Theerasak (Beer) Opatsuwan
Preston, United Kingdom
E: beer.opatsuwan@outlook.com
LinkedIn: bo033

27 May 2017

Professor Simon Bartlett AM
BE(Hons) BSc FTSE FIE Aust FAICD MIEEE RPEQ CPEng
The University of Queensland, Australia
E.S. Cornwall Scholarship Advisory Committee – Chairperson
Email: simon.bartlett@uq.edu.au

Ref: E.S. Cornwall Scholarship 3rd Quarterly Report period: January to March 2017
Research Theme: Asset Management Excellence

Dear Professor Bartlett,

Please find attached my third scholarship quarterly report covering the period of January to March 2017. The report provides an insight into my work experience at Electricity North West Limited (ENWL), a leading electricity distribution company based in the UK. The report covers the key learning through project works, observations, and interviews with leaders across ENWL.

Specifically, the following work aspects are covered in the report:

- Continue observations on ENWL's innovative business operation and initiatives.
- Resubmission of the restated ENWL's Network Asset Workbook (NAW) to Ofgem.
- Commissioning of the Common Network Asset Indices Methodology (CNAIM) asset intervention software.
- Brief summary of my experience at the European Utility Week 2016.
- Updates on the work of CIGRE working group C1.34 (Asset Management).

I welcome the scholarship committee's feedback on my report and recommendations for the 4th and final quarter of my overseas work placement. On behalf of my family and I, thank you once gain for the committee's continuing support during this exciting period.

Yours sincerely,

Beer Opatsuwan
MIEAust CPEng NER RPEQ IntPE(Aus) BEng(Hons) GradCertEng
E.S. Cornwall Scholar 2016

electricity north west

Bringing energy to your door

University of Queensland, Australia
E.S. Cornwall Memorial Scholarship

Asset Management Excellence
3rd Quarterly Report
January to March 2017

Beer Opatsuwan CPEng

Electrical Engineer

The University of Queensland, Australia

E.S. Cornwall Memorial Scholarship
3rd Quarterly Report
Period: January to March 2017
Research topic: Asset Management Excellence

Prepared By

Theerasak "Beer" Opatsuwan
Electrical Engineer
Energex Limited

Version Control

Version	Description	Date of Issue
1	Reviewed & approved by Electricity North West Limited.	17/05/2017
2	Submission to the University of Queensland.	27/05/2017

Acknowledgements

I'd like to thank the University of Queensland, Energex Limited (Energy Queensland), EA Technology Limited (EATL), and Electricity North West Limited (ENWL) for the support provided during the scholarship tenure. Specific thanks to the ENWL's Asset Management Team (Jonathan Booth, Bob Wells, Ian McCormack, Phil McFarlane, Dan Wilson, Jabulani Mpofu, Ebrahim Hajat and Ian Fenton) and ENWL's staff at the Preston office UK who have contributed to my overall learning during my scholarship placement.

TABLE OF CONTENTS

1. REPORT OVERVIEW 4

2. COMMON NETWORK ASSET INDICES METHODOLOGY (CNAIM) 4

2.1. PROJECT OVERVIEW 4
2.2. SOFTWARE SYSTEM ARCHITECTURE 5
2.3. TEST STRATEGY AND TACTICS 6

3. NETWORK ASSET WORKBOOK 7

3.1. FINAL NAW MONETISED RISK 7
3.2. BENCHMARKING 8
3.3. NAW REBASED PROCESS OVERVIEW 10

4. BUSINESS OPERATIONS 12

4.1. VISIT FROM INTERNATIONAL DNOS 12
4.2. BUSINESS INITIATIVES 12
4.3. ASSET INSPECTION 12
4.4. FLOOD MANAGEMENT 13
4.5. DELIVERING A SMART AND FLEXIBLE ENERGY SYSTEM 14
4.6. RISK OPTIMISATION 14

5. OTHER BUSINESS 16

5.1. CIGRE WORKING GROUP C1.34 16
5.2. EUROPEAN UTILITY WEEK 16

6. CONCLUSIONS & FUTURE DIRECTION 17

7. ACRONYMS 18

8. BIBLIOGRAPHY 20

1. Report Overview

During the 3rd quarter of my scholarship placement with Electricity North West Limited (ENWL), I continued to learn many aspects of ENWL's business operations and further progress the works on the implementation of the Common Network Asset Indices Methodology (CNAIM). The following areas of my work experience are discussed in this report:

a) Implementation of an add-on "intervention" CNAIM software suite enabling ENWL to optimise their programme of work using a value-based framework through the concept of monetised risk.

b) Continuing the process of Network Asset Workbook (NAW) restatement, improvement iterations, and adjustments based on the outcomes of the 1st bi-lateral meeting with Ofgem (held in January 2017). Support the knowledge dissemination process regarding CNAIM to the critical stakeholders.

c) Overview of ENWL's flood management strategy and key learnings from storms Desmond and Eva during December 2015.

d) Progress updates on the work of CIGRE Working Group C1.34 and a brief highlight from the European Utility Week 2016.

2. Common Network Asset Indices Methodology (CNAIM)

2.1. Project overview

This section provides a progress update on the CNAIM implementation project which continues to take place during the 3rd quarter of my work placement. During this period, my main mission was to performing functional tests on CNAIM "intervention" software suite to identify software defects and enable the software to be commissioned, i.e. go live. The overall project timeline is summarised in Figure 1.

