

The Inverse Times

Tesla Consultants

Specialist Consultants to the Electric Power Industry



October 2020

In this Issue

- 1** - From our General Manager
- Connecting Battery Storage Systems

- 2** - New Tesla Wellington Office
- Retirement
- Marking another employee milestone

- 3** - Large Windfarm Connection to the Grid
- Reducing our Environmental Impact

- 4** - Riding through the additional load – An SPS Story
- New additions to the team

- 5** - Soil Resistivity Testing
- Protection Services over an IP Network

- 6** - On-Line Technician Skills Training
- Geothermal Development

- 7** - Fault current v conductor size v conductor temp

- 8** - Upgrading a vital supply
- Board of Directors
- Contact us



Sean Lewis

From our General Manager

We're now four months into the role as Tesla's General Manager and I'm really enjoying the challenges and opportunities being put to me as part of the position. It is such a privilege to be leading the Tesla team and to be part of organisation that delivers high quality engineering consultancy to the New Zealand electricity supply industry.

Since our June newsletter, Tesla has continued to grow. We are now sitting at just over 50 staff, of which 45 relate directly to the provision of engineering consultancy services. This growth in our staff and the projected future growth has necessitated the need for larger office spaces in Auckland and Wellington. It has also meant investing in our future, with a renewed focus around coaching and training of Tesla's junior and intermediate engineers and draughtspersons.

Alan Wallace continues to support the Tesla business in his new role as the Business Development Manager. This is quite an important role for Tesla, with key responsibilities including maintaining Client relationships and the marketing of Tesla's ever-growing capability. It is great having Alan's many years of engineering consultancy and business experience close at hand, and to be able to use his expertise.

If you see anything in this newsletter you would like to discuss further, please drop me an email at sean.lewis@tesla.co.nz, call me on 021 345 300, or contact any of our staff directly.

Connecting Battery Storage Systems

The number of grid-sized Battery Energy Storage Systems (BESS) in New Zealand is continuing to grow. Tesla has been involved in different aspects of the design and commissioning of BESS units across several clients. These tasks have ranged from control system integration through physical design engineering to protection aspects.

One recent project was for a major client who was installing a BESS as load support adjacent to a new substation. For this site Tesla carried out a detailed review of the connection of the BESS to the substation, ensuring correct

integration of the BESS protection and control settings with the substation settings. Tesla's design included new protection settings and SCADA mapping information for the client's control system.

IEC61850 MMS functionality was used for SCADA communications between the substation incomer breakers and switches, and the battery system.

The BESS was commissioned by our client with no issues.

For further information contact David Harris david.harris@tesla.co.nz



Battery Energy Storage System

New Tesla Wellington Office

Our Wellington office has relocated from Boulcott Street to a bright and cheerful new spot on the 5th floor at 15 Murphy Street. The new office provides a more modern space with excellent facilities, more space for our expanding team, and a great staff environment with panoramic views across Thorndon and the harbour.

An important inclusion was a table tennis and darts area, where we can enjoy some team time, and exercise their competitive traits.

Tesla has operated a Wellington office for 15 years, and we are proud to serve both local and nation-wide clients from this growing team of cross-subject experts. Tesla's services are well distributed throughout New Zealand, from our CBD offices in Auckland, Hamilton, Wellington and Christchurch with regional offices in Warkworth, New Plymouth and Nelson.

For further details contact Tim Crawley tim.crawley@tesla.co.nz



Retirement

It was with mixed feelings we marked the retirement of Judy Love on 24th September. Judy joined us on 20th September 2010 and has completed 10 years with Tesla, providing reliable and accurate specialist draughting services for key clients. Judy originally joined us part time after completing a lengthy draughting career within the NZPO and with other participants in the Electricity Industry. Judy's friendly smile and willingness to help newcomers will be missed at Tesla. We wish Judy well with her well deserved retirement.



Marking another employee milestone

Kevin Corbin joined Tesla in 1995. His outstanding service to the company was recently celebrated with the presentation of a 25 Year Service Certificate in September. Kevin is responsible for running our accounts and payroll and joins a group of four current "quarter century" members of the Tesla team.



