28th August 2009

Mr Simon Bartlett
Chairperson
E S Cornwall Scholarship Advisory Committee
P O Box 1193
Virginia QLD 4014

Dear Mr Bartlett

E S Cornwall Memorial Scholar – Aidan Roberts
Third Quarterly Report

Please find enclosed the third quarterly report for the E S Cornwall Memorial Scholarship for 2008-2010 which is a requirement set out in the scholarship rules (6).

The points of interest for the quarter are the commencement of second placement with EA Technology Consulting Ltd., IEA ENARD Smart Grids information subtask 1, IEA DSM Task XIX Subtask 3 and my attendance/presentation at the ENARD Annex I Workshop on Communications and Control.

I would welcome the committee's feedback and advice on the report, particularly concerning my proposed goals for the next quarter and placement.

Yours faithfully,

Aidan Roberts

Enclosures: E S Cornwall 2009-10 Quarterly Report 3
Appendix A – Power Utility Communications from an Australian Perspective

1. Introduction

My tenure of the E. S. Cornwall Memorial Scholarship is currently from October 2008 through to October 2010. The purpose of the proposed program is to gain experience in the areas of Smart Networks and Distributed Generation. In particular, I hope to gain an understanding of how these areas will impact and/or enable network operation & planning, energy & demand management, metering and carbon emissions. The proposed program is designed to give me experience with a regulator, a consultancy/research facility, a technology provider and a distribution network operator.

This report is the third of 6 quarterly reports required under the rules of the scholarship. The period of employment reported on is April 20th to July 20th 2009 which covers the first half of a planned 6 month placement.

My current placement is with EA Technology Consulting Limited. The main objective of this placement is to gain exposure to New Energy Technology projects relating to my areas of interest.

2. EA Technology Consulting Limited

General Information

Until recently, EA Technology Limited was a single organisation with multiple divisions. Just prior to my commencement, EA Technology Limited underwent an organisational restructure which resulted in each of previous divisions becoming independent businesses. Although still a part of the EA Technology Limited group, the individual businesses are:

- EA Technology Consulting Limited (EATLC) – Consultancy
- EA Technology International Services and Instruments (ISI) Limited– Asset Management Services & Instrument Development/Sales
- EA Technology Ventures Limited – Innovation Platform
- Blah d blah Limited – Marketing Company

My current placement is with EA Technology Consulting Limited which is a Power Asset Management Consultancy.

EA Technology previously known as the Electricity Council Research Centre and was opened in the mid 1960s. At that time it was responsible for research, development and technological support for the then nationalised Electricity Supply Industry (ESI).

Work Experience

For the duration of my placement in Consulting, I am based with the New Energy Technology (NET) team. The NET team is involved with a number of projects within a wide

range of technology areas. The NET team is not restricted to specific types of work and often tackles any opportunities that do not naturally fit within existing teams. That being said, the primary technology areas are:

Demand Side Management	Field trials
-simulation / modelling -pilots / field trials -device demonstration and validation -IEA DSM	-biomass / condensing boilers -heat pumps / solar thermal -micro-generation (µCHP) -voltage optimisation
Electrical Energy Storage	**Low Carbon Technologies**
-technologies -applications -distributed -benefits and markets	-foresighting studies -laboratory testing -test house trials -due diligence
Electrification of transport	**Network Engineering**
-charging infrastructure -communications -electric vehicles	-distributed generation integration -smart grids -IEA ENARD

EATLC's client base consists of organisations from both the public and private sectors. The NET team carries out work for both government bodies and privately owned organisations. For example, the majority of monitoring trials are run by EATLC on behalf of the Energy Savings Trust (EST). Other government bodies include The Carbon Trust, the Department of Energy and Climate Change (DECC) and the Office of Gas and Electricity Markets (Ofgem). A lot of work is also undertaken on behalf of privately owned UK Energy Suppliers and international Distribution Network Operators (DNOs). The remaining clients include universities, technology developers and manufacturers.

