission is the necessary foundation for preserving and upgrading NEM system strength.



The rapid shift from traditional generation to renewables represents a seismic shift that cannot easily be reversed.

Source: *Australian Energy Market Operator*

CT LAB's submission is for a multi-parameter, synchronous, second-by-second monitoring, data collection and analysis system, as the basis for the real-time control of the national grids. The integration of renewables has been focused on distributed energy resources (DER) in distribution grids, with bespoke and partial solutions addressing mainly voltage control. However, the increase in large capacity wind, solar and batteries, demand a sea change in analytical monitoring, data collection, processing and control for the transmission grids, remote energy zone links and zone substations including DER. This would put Australia in the vanguard position relative to Europe and the USA, whose meshed grids have larger proportions of synchronously generated power than Australia will have in the very near future.

Introduction

Australia's early adoption of wind and solar energy puts it in a world leading position. Critically, the integration of the technologies associated with solar and wind renewables into traditional networks and generation requires new ways of planning and operation, such as a live, second-by-second, network-wide measurement, and information system as the basis for ensuring resilience and stability of the national networks. The application of such new ways is essential for Australia to maintain a reliable and affordable national grid while smoothly transitioning towards a CO_2 zero-emission electrical energy sector.

The solution to the renewables problem lies in clearly identifying where the capital needs to be invested. Engineers need comprehensive access to grid information as it happens. Without it, the stability of the grid cannot be assured. Traditionally, power stations had extensive control rooms with many manual controls, and therefore trained operational personnel to supervise procedures. Decades ago, this methodology, supported by conventional electrical measurement technology and limited scale telemetry and telephone communication between power stations, was sufficient for forecastable control of electricity consumption. Wind and solar generation are now responsible for an overlay of high variability, superimposed on 'traditional' diurnal and nocturnal electricity consumption patterns and therefore necessitate new information and control technology to augment current operational control. This forms the heart of our submission.

As part of the Australian Energy Market Operator (AEMO) technical operations underlying its integrated systems plans (ISP), it conducts simulation studies based on increasing penetration of inverter-based resources (IBR) that form the connection to the grid of wind and solar VRE as well as large-scale batteries. The simulation studies are based on electromagnetic transient (EMT) observations on transmission models with various levels of IBR. AEMO has stated that EMT studies are computation-intensive and therefore impractical for control room applications such as dynamic security assessment.

Comparisons with the UK (with nuclear generation) and various European countries that are part of an inter-country, vast interconnected, highly meshed (synchronous generators everywhere) network, do not serve as a basis for comparison. As Australia is heading to the vanguard position in terms of the penetration of renewable sources, unless we take stock that the laws of physics are not going to be suspended to accommodate conveniently argued electrical systems by economists, we'll build ourselves a 'very interesting' experiment. The AEMO system strength report (December 2020 extract—see Page 9 below) makes interesting reading!

Establishing the need for contiguous, second-by-second, synchronised measurement and control systems for Australia's transmission and distribution networks

This submission focuses on the need for a live information system as a critical component of the transition. A short review of technologies will aid in the appraisal for the need of such a system:

- Synchronous generation as provided by hydro, gas and coal has been the basis of system frequency stability up to the present.
- Current technology employed in solar farms and wind farms relies on existing synchronous generation to generate electrical power.
- Wind generators and solar farms connect to the grid via 'grid following' inverters, requiring stable voltage and frequency.
- Current and proposed battery grid-firming projects also connect to grid via inverters and cannot be considered as replacements of synchronous generation because of technical limitations of their inverters.

To place the foregoing into perspective, the technology discussions taking place in the USA (Energy Systems Integration Group, the National Renewable Energy laboratories, the Electrical Power Research Institute) and in the United Kingdom reveal that further development in inverter technologies are required for electrical grids relying for 50% or more on wind and solar generation. Specifically, inverters in mainly renewable grids will have to be capable of operating in grid following, grid supporting and grid forming mode, the latter being important as that role is still fulfilled by conventional synchronous generation.