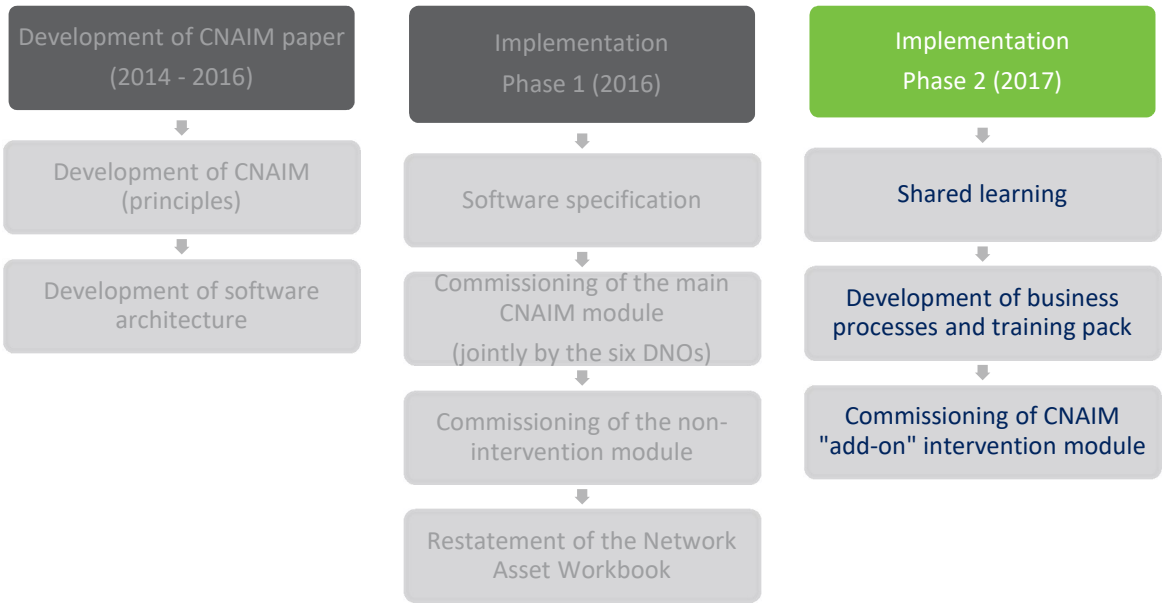


Figure 1 - CNAIM project implementation timeline

2.2. Software system architecture

During this phase, I developed a software testing strategy, rebuilt and calibrated asset models and finalised a number of essential process documentations. A similar testing process to that detailed in the previous quarterly reports was adopted. The architecture of the CNAIM add-on "intervention" module and its connectivity to the "non-intervention" module are illustrated in Figure 2.

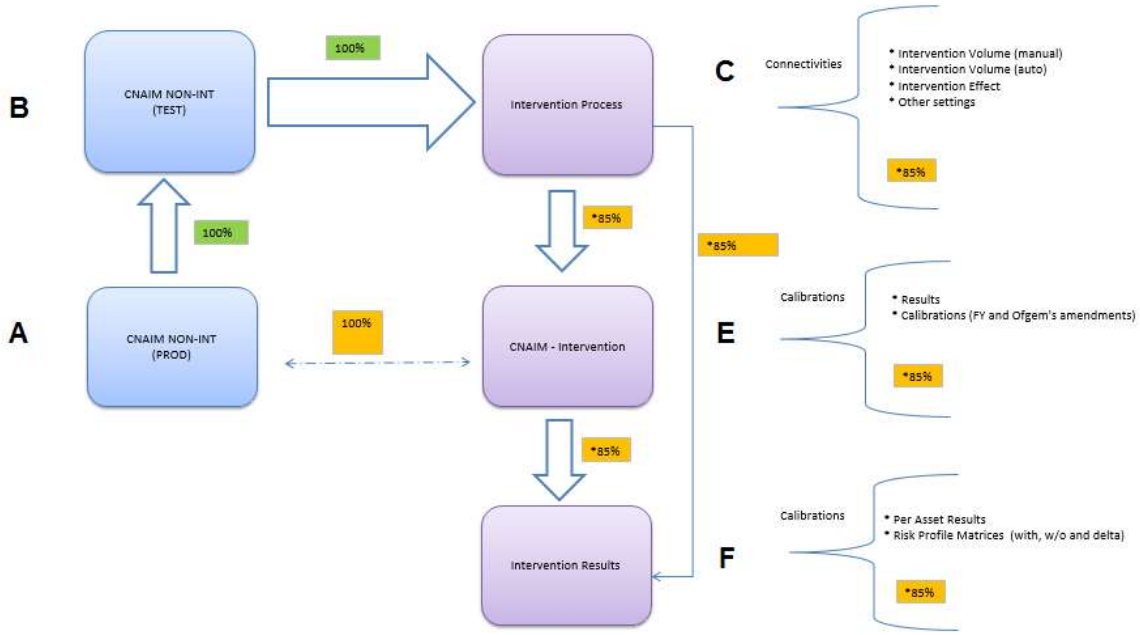


Figure 2 - CNAIM "Intervention" and connectivity to "Non-Intervention" System Architecture

CNAIM intervention module has functionalities for planned intervention programme of individual assets to be submitted. Specific asset risk and/or criticality bands in the 5*4 risk matrices can be targeted for intervention based on the business requirements. In a broad sense, CNAIM intervention module acts as a preliminary platform for ENWL to optimise their asset investment portfolio as it enables ENWL to do the following:

a) Submit information pertaining to their investment programmes and understanding the impact of asset health across the regulatory period.
b) Gain a deeper understanding of how certain asset investment programmes may be deployed to outperform their business targets.

It is noted that the software does not provide a full risk optimisation capability and only serves as a preliminary platform for smarter or more complex engines to be built on in the future. The risk optimisation engine (next phase of ENWL's asset management improvement journey) is briefly discussed in section 4.

2.3. Test strategy and tactics

Samples of the software test strategy and tactics adopted are illustrated in Figure 3 and Figure 4.

Electricity North West Limited

CNAIM Intervention Software

User Acceptance Test (UAT) in test IT environment

Date: 14.02.17 to .....