Large Windfarm Connection to the Grid

Tesla has assisted Transpower with investigation and design services for connection of a large windfarm to Waverley Substation. The Waipipi Windfarm will generate a total of 133MW from 31 turbines when complete, requiring significant development at Waverley.

Tesla carried out a comprehensive wide area protection study, reviewing the adequacy of existing protection schemes to handle the new type of wind turbine generators, and proposing the required changes that would be needed to accept this significant generation injection.

Our substations team then moved into design phase for the primary and secondary systems work required at this site. This included expanding the substation by an additional bay and fitting new secondary systems equipment.

Overall, new protection equipment was installed at 6 transmission line ends, modifications carried out on 6 further transmission line ends, 3 bus protection upgrades, an anti-islanding scheme and an overload SPS were needed. These design works were spread across 6 substations in total.

Additional tasks included feeder

protection setting changes for the connected distribution company, and the production of 3D drawings for consenting applications. Tesla also reviewed the impact of new radio comms links at the substation planned by the windfarm owner, including providing an EMR assessment required for consenting authorities.

A special aspect of this project was the inclusion of design for the deployment of the Transpower Mobile Substation, to allow construction works to proceed without multiple customer outages. The deployment of this truck-mounted substation is a specialist task, and for each substation, site designs including layouts, interconnections and SCADA details are required.

The mobile substation is in place and construction and commissioning of the works at Waverley plus the adjacent line-end substation is under way, with progressive commissioning scheduled in stages over the next 6 months.

The Tesla team included Matt Hall leading the primary works, David Newlands leading the protection works, Geoff Torr leading the secondary works and Garry Rodgers leading the comms work. For further information contact Matt Hall at matthew.hall@tesla.co.nz



Mobile Sub. Photo supplied by Electronet



Transpower Mobile Sub. Photo supplied by Transpower



Waverley Substation

Reducing our Environmental Impact

Tesla is committed to developing initiatives to reduce our impact on the environment. We have recently formed an action group of staff who are tasked with assessing our current environmental footprint, and bringing forward initiatives in this area.

One opportunity we took up last year has progressed well. When we needed more space for our Christchurch Team in early 2019, we were very pleased to have had the opportunity to take up a sub-lease and share a building with Lumen in Hazeldean Road. Tesla have worked closely with Lumen (formerly LineTech) on projects for many years, so cooperating with building space in Christchurch was an easy step.

A feature of the building fit-out was a new 10kW set of solar panels on the

roof. This has provided 13,200 kWh in the first year of operation, of which 84% was used directly by Lumen and ourselves within the building, and 2,500 kWh (16%) was exported back into the

grid. The installation has produced a 20% rate of return, while reducing the building's carbon emissions by just over 1 tonne – an excellent outcome on two fronts.



Riding through the additional load – An SPS Story



Maik testing the SPS

Our client's substation has two transformers that are loaded close to their n-1 load limit, however an industrial customer was planning to connect a large load that exceeds this limit.

The obvious solution of installing new transformers with higher ratings has a very high cost and long lead-time.

Tesla was engaged to carry out a detailed investigation, then design a Special Protection Scheme (SPS) that

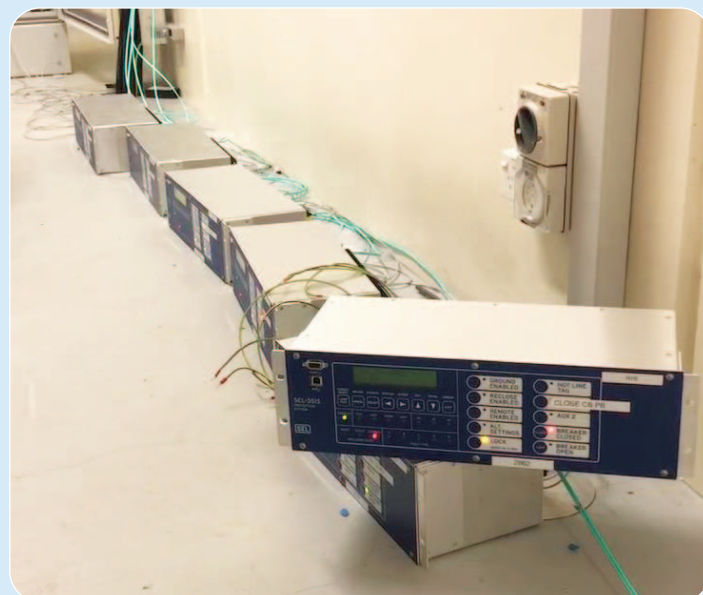
uses smart features of modern devices to allow the large load to be carried when both transformers are in service. The scheme provides automatic overload protection for the transformers through a feeder load shedding scheme involving communication between transformer and feeder protection.