Furthermore, in grids such as Australia's, stretching over large distances, inverters will have to be capable of changing between these modes of operation based on second-by-second network conditions in order to provide resilience and stability. For example, in a situation where a congestion limit of an interconnecting transmission line would result in an under-frequency event were power demand to be exceeded with consequent islanding (cut off) of a large grid section (as has happened in South Australia), the new data and control system, as proposed in our submission, would automatically switch designated inverter-based resources (IBR) in that grid section to voltage forming mode, and maintain stability of supply. We envisage that these flexible control modes will increasingly be called on by the real-time supervisory information and control system as proposed.

Stability and resilience either require a market as is the case for energy markets or have to be built in by regulation. We have neither mechanism. The absence of an overriding engineering authority means that such projects as inter-state interconnectors, subjected to RIT-T (regulated investment test for transmission) catering for future power flows, are based on AEMO integrated systems plan (ISP) projections that can be significantly affected by commercial decisions of generator owners. Furthermore, individual states are setting their own targets for renewable generation without any considerations regarding effects on stability and resilience.

Stability requires that voltage and frequency standards be maintained throughout the nation's electricity grids. Resilience requires that the grids recover rapidly from manmade faults and those due to weather and natural disaster events. AEMO intervenes from time to time through mechanisms including FCAS (frequency control ancillary services) and reliability and emergency reserve trader (RERT) demand reduction to maintain stability of voltage and frequency. Resilience of grids is a challenging attribute to quantify but the consequences of the occurrence of faults need to be taken account of, by for example, modelling fault occurrence scenarios.

The retirement of baseload generators and therefore the reduction in synchronously generated electricity is planned to be augmented by large scale batteries, termed as 'firming' the networks. What should be clearly understood is that batteries support synchronous generators, for example, when rapid changes in power demand occur, but unlike synchronous generators, are unable to restart energy supply following a blackout event if no synchronous generators of sufficient capacity are already in service.

The largely uncontrolled distributed solar PV resources, although augmenting energy supply, are increasingly affecting resilience as well as voltage stability. To understand this, imagine a scenario in which a minimum amount of power is required from the grid, and because of a fault or faults in distribution networks, the solar inverters stop functioning. Upon clearance of the faults, a time lapse to re-establish the operation of the inverters, requires sharp increase in power during this interval causing instability and 'islanding' (separating) of the distribution network/s. Such events have already occurred. It must be noted that the discussions on solar batteries for domestic, commercial and industrial purposes as well as the so called 'community' batteries, do not address network stability, as minimum inward power flow (i.e. from external synchronous generators to distribution networks) is required to establish stable voltage and frequency for inverter resources to be capable of generating power. In fact, if anything, in furthering the 'self-sufficiency' of distribution networks, network stability is negatively affected.

What is needed is:

1. An integrated network plan that allocates where generating and battery-inverter firming resources can be placed, and within what range of capacities, i.e the ISP with holistic, coordinated monitoring and control.

2. Real-time monitoring of the national grids, including distribution networks, is urgently required. It is only on comprehensive, real-time data that planning for stability and resilience can be carried out.

3. A measurement and data analysis system for the national grid that allows for the continuous measurement of positive, negative and zero sequence voltage and current phasors as well as EMT (by virtue of fast sampling of waveforms) as indicated in the recent review of the impact of renewables: *Grid forming inverters: Are they the key for high renewable penetration?* (IEEE Power and Energy Magazine, November 2019 by Babak Badrzadeh, AEMO; Julia Matevosyan, ERCOT; Deepak Ramasubramanian, EPRI et al.)

4. The intelligent control of DER within distribution networks requires substation monitoring and AI control of DER, based on monitoring and data systems as well as the integration of such control with that of the national grid as in (2) above.

5. An Australian Centre of Electrical Engineering Excellence, a combination of the USA's National Renewable Energy Laboratory (NREL) and the Electrical Power Research Institute (EPRI). CT LAB is prepared to be a co-founder, working in conjunction with academia and selected industry partners. The aim of the proposed centre of excellence is the provision to the NEM of detailed network and generator control schemes, monitoring, software, artificial intelligence and data security in order to enhance the strength of Australian grids, and to provide an expanding export market for Australian technology, insofar as Australia is already a leader in the area of renewable energy.