By: Beer Opatsuwan

		Critical Functionality Tests	Screenshots	P LV OHL Support	S LV UGB	S LV Switchgear and Other	P HV OHL Support - Poles	S HV Switchgear (GM) - Primary	S HV Switchgear (GM) - Distribution	T HV Transformer (GM)	P EHV OHL Support - Poles	TOHL EHV OHL Fittings	
				1	2	3	4	5	6	7	8	9	
1	a	**Data Import from PROD to DEV environment** Check that the non-Intervention data is imported into the model. Confirm the following: *Volume of non-intervention in dev and prod environments are the same. *volume of asset conditions (check data flow from data mapping output -> intervention process input)		Pass	Pass (defect: 2)	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pas
2	a	**Linkage with the Non-Intervention Module** * Confirm data is imported from Non-Int to Int * Link a Non-Intervention model * Go to: Intervention Process --> Calibration --> Linked Non-Intervention Model & Run the model * CHECK 1) Volume: Invention process -> Input data 2) Replication of risk matrix for Y0 (note: Future Yr does not linked) 3) Current Yr0 - 5x4 matrix (must be the same) 4) Future Yr8 - 5x4 matrix (must be the same)		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass (defect: 1)	Pass (defect: 1)	Pas
	b	**Repeat** Repeat with "observed condition" significance point change in the non-intervention module * Check to see if the impacts flow through		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pas
	c	**Reverse** * Can the results be reversed? i.e. 5x4 matric as found before the calibration * Ensure to reverse the process		Pass (defect: 1)	Pass (defect: 1)	Pass (defect: 1)	Pass (defect: 1)	Pass (defect: 1)	Pass (defect: 1)	Pass (defect: 1)	Pass (defect: 1)	Pass (defect: 1)	Pas
3	a	**Hygiene Tests** * Click test for all functions to ensure no errors dialogue box appear		Pass	Pass	Pass	Pass	Pass (defect: 1)	Pass	Pass	Pass	Pass	Pas

Figure 3 - CNAIM Intervention Module Test Strategy (1 of 2)

Electricity North West Limited

CNAIM Intervention Software

User Acceptance Test (UAT) in test IT environment

Date: 14.02.17 to .....

By: Beer Opatsuwan

		Critical Functionality Tests	Screenshots	P LV OHL Support	S LV UGB	S LV Switchgear and Other	P HV OHL Support - Poles	S HV Switchgear (GM) - Primary	S HV Switchgear (GM) - Distribution	T HV Transformer (GM)	P EHV OHL Support - Poles	TOHL EHV OHL Fittings	EHV OHL
				1	2	3	4	5	6	7	8	9	
	b	* Check that the column headers (e.g. AssetID, Distance from Court, Age, etc.) appear correctly in the table		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	c	* Human factors & zone test (e.g. significant ranking table etc.)		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
4	a	**Intervention Application (Automatic Method)** ***see record*** Intervention Process Note: See the guide to perform intervention volume tests for test 4, 5 and 6		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	On-hold	Pass
	b	Per Asset Results		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Defect: Volume calibration	Pass
	c	HI/CI Matrix Results		Defect: linkage between CNAIM & Int	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Defect: linkage between CNAIM & Int Results (Y0)	Defect between Int Res
5		**Forced Manual Intervention**		Pass	Pass (defect: 1)	Pass	Pass (defect: 1)	Pass (defect: 1)	Pass (defect: 1)	Pass (defect: 1)	Pass	Pass	Pass
6		**Intervention Calibration Impact** ***see record***		Pass	On-hold	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
7		**Reverse the process for model generation**		Pass	On-hold	Pass	On-hold	On-hold	On-hold	On-hold	Pass	On-hold	Pass
8	a	**Intervention Application (Manual Method)** - via spreadsheet * Export the list of asset requirements via .csv * Remove all interventions in .csv. * Import in with clean .csv. * Select each type of intervention and driver. * Export the file * Prepared manual intervention via .csv (adopt multiple configurations and quantities). *Leave in full asset volumes * Import the list of the asset requirements via .csv * Check the impact in input data		System limitation (timeout)	Pass	Pass	System limitation (timeout)	Pass	Pass	Pass	Pass	Pass	Pass
	b	* Load in specific asset requirements manual intervention (lower asset volume)		Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
9	a	**Settings: Intervention Effects** * Go to Intervention Process -> Calibration -> Intervention Effects * Review the current calibration * Refer to CNAIM paper (if applicable)		PROD	PROD	PROD	PROD	PROD	PROD	PROD	PROD	PROD	

Figure 4 - CNAIM Intervention Module Test Strategy (2 of 2)

3. Network Asset Workbook

3.1. Final NAW Monetised Risk

During the 3rd quarter placement, several cross cutting issues were debated as a result of numerous interactions between GB DNOs and Ofgem. As a result, the submitted restated NAW in December 2016 has to be revised and resubmitted for public consultation in February 2017. It was an interesting experience to learn the interactions and chemistry between individual GB DNOs as well as Ofgem during this period. Table 1 and Figure 5 highlight key results in ENWL's NAW output, i.e. asset risk reduction (risk delta) as a result of ENWL's proposed asset investment plan (asset intervention) during the course of RIIO-ED1.