The SPS design was encompassed within a scheduled transformer protection replacement project, and aligned with an RTU replacement, further widening the scope of the design works.

The new scheme was comprehensively tested in a simulation facility to prove all the required scenarios were covered, and that safe operation was maintained through any failure mode of the equipment.

The scheme passed its simulation tests, and was installed successfully. This has deferred significant immediate expenditure, and allows our client's customer time to consider other ways to manage the load increase in this area.

Tesla's project team was lead by David Collins, with Maik Ufferhardt and Bevan Cooper. For further information contact David at david.collins@tesla.co.nz



Relays set out for the lab test.

New additions to the team

Marina Smith joined Tesla as a Protection Engineer in June with 19 years' experience in the New Zealand Industry including extensive experience across Utilities and Engineering Consultancies. Marina is currently working on Tesla protection designs for both Transmission and Distribution clients.



Marina has a special interest in renewable energy, having worked on protection projects for wind and solar energy, and is based in Tesla's Wellington Office.

Alex Wood joined Tesla in June as a Junior Draughtsperson in our Hamilton Office. Alex recently completed an electrical apprenticeship and holds an electrical registration so has a very useful high degree of site work knowledge.



In 2017 Alex was awarded the High-Performance Sport New Zealand Prime Ministers Scholarship for his achievements in Javelin, which is assisting him with his study towards a Bachelor's Degree in Engineering Technology (Mechatronics).

Dhiren Panchani joined Tesla in July as a Junior Draughtsperson in our Hamilton Office also. Dhiren is currently completing his Bachelor's Degree in Electrical Engineering Technology (Power) and was recently awarded the Top Student Bachelor Award for Engineering Technology (Electrical) by the Waikato Institute of Technology.



Camden Sutherland joined Tesla in September to provide internal IT support and software development within Tesla's widely distributed company. Cam has a Bachelor's Degree in Computing and Mathematical Sciences, and significant experience in IT Support within the public sector. One of Cam's roles is to formalise the development, documentation and support of specialised scripting and code prepared by Tesla's wide-ranging team of highly technical engineers. This will further strengthen Tesla's ability to provide unique services across the full range of client requirements.



Soil Resistivity Testing

Tesla has recently added a ground resistivity test kit to our tools, to facilitate testing as part of earthing design. With this test set we are able to measure many parameters:

- Ground Resistance with 2 clamps (no auxiliary rods required)
- Ground Resistance (3-Pole or 4-Pole)
- Bond / Connection Resistance (2-Pole and 4-Pole Kelvin sensing)
- Ground Coupling Resistance
- Selective Ground Resistance
- Soil Resistivity (Wenner or Schlumberger method)

Using this test kit and our specialist's comprehensive range of modelling software enables us to produce complex earthing designs for a wide variety of clients. Whether it is an earthing design for a new substation, a new compound or generation facilities in remote locations subject to hazardous environments, we can identify and solve technical problems. Our team thrives on technical challenges and gains satisfaction out of delivering comprehensive designs in

a professional and timely manner. No job is too big, too small or too complicated.

Carrying out this on-site testing further develops our "one stop shop" strategy for all categories of engineering design in the New Zealand power industry. Earthing design is a critical factor for works in any distribution, transmission or generation facility. This new soil resistivity kit enables us to provide this wider range of quality engineering services to all our existing and potential clients.



Protection Services over an IP Network

For some years Tesla has been providing design and support services to several Geothermal Power stations, including Eastland Generation's TAOM and GDL plants in Kawerau.