To flesh out the need for the information system as mentioned, the focus must be the state of instantaneous power flows in networks with large solar and wind resources. The laws of physics require that instantaneous generation and demand always balance. Resilience and stability require that we avoid, for example, a sudden burst of power that can cause synchronous generators to lose synchronism (in technical terms, 'slip a pole') requiring their disconnection and the possibility of cascading disconnections. However, as already mentioned, at present large battery systems cannot save a power system without the existence of synchronous generation. This is the current situation although several large manufacturers indicate they have the technology for voltage forming inverters to scale up, if there is a market requirement. Notwithstanding these considerations, incorporation of current and future IBR technology requires the overall measurement, analysis and control presence embodied by CT LAB technology.

Conclusion

Our closing point is this: gathering the real-time information across distribution grids, high voltage grids and electrical power sources will close the door on unwise investments, for example generation plants in remote energy zones with connection links subject to congestion. It will allow intelligent control of existing networks and re-examination of proposed interconnector investments because there are other solutions, including limiting the power output of distributed generation using artificial intelligence (AI) with minimal effect on individual solar rooftop installations.

The perceived task of the above-mentioned measurement, analysis and control technology based on live, synchronous, network-wide basis is:

- Develop specifications for NEM-grid real-time control systems
- Examine congestion limits of all links and high voltage transmission lines considering new design concepts permitting stable islanding and reconnection of sub-sections of the NEM-network including individual states.
- Analyse power flow stability parameters throughout the networks
- Set minimum and maximum substation power levels
- Set standards of minimum and maximum generation and generator types that may be connected at specified points in the national grids.

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Extract from '*AEMO System Strength Report: December 2020*'

Planning for the evolution of how future system security services will be sourced in the NEM.

The power system was planned and designed around large thermal and hydro synchronous generation. Most of the power system design has historically been centred around the characteristics of a system dominated by these power stations, and as such they are currently relied upon for provision of a range of system services needed to keep the system secure.

These power stations were located near their energy sources, which is different to where newer renewable generators are locating. This means the efficient redesign of the power system of the future will likely require provision of system services in new locations.

Commissioning of new utility-scale generation resources continues at a high pace; 4,074 megawatts (MW) of new inverter-based renewable energy generation is at the committed (final) phase of development as of November 2020, an increase of 1,138 MW since July 2020.

At the same time, due to increases in installations of distributed photovoltaic (PV) generation, AEMO has observed record minimum demand in several regions of the NEM, with South Australia experiencing a minimum demand of 270 MW (operational demand, sent out) on 7 November 2020, Victoria experiencing a minimum operational demand of 3,073 MW on 6 September 2020, and Queensland experiencing a minimum operational demand of 3,712 MW on 27 September 2020.

These trends have significant implications for the future operation of synchronous generation units. AEMO and transmission network services providers (TNSPs) need to re-engineer the power system and seek new opportunities for system service provision to ensure system security as the electricity system transitions.

In addition, the Energy Security Board (ESB) and the Australian Energy Market Commission (AEMC) are progressing major regulatory reforms which will affect future provision of system strength and inertia – the post-2025 NEM market design project, and the consideration of seven National Electricity Rules (NER) rule change requests relating to the provision of system services. AEMO is currently preparing an Engineering Framework intended to help stakeholders stay informed of the changing technical needs of the power system2. When planning for the provision of new system strength and inertia, AEMO and TNSPs must also account for other system needs, including thermal network capacity, stability of DER, and voltage requirements. There will be increasing opportunities for sourcing these services from non-energy providers, which may provide further efficiencies in the future power system design. AEMO looks forward to working with TNSPs and the broader industry as work progresses on assessment of the power system, and system strength and inertia in particular.

Appendix A

About CT LAB

Established in 1994, CT LAB is on a mission to transform how the power grid is monitored and managed. The electricity industry is dominated by a handful of major players; their bespoke solutions created for a centrally managed grid paradigm. More has changed on the grid in the past decade than in the century preceding it, and there is a tsunami of change that is challenging grid managers and engineers. CT LAB is a company built on a steadfast belief in the revolutionary potential of fresh ideas. Our technologies have always sought to change the game rather than add to the market offering.