Asset Portfolio	Start ED1	Mid ED1		End ED1	
	Position at Beginning of RIIO-ED1	Mid Period (WoI)	Mid Period (WI)	End of RIIO-ED1 (WoI)	End of RIIO-ED1 (WI)
LV	£5,122,408	£5,918,131	£5,436,357	£7,080,325	£6,116,776
HV	£10,812,249	£14,361,767	£12,756,405	£17,862,495	£14,651,771
EHV	£10,304,672	£11,886,911	£9,733,826	£15,678,920	£11,374,245
132kV	£8,477,845	£10,176,212	£8,660,041	£12,179,993	£9,147,650
Other	£0	£0	£0	£0	£0
Total	**£34,717,174**	**£42,343,021**	**£36,586,629**	**£52,801,733**	**£41,290,441**
		Increase in risk since start of RIIO-ED1	Reduction in risk compared to mid-point WoI	Increase in risk since start of RIIO-ED1	Reduction in risk compared to end-point WoI
LV		£795,724	-£481,775	£1,957,917	-£963,549
HV		£3,549,518	-£1,605,362	£7,050,246	-£3,210,725
EHV		£1,582,239	-£2,153,084	£5,374,248	-£4,304,675
132kV		£1,698,367	-£1,516,171	£3,702,148	-£3,032,343
Other		£0	£0	£0	£0
Total		£7,625,847	-£5,756,393	£18,084,559	**£11,511,292**

Table 1 - NAW Monetised Asset Risk Outcome

Notes: WI = With Investment & WoI = Without Investment

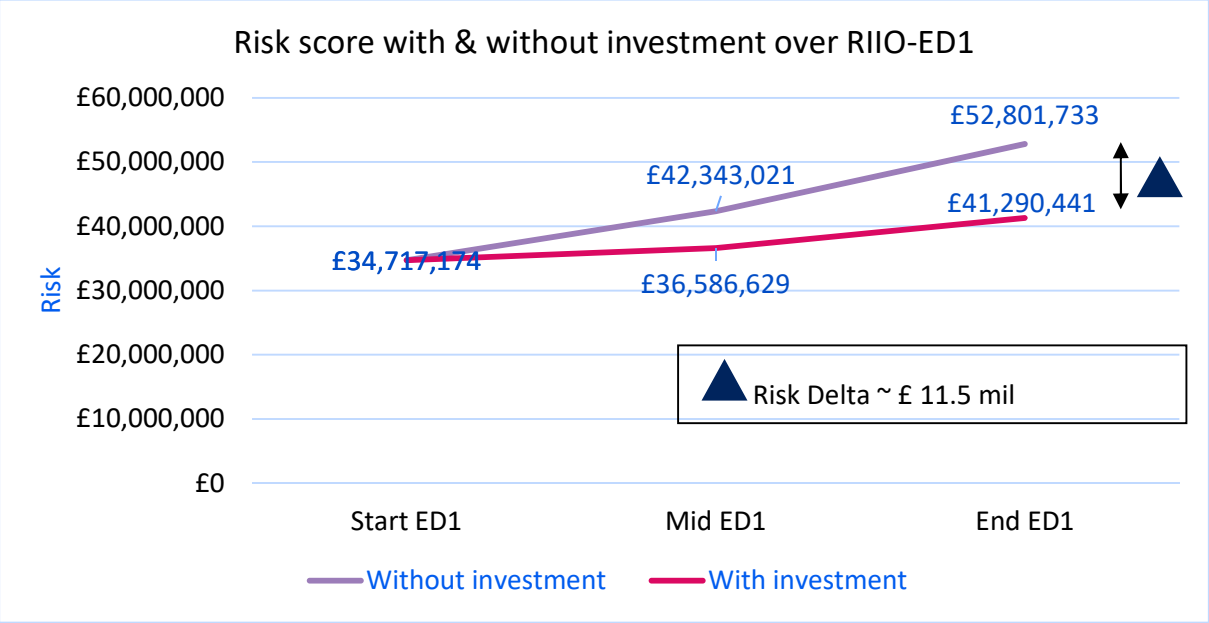


Figure 5 - NAW Monetised Asset Risk Outcome

3.2. Benchmarking

In March 2017, Ofgem has published a consultation document titled Network Asset Secondary Deliverables Rebasing Consultation which provides a summary on the positions of various GB DNOs and their comparison. The figures below illustrate the asset risk comparison undertaken by Ofgem which enables appropriate further benchmarking processes to be conducted. Ofgem is expected to issue its final decision regarding their approval of the restated risk delta targets from all GB DNOs in May 2017.

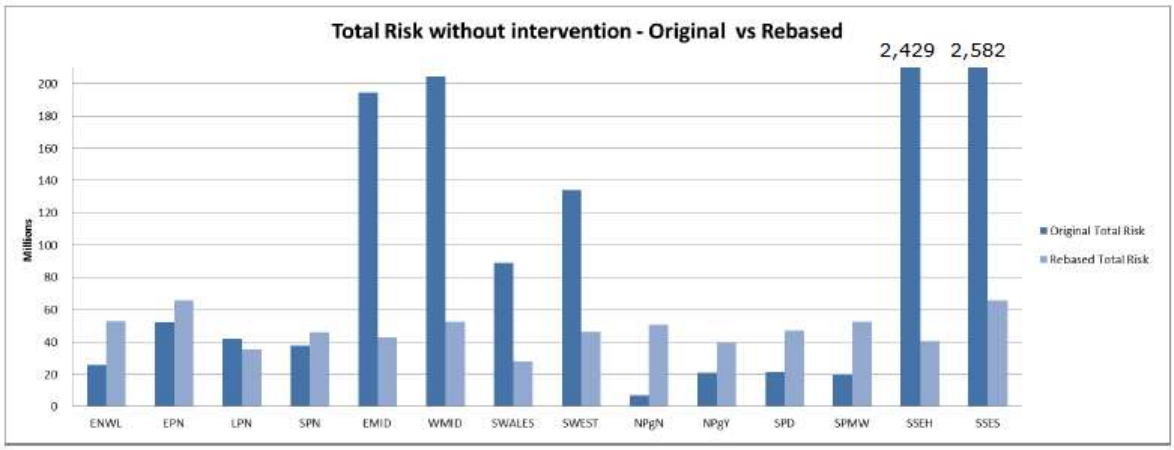


Figure 6 - Total risk without intervention (original vs rebased NAW)