Another area of work is completing Due Diligence reviews. This essentially involves assessing the opportunities and effectiveness of new technologies on behalf of clients, typically Suppliers. Similarly, EATLC also performs Technology Assessments for various government bodies, such as The Carbon Trust. The Carbon Trust provides funding for various low carbon projects. The Carbon Trust receives numerous applications for funding and enlists EATLC to carry out Technology Assessments of the submissions. This work is typically done by a number of teams within EATLC but is largely dependent on the type of project under review. EATLC provides recommendations on whether the application should be granted funding. The Carbon Trust takes these recommendations along with recommendations from other reviews and decides whether the applicants are eligible for funding.

Another major area of work is undertaken through the International Energy Agency (IEA)[1]. The IEA is an intergovernmental organisation which provides energy policy advice to its member countries. The IEA currently has 28 member countries (including Australia) which form the basis for international collaboration on a range of research and data collation activities. The IEA carries out a lot of its work through a series of Energy Technology Agreements or Implementing Agreements (IAs). The NET team is primarily involved with the Demand Side Management (DSM) Programme[2] and Electricity Networks Analysis, Research and Development (ENARD)[3]. The IAs are further broken down into a number of Tasks and Annexes that are focused on particular areas**.** Within each Task/Annex, one of the member countries is nominated as an Operating Agent and is given the responsibility for coordinating the activities within the respective Task/Annex. EA Technology is the Operating Agent for ENARD Annex I and DSM Task XIX.

Each IA has an Executive Committee (ExCo) which oversees the activities of the overall IA and provides guidance for individual Tasks/Annexes. Each member country nominates a representative for the ExCo. The member country also nominates technical experts to carry out information collation and/or research activities. The technical experts also represent the member countries at any respective workshops and conferences.

Most of my work with EATLC to date has been completing tasks on a reimbursable fee basis, in line with EATLC's normal mode of operation. The majority of this work has been completed for ENARD in EATLC's role as Operating Agent for Annex I. Toward the end of the quarter I was also asked to undertake some work for Task XIX of the DSM programme.

IEA ENARD IA Annex I Information Subtask – Smart Grids

The ENARD IA was established in 2006 and initially comprised a single Annex. Annex I provides a forum for member countries to share information on various network issues and also provides a platform for the development of additional Annexes. Since its inception, ENARD has grown to 4 annexes:

- Annex I – Information Collation and Dissemination
- Annex II – Distributed Energy Resources (originally Distributed Generation)
- Annex III – Infrastructure Asset Management
- Annex IV - Transmission

There are provisions within Annex I scope of work for particular information collation activities (Information Subtasks) at the discretion of ExCo. The information subtask on Smart Grids was one such activity requested by the ExCo.

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1 www.iea.org

2 www.ieadsm.org

3 www.iea-enard.org

The scope of the subtask was to determine the current status of Smart Grid developments and trials (see **Error! Reference source not found.**) around the world with particular attention to business models and regulatory frameworks conducive to the development of Smart Grids. The reviewed information was gathered through various conferences and third party publications. Information sources included presentations and articles presented at SmartGrids Europe 2009, CIRED 2009, GridWeek 2008 and a series of ENARD expert workshops.

One of the key findings for me was that the concept of a Smart Grid has evolved over time and will most likely continue to do so. The interpretation of a Smart Grid can differ depending on the stakeholder's perspective, eg. base country, position in the Electricity Supply Value Chain and the product groups (not surprisingly from a manufacturers perspective).