CT LAB currently manages and hosts one of the world's largest grid performance data-stores, encompassing over 1,200 devices, from more than 65 individual customers. South Africa's national grid, ESKOM, has recently awarded CT LAB a contract for an additional 1,300 monitoring and analysis devices bringing the total, in the near future, to in excess of 2,500, synchronised monitoring points, feeding into CT LAB's OTELLO Big Data system. Our comprehensive electrical parameter big-data data-set technology spans a period of 9 years.

Appendix B

An introduction to important electrical engineering concepts relating to this submission

Once the province only of electrical engineers, working in the highly predictable areas of generation, transmission, distribution and demand for electrical energy pre-2000, these segments of the electrical energy market now give rise to a hotbed of discussion in public fora because of the impact of renewable energy sources. The value of much of the debates concerning future projections of generation and demand and development of new markets such as capacity and frequency support, etc. is incontestable. It is also incontestable that the impact of renewable energy in electrical generation and reticulation systems of yesteryear is posing questions about their stability and resilience.

The questions are legitimate and are not easily answered without the benefit of electrical system transparency. It is that very transparency that will provide the tools for new engineering solutions required for stability and resilience. Stability implies constancy of voltage and frequency, requirements of the bulk of electrical apparatus and appliances. Resilience is the property that allows electrical networks to quickly resume service following faults such as short circuits or breaks in lines, etc.

Transparency

In short, transparency provides a series of instantaneous 'pictures' of an electrical grid, its loads (i.e., consumption of energy centres) and its generators. Another way of expressing transparency is the provision of a synchronous, live database, with very small time increments between updates thus providing a live database. The term 'synchronous' implies that all electrical parameter measurements are made at identical instants in time, therefore allowing correlation, this being essential for effective network control. Electrical parameters measured include voltage, current, power, phase angle, etc.

Why is transparency essential?

In answering this question, the essence of alternating current generation and transmission need be understood. Without that basic understanding, the essence of CT LAB's submission cannot be appreciated.

Basic concepts

In a conventional synchronous generator as found in steam, hydro and gas turbine plant, a rotating magnet (the rotor) within a set of stationary wire coils that surround it (the stator) induces a voltage in the coils whose magnitude at any instant depends on the angle of rotation of the magnet with respect to the coils. For a two-magnetic pole (i.e., one north and south pole) generator, a complete revolution will have generated a voltage whose amplitude has the shape (voltage plotted against time) of a sine wave, comprising a positive and negative voltage portion. The frequency of the voltage depends on the rotational speed of the rotor. For example, the rotor in the above example, rotating at 1500 revolutions per minute, will generate a sine wave voltage, oscillating at 50 cycles per second (Hertz).

By contrast, inverters can (note; distinctions in types are made further down) generate (mimic) the electricity produced by synchronous generators. This is achieved by means of switches (electronic switches such power transistors) that change the direction of electrical current flow and then reverse it again at the frequency of 50 Hertz.

Without doubt, inverters and synchronous generators can participate and share power generation in electrical grids. However, there are two properties of synchronous generators that inverters by their very nature do not share although, by means of electronic control engineering, they can be made to mimic these two properties. The first one is voltage-angle response with power demand; the second is inertia—a property often discussed in the popular press as a matter of concern.

Voltage-angle response in synchronous generators

When more power is required from a synchronous generator, the response is to slow down a bit – resulting in a change in voltage phase angle. More steam or gas or increased water flow restore the speed of the rotor and therefore, the phase angle. This may appear as a technical curiosity, but it is an important property. The synchronous generator is connected via a transmission line to the load (consumption centre). The increased electrical power transferred through the transmission line has caused the change in voltage angle at the generator which also considers the electrical properties of the transmission line (principally its self-inductance and resistance for short lines, and in addition, conductance, and capacitance to earth and between conductors for long lines). If it were possible to conceive in theory of a synchronous generator without this voltage angle-power relationship, then its load would have to be static or in the alternative, voltage phase angle would have to increase as load increased if we were considering an isolated case (i.e., a single generator supplying one load). In practice, a single generator sharing a network comprising of many load centres and other generators is considered as being connected to an ‘infinite bus’, and therefore having to respond to power increase with an increase of its voltage angle (however achieved if the generator is in fact an inverter powered by a battery).