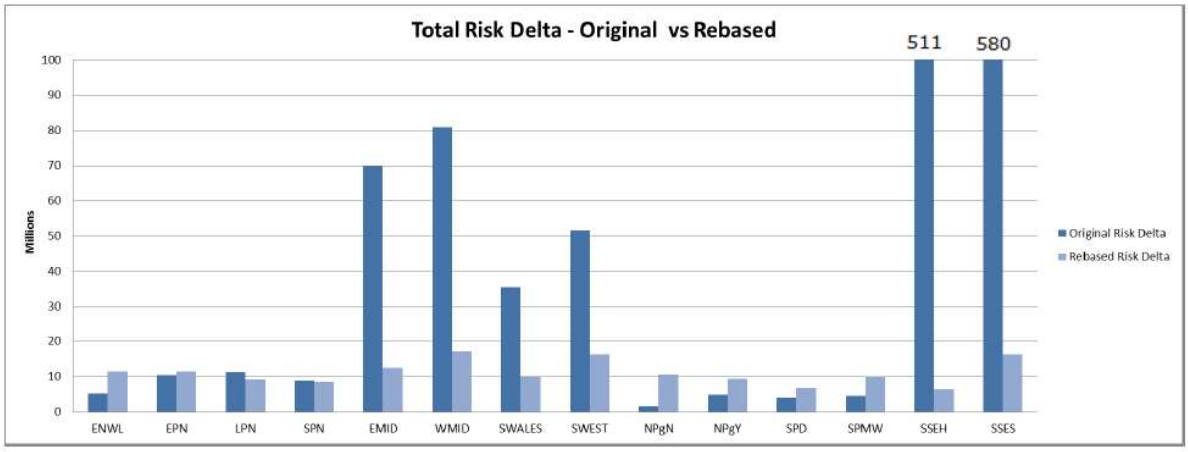


Figure 7 - Total risk delta (original vs rebased NAW)

In summary, CNAIM enables conversion of asset information into a "common currency" monetised asset risk profiles, in this case pound sterling (£). The information above is included to illustrate the point that a better comparison of network investment performance can be made by Ofgem, DNOs and the wider industry stakeholders. The asset risk output of CNAIM through to NAW can be sorted and analysed using various techniques and methods. Table 2 provides a summary of all GB DNOs rebased network asset workbook monetised risk profiles.

DNO Group	License	Rebased NAW			
		Without Investment	WITH Investment	Risk Delta	Variation %
ENWL	ENWL	£52,801,733	£41,290,441	£11,511,292	78.2%
NPg	NPgN	£50,635,472	£40,069,117	£10,566,356	79.1%
	NPgY	£39,226,669	£29,830,608	£9,396,061	76.0%
WPD	WMID	£52,621,580	£35,393,380	£17,228,200	67.3%
	EMID	£42,724,720	£30,194,502	£12,530,218	70.7%
	SWALES	£27,797,838	£17,981,336	£9,816,502	64.7%
	SWEST	£46,546,171	£30,235,486	£16,310,684	65.0%
UKPN	LPN	£35,728,248	£26,585,581	£9,142,667	74.4%
	SPN	£46,097,951	£37,659,235	£8,438,716	81.7%
	EPN	£65,823,785	£54,362,805	£11,460,979	82.6%
SPEN	SPD	£46,997,140	£40,114,397	£6,882,744	85.4%
	SPMW	£52,578,038	£42,446,658	£10,131,380	80.7%
SSEPD	SSEH	£40,727,721	£34,325,215	£6,402,507	84.3%
	SSES	£65,647,485	£49,343,867	£16,303,618	75.2%

Table 2 - GB DNOs comparison of the rebased network asset workbook monetised risk profiles

Legends:

ENWL	Electricity North West Limited
NPg	Northern Powergrid
WPD	Western Power Distribution
UKPN	UK Power Networks
SPEN	Scottish Power Energy Networks
SSEPD	Scottish and Southern Energy Power Distribution

3.3. NAW rebased process overview

During the working process, I worked with the Asset Modelling Manager to develop a process document outlining the structure and framework the NAW restatement process. A high-level relationships diagram of the core functions of NAW is illustrated in Figure 8.

