# Executive Summaries

**2011-2012 Bursary Vacation Placements in Tasmania**

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STUDENT: Andrew Koolhof (UTas)
COMPANY: Hydro Tasmania

My summer vacation placement was undertaken at Hydro Tasmania, Australia’s largest renewable energy generator and the key electricity provider for Tasmania. While working at Hydro I was positioned within the Asset Performance Assurance team, which is part of the Technical and Operations division of Hydro Tasmania. The team’s broad outline is to carry out any testing/commissioning which is required on Hydro Tasmania assets after key work and refurbishment has been carried out.

To begin with I participated in the numerous inductions, safety briefings, and trainings which are part of working for a large company in a field oriented position. I then had the opportunity to go out on site and have a hand in the testing of various pieces of electrical equipment at both the Reece and Tribute power stations. There I had the opportunity to see Hydro stations both when fully operational and when going through a period of outage and refurbishment.

I then went on to build a database of information about each of Hydro’s machines. This involved finding and analysing a wide variety of engineering drawings for specific pieces of data, such as a machine’s MW rating and the areas of various servomotors integral to the machine’s function.

My involvement with the planned re-commissioning of Tungatinah M/C5 showed me just how susceptible to change and delays large projects can be. I saw how relatively small events can have a flow on effect to numerous different components of the company. It was also valuable to spend time up at the Wilmot outage on several different occasions and feel that I had had a meaningful involvement, interacting with the personnel up there over a period of time. I also participated in a number of smaller pieces of design and analysis work which I found most rewarding.

During my work placement at Hydro Tasmania I have had the opportunity to work in an experienced, enthusiastic and dynamic team of individuals. Working there has given me a much clearer idea of the roles, tasks and workload which engineers carry out on a day to day basis as well as the large variety of work which can occur. I have seen the level of complexity which can arise when large projects are underway and gained some understanding of the flow on effects which occur when there are problems and delays.

My time at Hydro Tasmania was highly varied and exciting, with an extensive but balanced array of work onsite in the field as well in the office. I would like to thank Hydro Tasmania for the providing me with such an exciting vacation placement and the Australian Power Institute for their support throughout my engineering degree.
This report is a summary of my vacation work placement being an Australian Power Institute Bursary recipient. From December 2010 to February 2011, after the completion of my second year at university, I spent twelve weeks at Transend Networks where I worked in the Protection and Control team in the Engineering and Asset Services group.

I am grateful for another opportunity to work in the industry and to learn about the protection and control of an electrical transmission network. During my twelve weeks of placement I was given the opportunity to visit some transmission substations where various works were being carried out.

Transend Networks, owned by the Tasmanian Government, is Tasmania’s electrical transmitter. Transend delivers energy from generating plants to a number of large industrial plants in Tasmania and also to the state’s electrical distribution network.

During my time at Transend I was in the Protection and Control team. The team is responsible for the control systems used to operate the network and the protection of network assets during electrical fault conditions. My work involved updating lists of information about the configuration of SCADA points. When I found errors in the information about a SCADA point I had to trace the origin of the point through several RTUs and drawings to determine the correct information. Additionally, I observed factory acceptance testing of new transformer protection panels - injecting test currents into the device while monitoring the relay outputs and SCADA signals - recently installed in the new Kingston substation. At Kingston, two new 110/33 kV transformers were being installed next to the existing two 110/11 kV transformers, a new 33 kV switch house had been constructed and extensive reconfiguration of the 110 kV switchyard was taking place.

I would like to thank my supervisor, Transend Networks and the Australian Power Institute for the opportunity to experience work in the industry.
I spent 2011 studying abroad at The University of Texas at Austin (UT Austin), USA. During my stay in Austin I joined the UT Satellite Laboratory and spent eight months working on the thruster of the 3U CUBESat being developed there. The satellite, classed as a 'nanosatellite', had dimensions 100mm X 100mm X 300mm and was being designed to fly two missions in late 2012 and early 2013. The missions, financed by NASA and the US military respectively would be used to evaluate the functionality of the satellite in preparation for a mass-producible version. The NASA mission dubbed ‘Bevo 2’ would carry a star tracking camera, GPS and space debris detector to map the density of space debris in Low Earth Orbit (LEO). The satellite and mission development had been in progress for about 12 months when I arrived, most of the mission requirements had been set out and one prototype thruster had already been constructed. The project was run exclusively by undergraduate and post graduate students. A total of 35 electrical, aerospace, mechatronics and mechanical engineering students worked on the project; myself and two aerospace engineering students being assigned to the thruster. The aim of the project was to produce a small, cheap orbital platform with a chamber to carry a variable payload (depending on the satellite’s intended function). This highly versatile satellite would be able to manoeuvre in space, dock with other satellites and, if need be, execute a controlled re-entry. All parts used on the satellite which were not produced by the team were built to US Military specifications.