Inertia

Inertia is the resistance to a reduction in rotor speed as more power is demanded from the synchronous generator. The advantage of inertia is that it provides a short time span to the generator to make adjustment to rotor speed, i.e., the rate of change of speed is slowed down (as is the frequency). An important postulate (before we go further with the basic but very important properties of alternating current (AC) power systems)

An AC power system (interconnection of transmission lines and generators) requires that there be sufficient participating generators with voltage angle response for that system to operate under variable load demand conditions at constant frequency.

The AC network of generators and loads

The topology, that is the pattern of transmission lines connecting loads with generators, is of importance. The advent of wind turbine generators, solar farms and large battery banks and their often-remote locations to connection points within the grid topology is important as to the stable operation (voltage and frequency) of the system.

Australia has long transmission lines. They are also 'electrically long' meaning that in the transfer of electrical power from generators to loads some power is lost by heating the resistance to current flow, further power is lost in conductance to earth—and power is stored and discharged in magnetic fields surrounding the wires, and in electric fields stored as electric charge and discharge. These processes result in changes in voltage angle between the generator 'buses' (the electrical term for the point of connection of generators) and load 'buses'.

In Australian networks with its long transmission lines, voltage angle differences are large compared to European and USA transmission systems, and rapid changes in angle are in fact local changes in frequency (unless resisted by nearby generation with voltage angle response properties.

Transparency Redux

Imagining a network of transmission lines generators and load centres, it will be apparent that a knowledge of, for example, power, voltage, voltage angle, rate of change of voltage angle (frequency drift) at every instant across the entire network would be the starting point for its control with stability as primary aim. Resilience will be discussed further down. There are other parameters of importance such as voltage distortion (deviation from ideal sinusoidal waveshape), balance of voltages as power is transmitted via three lines (phases), etc. Currently we do not have a national, contiguous, network-wide information system providing instantaneous snapshots on which to base control for both stability and resilience.

The question will arise as to why we need that now if we have managed our networks without such an information system in the past. The short answer is that in the past we were able to rely on predictable load patterns and predictable generation patterns. All that is changing at an alarming rate as more and more rooftop solar is installed and more large-scale wind and solar generation are connected to the grid. Rooftop solar is reducing demand in often difficult to predict patterns. Large scale solar and wind generation are connected via inverters that possess neither inertia nor voltage angle response. Being able to monitor zone substations whose power demand can fluctuate markedly due to local solar generation variations, the substation transmission links, the remote energy zone links, the high voltage interconnectors, the response characteristics of interposed synchronous condensers, static var compensators, generator buses and battery banks connected via inverters—all on synchronous, second-by-second basis would be the foundation for Australia's electricity system future. More is needed than the information base that is the essence of CT LAB's submission, but it is the essential building block for control strategies that can be flexibly developed given that all relevant information is available on a live, national, all encompassing, continually updated database.

Inverters

Inverters fall into three main classes; grid following, requiring the presence of AC voltage; grid supporting, requiring the presence of AC voltage but capable of delivering power and reactive power in programmable quantities; and grid forming, capable of black start independently or in conjunction with synchronous generators. Grid forming inverters are capable of voltage-angle response. For distributed generation, the first class of inverters is usually employed although for so called grid support, the second class is also used. As Australia transitions to higher renewable penetration, grid forming inverters with voltage-angle response will be required. Inertia, or forms of it that mimic synchronous generator response may also be required although control systems based on very short time-base data (as conceived by CT LAB) can be designed to work with much reduced system inertia.

Resilience

Networks are protected against electrical faults by a large array of protection relays that can operate circuit breakers of various types. A critical part of resilience is that generators stay connected for controlled times so that after clearance of a fault service is resumed as normal. For synchronous generators, capable of 'feeding' faults for specified times (without them losing synchronism) overall information bases are essential. Wind and solar generation contribute much smaller fault currents and furthermore the direction of current flow is important to determine in the case of zone substations with overall reverse power flow (yet this a rare occurrence but expanding installation of distributed resources will make this more likely). The enormous advantage of a contiguous, synchronised, second-by-second live database is that it allows the creation in software of all manner of protection 'relays' providing the type of system security appropriate to modern grids with very large renewable penetration.