Most of the reviewed publications subscribed to one of two schools of thought – the European Commission's EU TPS or the US Department of Energy's Modern Grid Initiative. In many cases, the publications referred to definitions published by both. These publications tend to describe functionalities or characteristics of a smart grid and are not limited to a particular set of technologies. As a result, the Smart Grid concept tends to encompass both existing and emerging technologies. Some technology areas commonly associated with the Smart Grid include:

- Active Network Management
- Network Automation
- Smart Metering Systems – Automatic Meter Reading (AMR), Automatic Meter Management (AMM) & Automatic Meter Infrastructure (AMI)
- Demand Side Management (DSM)
- Distributed Energy Resources (DER) – Distributed Generation (DG) & Energy Storage
- Asset Management and Dynamic Ratings
- Advanced Components

Regardless of the interpretation of the concept or the types and mixes of technologies employed, it is quite clear that any manifestation of a Smart Grid will require an increase in communications coverage and capacity. It is also almost certain that the level of network sensors and monitoring would also need to increase above what it is typical today. Another requirement will be the development of Standards to ensure the interoperability of multiple technologies and systems.

In the past, the Smart Grid concept has been regarded as a Network issue and in particular a Distribution Network issue. As the idea has evolved, it has been realised that the true Smart Grid at full potential could provide benefits for the entire energy sector and society in general. Although this is will help with the development of the Smart Grid, it also complicates the development of sustainable business models. As there is potential for widespread benefits, the difficulty is in determining how to apportion the costs appropriately. This is particularly difficult when value chains have been separated, as they are in Australia. In

vertically integrated countries such as the US, this is less of an issue. To complicate the matter further, many of the benefits (eg. for energy suppliers and consumers) are based on motivating consumers and/or modifying their behaviour. It is difficult to predict how successful any attempts at this may be. The key benefits of a Smart Grid include:

- Reduced Customer Interruptions
- Reduced Customer Minutes Lost
- Improved Fault Location
- Deferral of Capital Expenditure
- Reduced Operating Expenditure
- Increased Asset Utilisation
- Greater Network Awareness
- Greater control over demand
- Greater Consumption Awareness
- Greater Electricity Consumption / Production control
- Increased Supply Security
- Increased Supply Reliability
- Increased Supply Quality
- Decreased Losses
- Reduce Carbon Dioxide emissions
- Energy Efficiency
- Energy Savings
- Economic Stimulus (New markets & Job creation)

Individual Smart Grid enabled functionalities will naturally be more advantageous to particular stakeholders however in many cases there will also be coincidental gains for multiple stakeholders.

Key drivers for the Smart Grid are not dissimilar from those that underpin the existing grid. The Smart Grid retains the existing desires to achieve efficient, reliable, secure and affordable energy supply; however, it must perform against these measures in a modern and changing society. Market and Supply issues have always been key considerations, whereas Environmental issues, particularly Climate Change, have seen an increase in public and

political attention in recent times. Particularly in Europe, aggressive 20-20-20[4] targets have been partly responsible for this. More recently, the ability for the Smart Grid to provide a platform for economic stimulus has also become a major driver, namely due to the global economic downturn.

Although there are a range of potential benefits and drivers now linked to the Smart Grid, there are still a range of barriers that exist. For example, current regulatory frameworks that reward prudent expenditure and inadvertently discourage the risk prone expenditure required for innovation, research and development. As discussed above, the development of business models is also problematic in some environments. There is also a great deal of uncertainty surrounding policies and legislature particularly regarding energy and climate change.

Despite these barriers, it was still promising to see the level of government support emerging around the world. The prime example of this is the $ 4 billion provided for Smart Grid demonstration projects and matched grants now available in the US under the American Recovery and Reinvestment Act[5]. Similarly, the Australian Government has also provided $100 million for Smart Grid projects under the National Energy Efficiency Initiative[6]. The UKs Low Carbon Transition Plan[7] was released recently by DECC and includes an outline of various UK government initiatives to help promote Smart Grids. Government support of this nature should help to counter some of the risk associated with the Smart Grid and should encourage relevant stakeholders to get involved in technology development and demonstration. The range of projects that are successfully rewarded under these schemes should also help to refine existing definitions of what a Smart Grid is.