The thruster we were developing was classed as a 'Cold Gas Monopropellant Thruster', meaning it produced thrust by expelling a gas at relatively cool temperatures (~60°C). This technology is not new; it has been around for over ten years and is considered a standard method for propelling nanosatellites. The satellite being developed was designed to fit into a NASA PEAPOD deployment system. It had to weigh less than 3.4kg and contain no materials or pressure vessels which could constitute a threat to the launch vehicle in a contingency event. To meet these specifications and make the satellite light the thruster was produced using Plastic Stereolithography (SLA) from Solidworks models. This option was also selected because the finished product was relatively cheap and much more resistant to fatigue caused by high temperature gradients experienced in orbit. The only parts which were added to the SLA mold were three inline LEE Company space rated solenoid valves, which were mounted using a screw plate and O-ring seal technique designed by the
thruster team to create a dynamic seal capable of handling extreme thermodynamic expansion.

I primarily worked on developing a method for inserting temperature probes into the thruster’s pressure vessels, selecting valves and designing the plastic mold. Three new prototypes were built and tested before a viable product was produced.

This project was very rewarding as it gave me the opportunity to experience the design process from concept to prototype and testing. It was very challenging at times to work with the many quality control and design specifications set out by the team, NASA and the US military. I found myself facing a mental wall when putting my name to a design and submitting it for construction for the first time. This project helped me develop my ability to work independently and make choices based on engineering principles and standards.

I would like to thank Professor Michael Negnevitsky for his tireless effort and support of the API program and the guidance he has offered me personally. I would also like to thank the API for giving me the opportunity to build the industry experiences vital to completing my degree and a competent and well-rounded graduate engineer.
My name is Sophiya Patel and I am a recipient of the Australian Power Institute Bursary. I am currently in my third year of engineering at University of Tasmania. Over my recent summer holidays, I was given the opportunity to work at Transend, as a vacation student, for three and a half weeks from the 9th of January to the 1st of February 2012. Transend is a company that ensures that the transmission networks setup around Tasmania, are safe and secure to transport high voltage electricity from the generators to the distributor. I was assigned to the Grid Innovation Team of Transend and the main objective of this group was to look into further development and promote Transend’s Grid Vision 2040 plan. They were also required to update the plans to provide long-term views on the transmission network development in Tasmania.

As part of this team, I was given a small research project regarding smart meters and their potential as well as the possible effect that electric vehicles could have on the Tasmanian Grid. By researching this topic, I was able to learn a lot more than just about electric vehicles and how they work. I had to look into how electricity is dealt with in real life and how the AEMO, Australian Energy Market Operator functions and as well as how it procures FCAS (Frequency Control Ancillary Services) in order to maintain the frequency across the grid within standards, if some event occurs (such as a loss of a large generator).

By performing this preliminary research on electric vehicles I was able to look into the vast opportunities available for utilising electric vehicles and how it would benefit not only the users but also utilities, by combining it with the smart metering system. But with current lack of competition in electric vehicle production and the lack of demand of electric vehicles due to their high price, they may not be implemented any time soon. But with constant research and development it may be feasible as a long-term plan. This topic is very relevant to the grid innovation team, as in the near future (maybe after a decade) electric vehicles will be implemented more, especially considering rising fuel prices. With this research completed, I was required to write a report and as well as give a presentation regarding my findings.

Working at Transend gave me the opportunity to meet and interact with new people, and build up my network with industry people. It also gave me an insight into how things actually work in the industry and how different it is from university. The basic principles are the same but the applications can be quite different. I also got the
chance to visit some substations like the Risdon and Chapel Street, as well as the Liapootah power station. By visiting these sites, I learnt about how the electricity is transferred and the types of protection schemes present and how they all function (e.g. the isolators, circuit breakers, etc).

Overall this vacation work had been a very enjoyable and valuable experience, even though it was quite short. I would like to thank the Grid Innovation Team at Transend for sharing their vast wealth of information with me and for accepting me at the workplace. I would also like to thank the Australian Power Institute and Professor Michael Negnevitsky for their support and giving the opportunity to explore the power industry via vacation employment.
My name is Stuart Ednie; I am an Australian Power Institute Bursary recipient. From January 2012 to February 2012, after the completion of my second year at the University of Tasmania, I spent six weeks at Transend Networks where I worked in the Protection and Control team in the Engineering and Asset Services group.

I really enjoyed working in such an active and rapidly growing industry, Transend has a real buzz concerning daily operations and for office work there was rarely a dull moment. Examples of this included a loss of a transformer at Farrel, a bus outage at Sorrell, and the loss of several 11kV feeders into Nyrstar.

Transend is the only power transmission company in Tasmania, and as such are responsible for all the related infrastructure. This includes the Trans-lines themselves, the transformers and (most importantly for P&C) all EHV and HV feeder switchgear. Transends job is to provide a safe, secure and reliable transmission system to transport high-voltage electricity from generators to the distributor and some major industrial customers.