As part of a new development, protection communication services over diverse routes were required for the sub-transmission lines to the nearby Kawerau Substation and Pulp & Paper Mill. One communications route is over a fibre optic cable, the other route including a mix of fibre cable and a new IP (Internet Protocol) microwave radio link.

Tesla has developed designs for carrying protection services over IP on a number of occasions using different products, and in this case the SEL ICON multiplexer product was selected.

Operating protection comms over any communications bearer requires more stringent performance than is typically

needed for an all-IP service. Factors such as reliability, stability and latency all impact on the performance of protection services.

As part of the design and deployment process, Tesla specified and oversaw a series of comprehensive tests with the complete comms network set out in a test facility, as a full simulation of the final real-world arrangement. This included the selected NEC iPASO microwave radio equipment and the SEL ICON multiplexer, testing both the performance and the redundancy functionality between the radio and fibre paths. Tesla's responsibility included the liaison of the multiple parties involved, and detailing the tests to be carried out. The bench tests first used precision test analysers, then the actual protection devices over the actual radio equipment and fibre connection.



Redundant power supplies were also tested, confirming operation during all defined equipment failure modes and combinations.

The bench tests were carried out by BroadSpectrum technicians in their depot with Tesla's specialist engineers Gary Middlemiss and Reece Peters advising, and the results were reviewed in detail before the equipment was moved to site for installation and re-testing in service.

The specific requirements

for each protection communications service is often different, but the outcome of this project is confidence in another product that successfully provides this service over a typical IP bearer.

For this implementation the SEL ICON multiplexers carry traffic for control systems, ICCP and business WAN's along with the protection services, all across the same IP bearers.

For further information contact Gary Middlemiss gary.middlemiss@tesla.co.nz



On-Line Technician Skills Training

Tesla has been supporting a large client with delivering a training programme for commissioning and maintenance technicians. Maik Ufferhardt of Tesla's Wellington office has lengthy experience both in hands-on field work, and as a specialist design engineer so is well placed to provide a broad range of expert inputs to this task.

Most New Zealand organisations either train up future technicians “on the job” or recruit from overseas. A large share of both the national and the international workforce will retire in the next 10 years, so it is now crucial to build up expertise and training locally.

A significant part of the training is provided in e-learning modules which allow students to learn at their own pace and apply knowledge in the field.

Some of the training modules under development are

- Power Technician Fundamentals (entry module for every student to learn about the NZ power system, fundamental protection principles, legislation, etc.)
- Circuit Breakers and DC Systems
- SCADA Systems
- HV Insulation
- Generic protection schemes

- Line protection schemes
- Transformer protection schemes
- Busbar and CB Fail Protection schemes



The training programme is put together by Instructional Designers. Maik provides his expertise to the designers to create the content of new e-learning modules and block courses, and this support could easily be applied across other industry participants.

For further information contact Maik at maik.ufferhardt@tesla.co.nz

Geothermal Development

Tesla provides a wide variety of services to the Geothermal Generation Industry throughout the North Island. This part of our industry is always under modification as Geothermal reservoirs change significantly over time. Projects range from major multi-million-dollar new developments to smaller efficiency upgrades and the connection of additional bores. For this type of project our client will vary from the power station owner, to the major equipment vendor or experienced installation contractors.