CTLAB

CT LAB

COMPANY PROFILE

2021

REAL TIME INSIGHT INTO THE ENERGY GRID

ONE MISSION

MAKE THE POWER GRID VISIBLE

OTELLO

ABOUT US

A company founded to address today's unique energy grid challenges

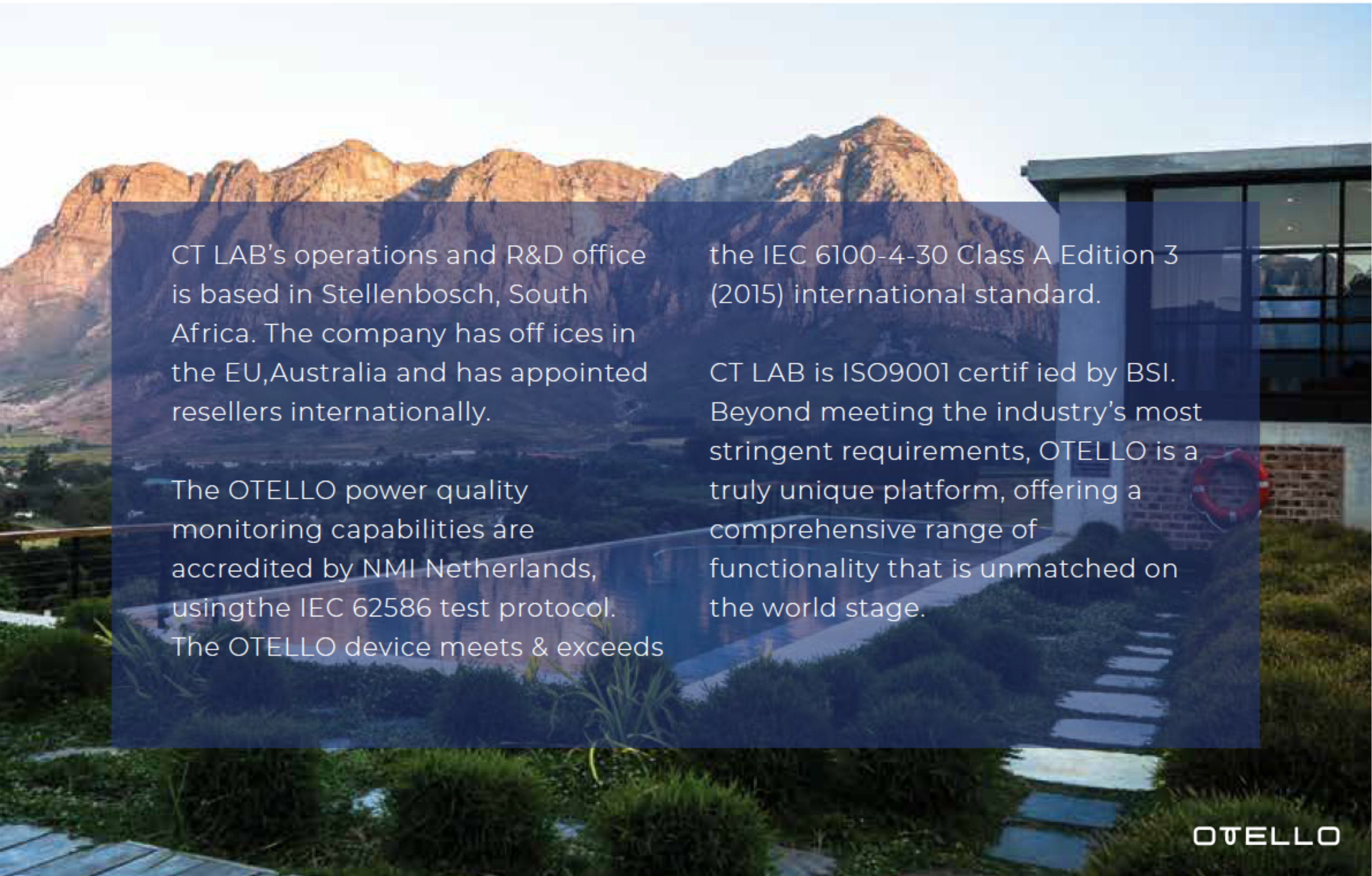
Established in 1994, CT LAB is on a mission to transform how the power grid is monitored and managed.