At Transend I was working in protection and control who are responsible for the acquisition and maintenance of secondary assets insider our substations. These include relays, feeder breakers, SCADA as well as metering and monitoring equipment. The first task I was assigned was the point to point checking of cabling for the new Kingston 33kV bus. This involved cross checking a list of cable connections with the actual wiring diagrams for the substation to confirm that things will actually work. While this sounds (and sometimes was) mind-numbing the process taught me a lot about generally how the innards of subs are hooked up. Which in turn left me prepared for my next task, settings.

All of the circuit breakers transcend uses are controlled by an external relay and in order to determine if a trip is warranted the relay will gather data from a variety of sources (current and voltage transformers) then perform the necessary action based on its programming. The task of programming comes to P&C. Now while in the case of Kingston the relay settings were out contracted to Alstom consulting, the finial ok and implementation is given by Transend, so I was tasked with looking over the reports sent to us from Alstom and deciding if there were any issues. Most of the settings I looked at were for the P543 distance protection relay, this involved big impressive words like “forward reactive reach”.

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The learning curve on understanding how modern electrical protection works was steep, and very little of that knowledge was taught in a lecture theater, so I learned a lot on the job. It's amazing just how complicated the systems have become since the days of mechanical contacts - relays are now basically giant microcontrollers that are fully programmable, with very little of their functions being implemented in hardware.

I really enjoyed my time at transend. It was a terrific place to work with excellent people to work with and everyone there is passionate about what they do. I had the opportunity to attend many site visits, including George town, St Leonards as well as various others. I look forward to being able to work there again next summer.
During summer, at the start of 2012, I had the privilege of five weeks of work placement at Transend, the owner and operator of the electricity transmission system in Tasmania. As part of this placement I had the opportunity to visit many sites around the state and view the ongoing maintenance and upgrade work happening to many of the system assets. Some examples of these projects are briefly outlined below.

During my first three weeks at Transend I spent some of my time learning about protection and control systems, testing new and old relays and determining a variety of relay settings for different protection schemes. Other tests conducted included Current Transformer (CT) and Voltage Transformer (VT) winding accuracy tests. The VT’s that were tested have two cores; one used for protection systems and the other used for metering. The main parameter of interest is the accuracy of the metering core. To test this we use the Omicron test set to inject the nominal voltages and currents into the primary coil and measure the secondary response for a given burden or power factor. The minimum required accuracy prescribed by the regulatory legislation is 0.5%. All VT’s that we tested were well within this accuracy level (averaging around 0.11%). The only discrepancies occurred when we tested at burden levels above 300% of their normal operating range.

Another significant task that I undertook at Transend was cost estimating of projects and proposals. The purpose of these project estimates is to provide a forecast of costs to a sufficiently reliable level for options analysis, planning decisions and project prioritization. They are created at three levels of identifiable uncertainty appropriate to the level of completed project definition documentation. The estimates help in the preparation of regional development plans, revenue proposals, annual planning reports and business cases for generators or directly connected customers.

The main project that I worked to create estimates for was a transmission security upgrade/development for the Queenstown area on the west coast. This area has a hydro pumping station connected as a direct customer through a substation at Lake Newton and other mining customers directly connected at Queenstown.

There were four options proposed for the security upgrade, so to begin creating these estimates I first worked through the Project Definitions for each of the proposal options with the Project Services Manager. We identified project objectives and desired outcomes. We looked at one line diagrams of the circuits, aerial photos of the existing structures and substations, transmission line route maps, a geospatial map of the area,
and reviewed the proposals. This helped to understand each proposal better to get a more accurate picture of the components involved and even come up with better and more appropriate solutions than those proposed.

The basic idea of these project options is to improve the supply security by providing a second supply to Queenstown/Newton at 110KV or 220KV. All of the different options involved the installation of new transformers, bays and towers in one configuration or another. An extension of the substation yard would be required and extra towers would be needed to tie into the existing 220KV transmission line. Relocating of existing 22KV feeders was considered and extra land may have to be acquired.

I was able to develop complete level one estimates for four different options which contain pricing for the general system components and standard upgrade/development requirements. This also accounted for other factors which affect the cost such as; locality, weather, staging factor, terrain, demolition, existing structures, soil geology and so forth. Other estimate components include contingency allowance, escalation and estimate shelf life. Once my estimates were completed I worked with the Project Services Manager to review them before handover to the estimate initiator.

For my next task at Transend I worked through the process of managing a project from start to finish. The project that I was to create a management plan for was conveniently the Queenstown/Newton security upgrade for which I had previously done the cost estimate. This was quite convenient. The initiation and development stages are based upon standard project preliminary schedule procedure within Transend and I was able to use similar examples to construct an overview for these stages. The implementation stage is more unique to each particular project so this was where I was able to go into the fine details of each step.

Overall I learnt a lot from my vacation work and would like to thank Transend Networks and the API for the opportunity and look forward to further experience in the future.