My involvement with this task has given me exposure to Smart Grid or Smart Network activities around the world and has also provided me with a broad understanding of some of the key issues, both current and future.

IEA DSM IA Task XIX – Subtask 3 – Delivery Mechanisms for Micro Demand Response and Energy Saving

The IEA Demand Side Management Programme (DSM) was established in 1993 and is aimed at developing and promoting opportunities for DSM. There are currently 18 member countries.

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[4] EU 20-20-20 Targets - 20% cut in emissions (on 1990 levels) and 20% increase in renewables by 2020 (http://ec.europa.eu/environment/climat/climate_action.htm)

[5] http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=111_cong_bills&docid=f:h1enr.pdf

[6] http://www.environment.gov.au/minister/garrett/2009/budmr20090512h.html

[7] http://www.decc.gov.uk/en/content/cms/publications/lc_trans_plan/lc_trans_plan.aspx

EA Technology is the Operating Agent for Task XIX of the DSM IA. The major objective for Task XIX is to define demand response and energy saving products and determine how these can be delivered into the residential and SME markets on a commercial basis. Task XIX is broken down further into a series of Subtasks and I have been asked to help with Subtask 3 which has two major objectives:

- *Define mechanisms for motivating and delivering energy savings by residential and SME customers (disaggregated demand information, TOU pricing, remote switching, Demand Side Bidding and customer interviews etc.)*
- *Define "smart" metering, disaggregated data and control mechanisms for motivating and delivering demand shifting by residential and SME customers (metering, switching, pricing, EUMF)*

Prior to my involvement, the first objective had been largely completed by a NET colleague who was also the UKs nominated DSM Technical Expert. My responsibility is to essentially develop the technical architectures required to deliver the products/mechanisms defined in the first objective. If the next phase of the project is requested, these technical architectures will also be used in the development of business cases for various Demand Response and Energy Saving initiatives.

To date I have liaised with the Operating Agent and the UK Technical expert and have gained approval for my proposed contribution. Obviously, each of the defined Products will need a tailored solution and each solution will have its own functionality requirements. To capture these differences and allow meaningful comparisons, I proposed to separate the solutions into a series of Technical Architecture Components (TACs).

- Controller
- Customer Interface
- Internal Communication
- Communication Gateway
- External Communication

Each solution can also have varying levels of sophistication whilst still performing the same function. Therefore within each of the TACs, I also intend to define a set of scenarios indicative of the levels of sophistication available both now and potentially in the future. I anticipate that this will aid in developing High and Low Cost/Benefit scenarios. The level of sophistication for each solution will be in measured in terms of its ability to deliver the desired demand response.

Other Experience

Consulting Contributions

Although, the majority of my time in the last quarter was spent completing projects exclusively assigned to me, I did have some involvement with a few of my colleague's

projects. Typically, the project work is delivered by the respective technical expert however there are often parts of the project that require collaborative efforts. Given my past experience with a Distribution Network Operator (DNO) and my recent project involvement, I was asked to make varying contributions to the following projects:

- Conference Proceedings for IEA ENARD Annex 1 Workshop on "Communications & Control"
- STP Module 5 - Microgrids
- STP Module 5 – Smart Grids
- Department of Energy & Climate Change (DECC) Tender – Smart Grids

Following, my attendance at the IEA ENARD Annex 1 Workshop on "Communications & Control", in Visby Gotland (see below) I was also asked to write the conference proceedings. This task was the responsibility of EATLC in its role as Operating Agent for Annex I.

The Strategic Technology Programme (STP) was developed by EA Consulting in 1997 and is a collaborative program of technical information, research and development[8]. The program members include Asset Owners, Asset Management organisations and, Asset Operators. The STP is owned by and directed by its members and currently consists of a range of modules focused on particular areas deemed of interest. There have been a range of STP modules over the years however the currently the active modules are:

- Module 2 – Overhead Networks
- Module 3 – Cable Networks
- Module 4 – Substations
- Module 5 – Networks for Distributed Energy Resources

Module 5 of the STP was formerly known as Distributed Generation but has been expanded to include all forms of Distributed Energy Resources. It is a collaborative research programme involving the UK DNOs and EA Technology.