The electricity industry is dominated by a handful of major players; their bespoke solutions created for a centrally managed grid paradigm.

More has changed on the grid in the past decade than in the century preceding it, and there is a tsunami of change that is challenging grid managers and engineers.

CT LAB's OTELLO platform takes a unique approach to solving the problem of grid visibility.

By placing processing power, using edge-computing, throughout the network, OTELLO unlocks a host of practical benef its and provides visibility that no other system can.



CT LAB's operations and R&D office is based in Stellenbosch, South Africa. The company has off ices in the EU,Australia and has appointed resellers internationally.

The OTELLO power quality monitoring capabilities are accredited by NMI Netherlands, usingthe IEC 62586 test protocol. The OTELLO device meets & exceeds the IEC 6100-4-30 Class A Edition 3 (2015) international standard.

CT LAB is ISO9001 certif ied by BSI. Beyond meeting the industry's most stringent requirements, OTELLO is a truly unique platform, offering a comprehensive range of functionality that is unmatched on the world stage.

OTELLO

The advent of the OTELLO platform

OTELLO, the company's flagship product, is the world's only scaleable, real-time, permanently time synchronised. grid-wide monitoring & management platform.

It consists of a cloud based big-data store and a fleet of remotely installed, edge-computing monitoring and control devices.

OTELLO's bespoke rating and analytics engine offers unprecedented insight into power performance on the electrical distribution network.

Product development timeline

- 1994 – Company Established, Provograph®
- 1995 – Vectograph®
- 2003 – Impedograph®
- 2006 – PQ-Portal.com
- 2013 – OspreyLITE®, ImpedoDUO®
- 2015 – VectoII®
- 2017 – VectoIII®, OspreyPRO
- 2019 – OTELLO®

CT LAB is a company built on a belief in the potential of revolutionary ideas.

Our technologies have always sought to change the game rather than add to the market offering. At OTELLO, we're striving to change the future of power grid management.

OUR MISSION

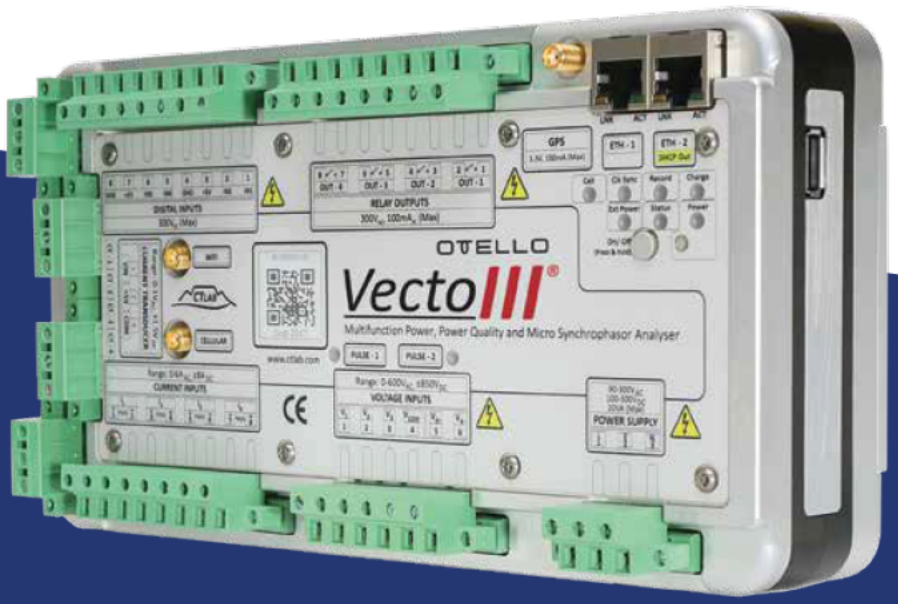
To make the power grid visible

The power grid is changing. It has changed more in the past decade than in all the decades previous. The pressures of climate change policies, technological advancement, COVID-19 and DC uptake means we are set to see a decade of change that eclipses this one.

OTELLO is a system designed to give grid managers and engineers the tools and data they require to build a stable, manageable and predictable electrical power grid.

The challenge of a more distributed, less dispatchable network, powered by variable and behind-the-meter generation, can only be met by one solution: grid-wide, real-time visibility of a comprehensive set of electrical parameters, converted into actionable information.