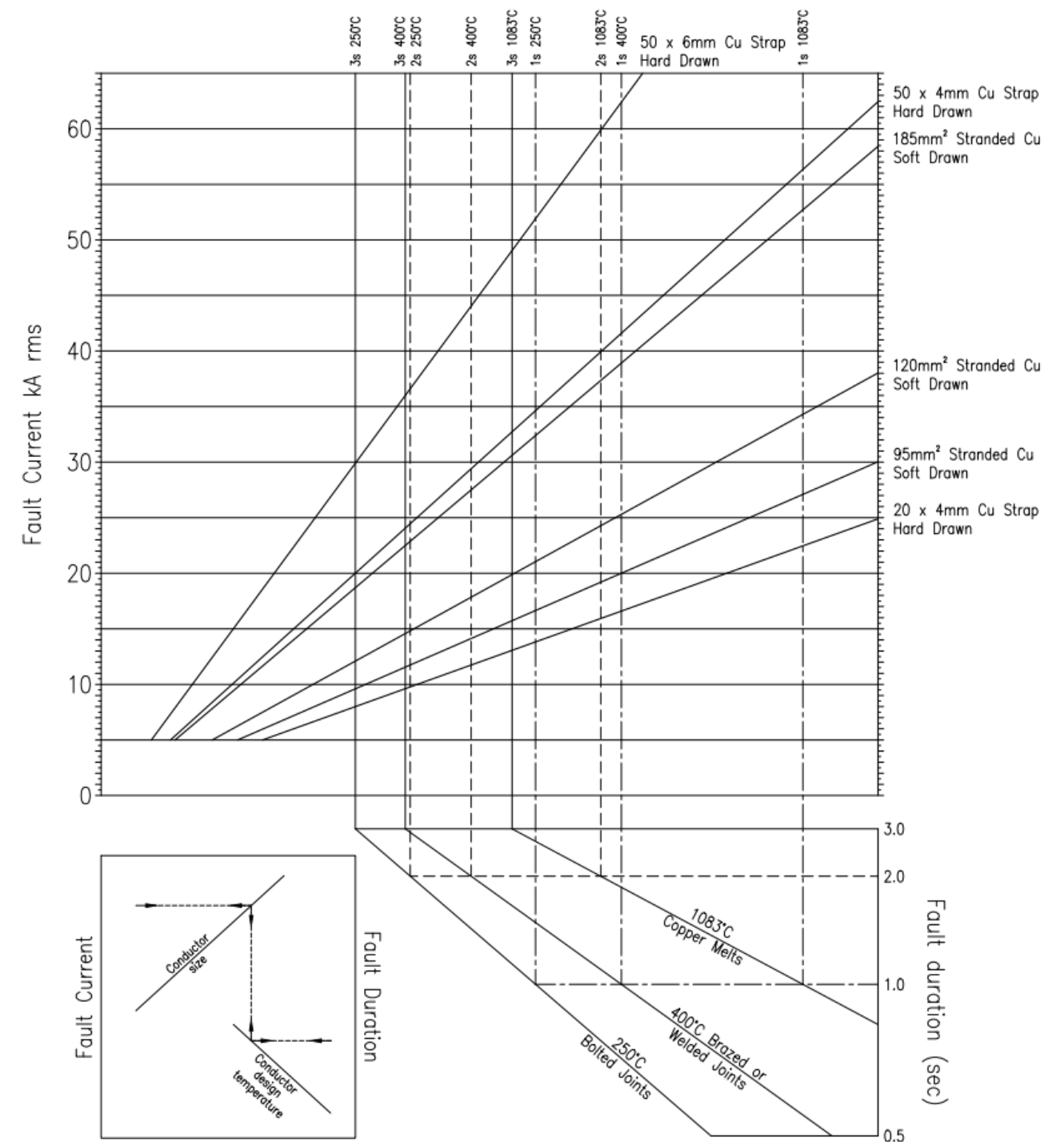
In a recent project Tesla provided the design for all electrical services and control and instrumentation for a new heat exchanger and booster pump installation at a large Geothermal power station. These exchangers extract heat from the geothermal fluid to operate generators, and significant pressure and temperature monitoring is required for safety and optimum performance. Tesla's team has worked in this field for over 15 years and holds significant knowledge of the Geothermal process, coupled with the sound Electrical and Control & Instrumentation design experience needed to provide these engineering services. For further information contact Mark Mullins mark.mullins@tesla.co.nz



Typical geothermal installation.