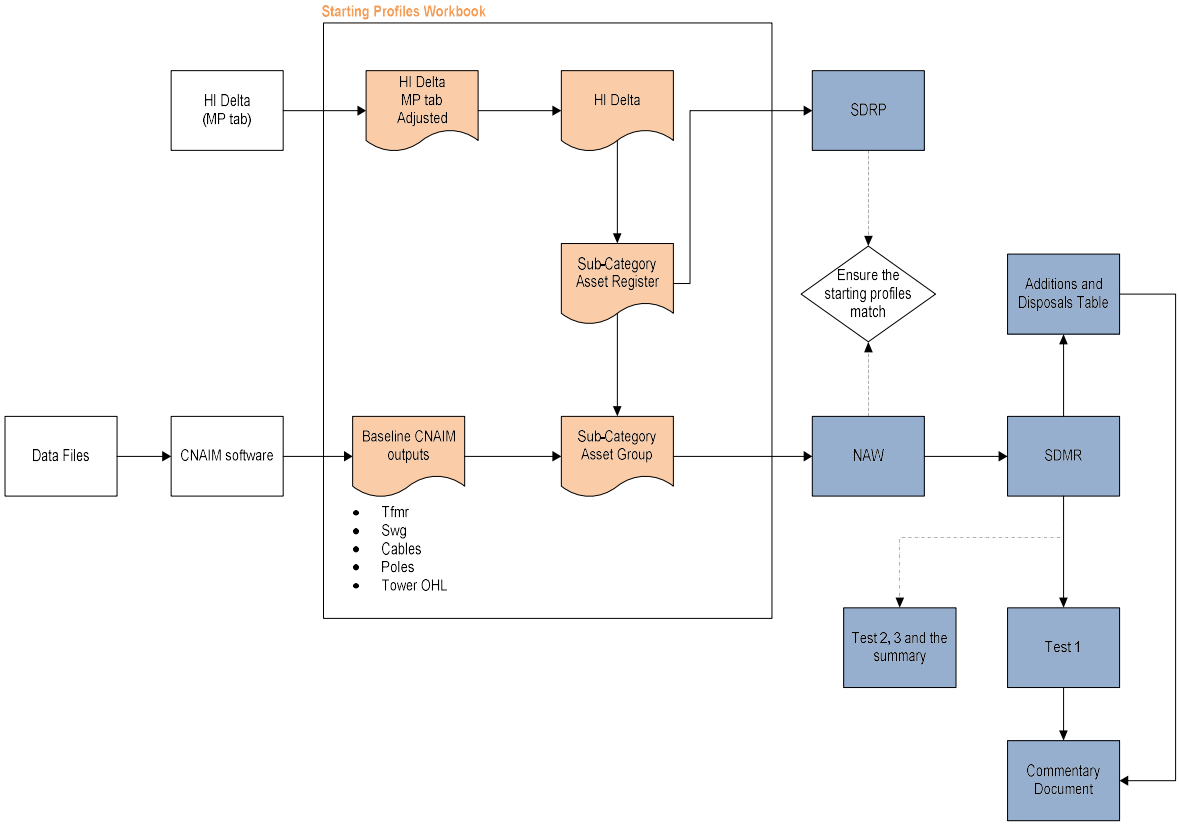


Figure 8 - NAW relationships diagram

Bringing it all together, CNAIM platform acts as an enabler for asset risk benchmarking process for the GB electricity distribution industry to take place. The entire process starting from asset information gathering through to conversion into monetised risk as well as benchmarking process is simplified in Figure 9.

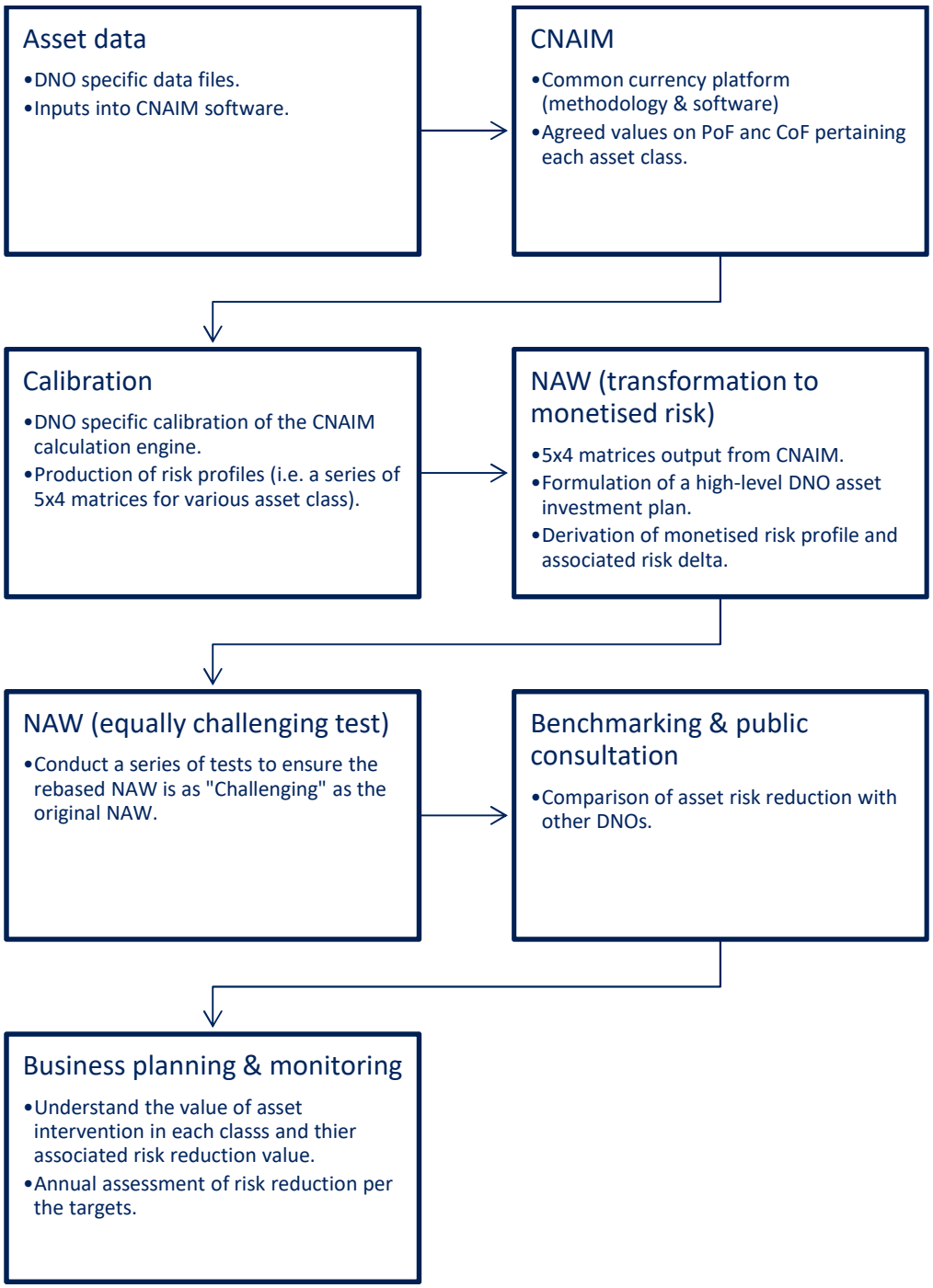


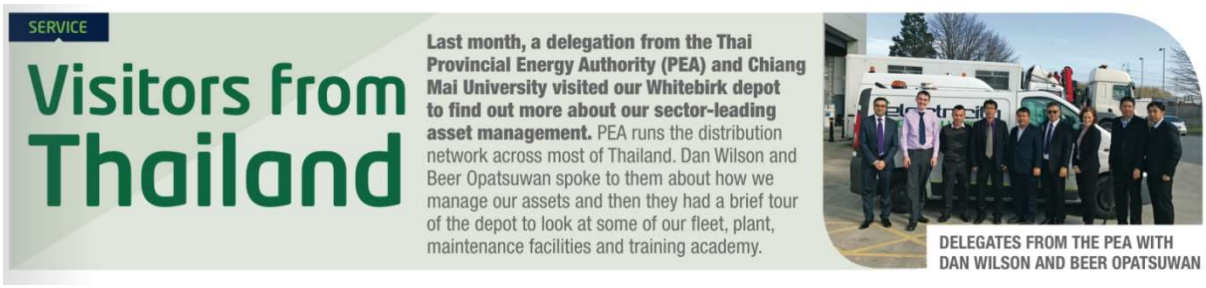
Figure 9 – A simplified process to convert asset data into asset monetised risk profile

4. Business Operations

This section provides key observations and activities I have been involved during the 3rd quarter placement.