Module 5 recently committed to a project, the final aim of which is a Smart Grid trial on a DNO network. My involvement was to help define "Smart Elements" to be included in the specification, the aim being to purchase equipment rather than enter into development. The trial will assess the costs, benefits and operation of a Smart Grid in the UK.

I also contributed to another STP project on Microgrids as part of Module 5. My task was to review a third party report[9] by SKM developed for the department for Business Enterprise

[8] http://www.eatechnology.com/STP_Home.asp

[9] http://www.skmconsulting.com/Site-Documents/General-Documents/GROWTHSCENARIOSFORUKRENEWABLESGENERATION.pdf

and Regulatory Reform (BERR). The report investigated UK growth scenarios for renewables and the implications for future developments and electricity network operation. My task was to review this report and ascertain any proposed projections for Micro-generation (ie. distributed generation connected at LV). This information was to be used to try and model possible scenarios for the uptake of Microgrids on UK Distribution Networks.

I also had a minor input into a submission for a recent DECC tender on Smart Grids. The tender was for the creation of a vision for the UK Smart Grid and an accompanying road map. My involvement was restricted to providing input to EA Technologies interpretation of the Smart Grid. I also provided a list of important existing Smart Grid publications to be noted in the tender document and reviewed by other contributing consultants.

IEA ENARD Annex 1 Workshop on "Communications & Control", Visby, Gotland, Sweden

Prior to my commencement with EA Technology, I was asked if I would attend an ENARD workshop on "Communications & Control". I was also asked to give a presentation from an ENERGEX and/or Australian perspective. I attended the workshop under the sponsorship of ENERGEX and gave a presentation entitled "Power Utility Communications in the State of Queensland" (see Appendix). I also attended the ExCo meeting as a National Observer on behalf of Energy Networks Australia.

The workshop participants included technical experts from each member country along with ExCo members. The meetings covered three days and included expert presentations, a workshop, the ExCo meeting and a site visit to the world's first HVDC light link ("Gotlight").

My participation in the conference provided an insight into the workings of such international collaborative programs. The expert presentations were all quite interesting and most of them were of particular relevance to my areas of interest. On a personal note, it was also interesting to meet and mix with engineers and other professionals from around the world. Although daunting at first, giving a presentation in that forum and participation in the workshop that followed, was a valuable experience in terms of developing interpersonal skills and confidence in public speaking.

Looking Forward

The major objective of this placement was to gain exposure to my areas of interest through participation in related project work. The projects that I have been involved with to date have contributed toward providing me with this exposure by allowing me to research several areas of interest along with providing tangible outputs for various stakeholders within the Energy Sector.

Throughout the remainder of my placement with Consulting, I hope to continue to gain relevant experience on projects relating to my areas of interest. Therefore my immediate goals are to complete:

- XIX Subtask 3
- STP Project – Smart Metering Next Steps

Time permitting; I also hope to gain some exposure to some of the other areas of work currently undertaken by the NET team, including:

- Distributed Energy Resources
- Electrification of Transport Investigation
- Technology Assessments

My scholarship proposal involved a further two placements with a Technology Provider/ Manufacturer and a DNO. During my scholarship application I had positive correspondence from Landis + Gyr (L+G) and Electricity De France (EDF) Electricity Networks regarding fulfilling these requirements. At present I have not received confirmation of my subsequent placement. Therefore, I will continue in my attempts to secure my placement with L+G and potential opportunities with another Technology Provider/Manufacturer. I have recently had some potential leads with Siemens and ABB. An alternative option is to switch the order of proposed future placements and so I will also continue to pursue this arrangement with EDF and other DNOs, including Scottish & Southern Energy (SSE).