Graph Relating Fault Current, fault Duration, Conductor Size and Conductor Temperature

Indicative Only - Dependent on Copper Conductor Composition



Method of using the graph

Typical Conductor Current Rating (kA)						
Fault Duration (sec)	1		2		3	
Max Conductor Temp (°C)	250	400	250	400	250	400
20mm x 4mm Cu Strap (Hard Drawn)	13.8	16.6	9.8	11.8	8.0	9.6
50mm x 4mm Cu Strap (Hard Drawn)	34.6	41.6	24.4	29.4	20.0	24.0
50mm x 6mm Cu Strap (Hard Drawn)	51.9	62.4	36.7	44.1	29.9	36.0
95mm ² Stranded Cu (Soft Drawn)	16.6	20.0	11.8	14.1	9.6	11.5
120mm ² Stranded Cu (Soft Drawn)	21.0	25.3	14.9	17.9	12.1	14.6
185mm ² Stranded Cu (Soft Drawn)	32.5	38.9	22.9	27.5	18.7	22.5

Phone: 07 834 6475 | **Email:** enquiries@tesla.co.nz | **Address:** 18 Von Tempsky St, Hamilton



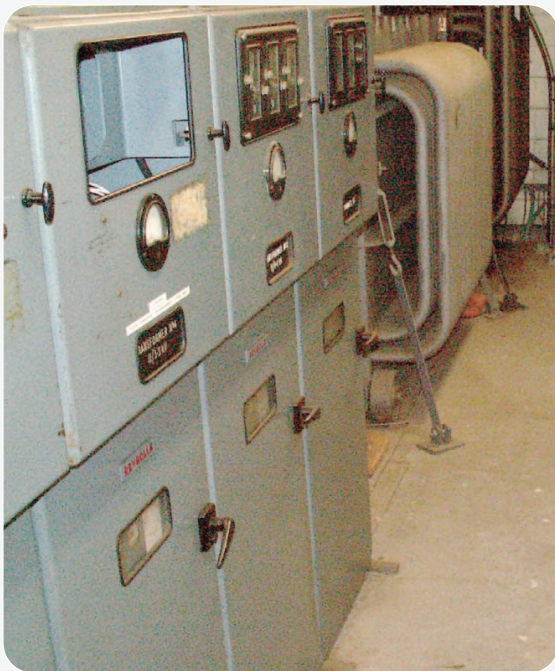
Upgrading a vital supply

As part of site developments at a major New Zealand port, Tesla was engaged to design the changes required to interface between the local Distribution Company's 11kV switchboard and power transformers, and the customer's new 3.3 kV feeder switchboard. The new 3.3 kV switchgear will supply vital large shipping container lift cranes, so any site visits and work on site need to be arranged around a busy shipping schedule.

The design for this older style substation included new DC supplies, increased switchboard monitoring, a new RTU and increased SCADA monitoring plus upgraded protection including an intertripping scheme between the existing 11kV switchboard and the new 3.3 kV switchboard. The project involved key members of Tesla Substation team including Tim Crawley and Jonny Lung, with Protection design by Chris O'Halloran.

The physical design is nearing completion, and protection settings are under way for an expected commissioning early next year.

For further information on these services contact Tim at tim.crawley@tesla.co.nz



Substation before the upgrade.

Board of Directors



Sean Lewis

General Manager

☎ 021 345 300

Email: sean.lewis@tesla.co.nz



Geoff Torr

Board Chair/Consulting Engineer

☎ 027 436 9657

Email: geoff.torr@tesla.co.nz



Tim Crawley

Consulting Engineer

☎ 027 565 1236

Email: tim.crawley@tesla.co.nz



Mark Mullins

Consulting Engineer

☎ 021 448 205

Email: mark.mullins@tesla.co.nz



Matthew Hall

Consulting Engineer

☎ 021 285 5504

Email: matthew.hall@tesla.co.nz

Contact us

Hamilton

Phone: 07 834 6460

Email: hamilton@tesla.co.nz

Address: 18 Von Tempsky St,
Hamilton East

Auckland

Phone: 09 953 3557

Email: auckland@tesla.co.nz

Address: Building 10, Central Park,
666 Great South Rd,
Penrose

Wellington

Phone: 04 831 1287

Email: wellington@tesla.co.nz

Address: 15 Murphy Street,
Thorndon.

Christchurch

Phone: 03 595 6606

Email: christchurch@tesla.co.nz

Address: 210 Hazeldean Road,
Sydenham.

Web: www.tesla.co.nz | **Facebook:** facebook.com/teslaconsultants | **LinkedIn:** linkedin.com/company/tesla-consultants