4.1. Visit from international DNOs

ENWL hosted visits from the Provincial Electricity Authority of Thailand (PEA) and Caruna (a Finnish DNO) to discuss various aspects of asset management and business operations. I participated in these meetings and was able to consolidate many aspects of asset management excellence learning through the management of programme of work, plant investment process, standards & policy business function and its link to innovation, work approval framework, asset monetised risk, business planning and benchmarking process.


SERVICE

Visitors from Thailand

Last month, a delegation from the Thai Provincial Energy Authority (PEA) and Chiang Mai University visited our Whitebirk depot to find out more about our sector-leading asset management. PEA runs the distribution network across most of Thailand. Dan Wilson and Beer Opatsuwan spoke to them about how we manage our assets and then they had a brief tour of the depot to look at some of our fleet, plant, maintenance facilities and training academy.

DELEGATES FROM THE PEA WITH DAN WILSON AND BEER OPATSUWAN

Figure 10 - Visit from PEA to learn about ENWL's asset management framework

4.2. Business initiatives

ENWL has launched a number of interesting initiatives including a customer services improvement roadmap, safety golden rules and an innovation road show aiming to improve their customer services, safety performance and innovation capability. I have gained a broader perspective and deeper understanding on how ENWL strives to improve and outperform their business performance targets. This is a highly recommended business approach for other asset managers to adopt in order to improve their asset management maturity scale.

4.3. Asset inspection

During February 2017, Ian McCormack (the Asset Manager of ENWL) and I visited a number of low voltage feeder pillars (street pillars). We conducted sample audits on condition of assets against their recorded information in the database. The process was an eye opener to ENWL's asset management end-to-end process through desktop analysis to front-line asset management.

Figure 11 - ENWL Asset Manager getting ready to inspect feeder pillars

4.4. Flood management

In the past 15 years, GB DNOs have made substantial progress to improve the resilience of their networks to the risk of flooding. ENWL network has experienced significant flooding events in the north of England in December 2015 and they have been actively contributing their learning into the GB future resilience planning and policy with the government and local stakeholders. Figure 12 illustrates the extent of the flood caused by Storm Eva in 2015. Following the flooding events, the Royal Academy of Engineering published a report "Living without electricity – One city's experience of coping with loss of power" [14]. The report provides many valuable insights into the criticality of electricity operators in modern society through our reliance on communications such as internet and Wi-Fi. Moving forward, GB DNOs will work with Ofgem to determine how these events may be appropriately valued as part of asset investment decision making criterion. It is a critical area for the Australian electricity supply community to keep abreast leveraging useful learning from the UK power industry.

Figure 12 – The impact of Storm Eva (left) and ENWL crews laying underground HV cable outside a substation (right)

4.5. Delivering a smart and flexible energy system

As part of the UK government's commitment to building a 21st century energy infrastructure, the Department for Business, Energy and Industrial Strategy (BEIS) and Ofgem are working on gathering thoughts from the industry to craft specific actions and enabling a smart, flexible energy system in the UK.

ENWL has recently released a paper outlining its vision and emphasis on an integral role for DNOs to enable a smart, flexible energy systems or simply in transforming themselves into a Distribution *Services* Operator model. The paper provides food for thought on the utility's potential business model, regulatory framework and the initial steps in doing so. The paper is recommended for further examination from the wider Australian electricity supply industry via reference [12]. The paper outlines the criticality for network operators to consider all options to make the most of their existing network assets. It draws attention to ENWL success in leading innovation projects to unleash value and capacities that already existing within their network through their flagship projects such as Customer Load Active System Services (CLASS) which has recently won the Energy Revolution Award at the European Utility Week 2016.

In summary, the GB DNOs community agrees that Distribution Services Operators (DSOs) need to play a central role in managing and operating network and that greater co-ordination between the network operators, distribution and transmission is required. Answers to detailed questions such as future market structures, integration of the storage provided by the commercial market place, current use of system and connection charging arrangements etc. require further exploration and it is an area for the Australian power community to keep abreast.

4.6. Risk optimisation

As part of ENWL progressive mentality to constantly innovate their business operating model and optimise their Programme of Work (PoW), ENWL has embarked on a business project through the Network Innovation Allowance (NIA), known as the Asset Risk Optimisation (ARO), which is expected to run from until the end of 2017. A brief project scope is illustrated in Figure 13.