And for the f irst time, there is a platform capable of delivering just that — CT LAB's OTELLO.



OTELLO's Vecto III® is a IEC 6100-4-30 Class A Edition 3 (2015), edge-computing monitoring and control device that synchronises with every other device installed across the network.

OSPREYPRO®

OspreyRPO® is designed for flexibility, allowing you to customise reporting on over 9,000 individual parameters.

Actionable insight into power performance across the energy grid

OspreyPRO® is where the OTELLO system comes to life. Designed with the user in mind, it delivers animated visualisations of synchronised data sets, real time alert monitoring, customised reporting and in-depth event analysis.

OTELLO's design ethos delivers a system that is:

SCALABLE

RESILIENT

COMPREHENSIVE

USER FRIENDLY

All this can be achieved on OspreyPRO® in minutes

Simultaneous, synchronised to ~100ns, comparison of any electrical parameter, incl. power factor, load, harmonics (up to the 500th) across any selected device or group of devices on the grid.

Report on your pre-defined, rated parameters on any device or group of devices over pre-selected time-frames, scheduled and delivered directly to the email inboxes of your choice.

Configure event alerting profiles to your requirements and submit them across the grid for real-time, consolidated event notification alerts to the channels and [groups of] people of your choice.

OTELLO

SUPPORT SERVICES

Delivering on the ground

CT LAB provides domain system expertise to assist our clients in maximising the use and application of OTELLO on their network.

The company is staffed by subject matter experts in electrical engineering and data management.

We offer on-site user training and support to unlock grid insight and deliver optimal system efficiency.

We currently manage and host one of the worlds largest grid performance data-stores, encompassing over 1,000 devices from more than 65 individual customers, spanning a period of more than nine years.

As the owner and developer of both hardware and software, OTELLO is highly customisable to user needs.

WHO WE WORK WITH

Our Clients & Partners

NamPower | Consol | Eskom | City of Cape Town Isixeko saseKapa Stad Kaapstad

Copperbelt Energy | City of Ekurhuleni | eThekwini Municipality | vodacom

BMW | Telkom | sappi | AngloAmerican

THE WORK

Key projects

POWER GRID
Stellenbosch

38 OTELLO devices are currently installed across this Cape city

POWER GRID
eThekweni

eThekweni municipality currently employs 38 VectoIIIs

INDUSTRY
BMW Rosslyn

BMW utilised OTELLO' Investigate to solve key factory problems.

INDUSTRY
Consol Glass

Consol Glass has 8 units across two industry sites.

MINING
Anglo American

AA's mining operations employs multiple units to monitor PQ.

MINING
Mutanda Mine

Mutanda Mine in DRC uses OTELLO extensively

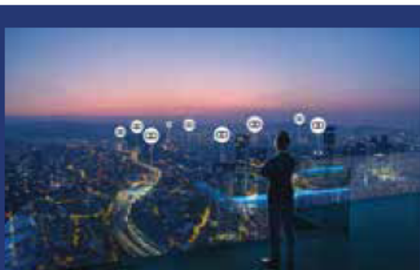
OTELLO's mobile investigation kit provides a comprehensive set of tools for in-depth power performance analysis, in a single hard-case box.

CAPABILITIES

Innovation out of the box

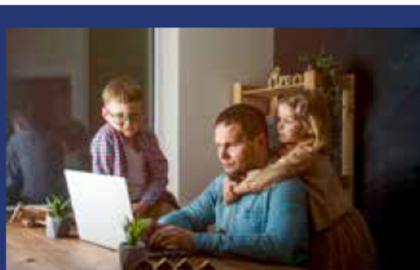
Event notifications in real time

Be aware the moment anomalies exceed preset benchmarks



Comprehensive, consolidated data

Share grid data from one source across the organisation



Remote grid-wide diagnostics

Edge computing within the grid provides remote management capability

Synchronised 100ns data streams

Easily pinpoint and compare power anywhere on the power grid.

Automated compliance reporting

Automate reports to your specific requirements & export to your inbox.

Billing validation & repudation

Compare consumption against all other power parameters.

COLLABORATION

CT Lab is teaming up with partners, investors &