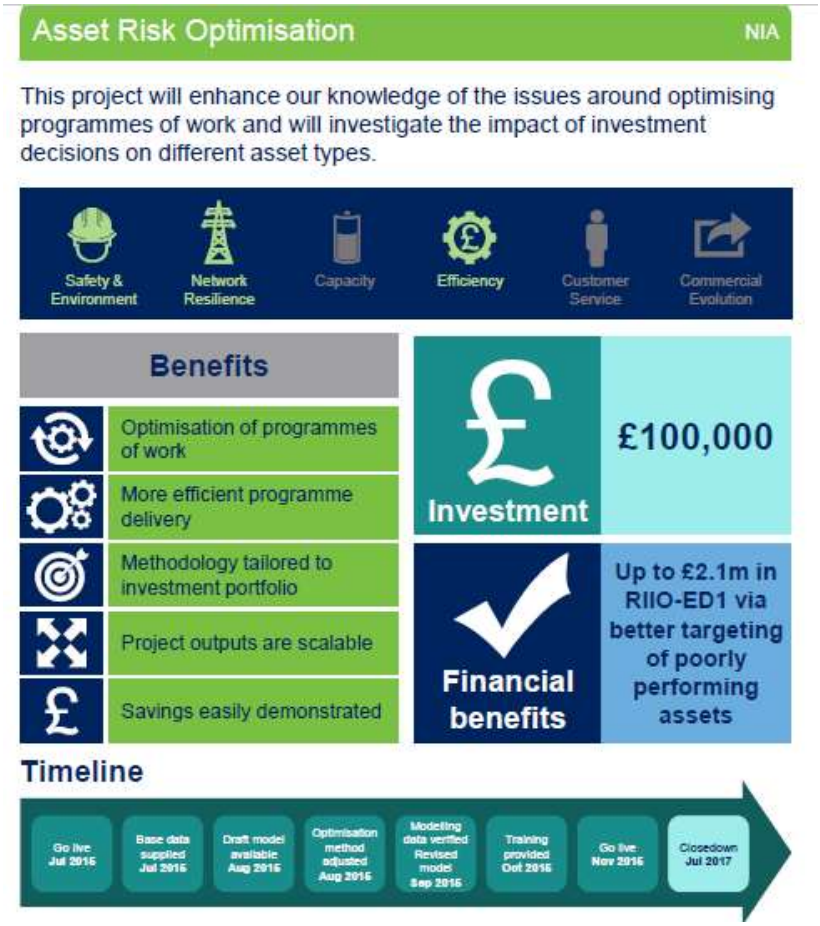


Figure 13 - A brief summary of the Asset Risk Optimisation by ENWL (Source: ENWL)

In the past 10 years, GB DNOs have been utilising the Condition Based Risk Management (CBRM) approach to managing their assets. This approach enables a detailed assessment of the relative condition of assets within an asset type and a consideration of their relative consequences of failure. However, CBRM does not provide an inter-comparison from one specific asset to another and enabling optimum investment on reducing the overall company-wide asset risk.

The development of CNAIM provides a platform for asset managers to categorise and quantify risk across all asset types. Thus enabling different asset risk profiles to be evaluated against one another, e.g. monetised risk reduction value per cost of investment (£) in switchgear can be compared to another asset class such as cables or transformer. Various configurations of asset investment can be constructed and compared to provide the company with an optimised investment portfolio.

In summary, ARO allows investment portfolios to be optimised to deliver the best possible asset risk reduction on the network which is currently beyond the conventional modelling capability of GB network operators. Some of the available learnings to date from the project are noted as follows: 1) the systems to be developed may have a potential limitation to factor in cash flow and business resources constraints, 2) complex intervention where multiple switchgear panels are replaced by a single Ring Main Unit may require manual adjustment to the system, 3) the complexity in system interconnection with the existing CNAIM platform is a working in progress. The project is expected to provide a good return on investment and it is recommended for further observation by the Australian power industry.

5. Other Business

5.1. CIGRE Working Group C1.34

During this period, CIGRE working group C1.34 has developed a survey question-set, circulated, and collated responses from all DNOs that participated. The development of an implementation guideline for ISO55000 implementation tailored to the electricity supply industry is also a work in progress by the team with a view for the first draft to be presented at the next working group meeting to be held in conjunction with CIGRE Symposium 2017 in Dublin, Ireland.

5.2. European Utility Week

During November 2016, Stephen Sproul (from Ergon Energy) and I attended the European Utility Week EUW during November 2016 through the platform of Initiate! Young Talent Programme. The program brought together a variety of talents across Europe covering university students, young professionals, start-ups, social entrepreneurs, HR professionals, utilities, and financial institutions, presenting a great opportunity for cross-fertilisation on innovative ideas. Topical issues were discussed based heavily on the theme of encouraging the next generations to make a positive impact on the energy industry, leveraging opportunities existing in the current period of significant change in the energy industry.

Specific topics covered in the program include: 1) the rise of the sharing economy, 2) how is blockchain adding value to utilities of the future?, 3) how may the industry attract, keep and stimulate the new generation?, 4) how can energy start-ups gear up for corporate investment?, and 5) the legal and finance differentiators for scale-ups and start-ups.

Figure 14 - Initiate! Young Talent Program, European Utility Week 2016, Barcelona Spain

The programme provides a valuable insight into the latest thinking of young talents within the energy industry. It is good platform for the Australian utility community to build strong ties to the European utility community to foster a long term partnership through professional connections with these groups of motivated and talented young professionals in Europe.

6. Conclusions & Future Direction

I have drawn a number of learnings and conclusions as a result of my 3rd quarter placement as follows:

a) Asset management starts from having a good business operational discipline which can be supported through various organisational structures and robust quality management principles such as customer focus, leadership, engagement of people, a process approach, continuous improvement, evidence-based decision making, relationship management etc.

b) The value of having ISO55000 certification comes from the business motivation to improve their asset management systems and practices. ISO55000 certification should not be treated as "be all, end all" but rather as an indicator of the company commitment to obtain the most value out of their assets.

c) The use of an experienced asset management external service provider to help improve the company's asset management maturity may prove useful as a stimulant to drive change as they potentially can offer new perspectives and provide a non-biased view of the company's current asset management status. They also bring a wider angle asset management knowledge from other organisations to the table.

d) It is essential that asset management organisations to have a clear roadmap and a structured approach to test their progress on the asset management maturity scale.

e) As the GB DNOs community is leading the development of a platform to benchmark network asset risk, there appears to be significant interests from other sectors and the wider community of network operators regarding the subject. The very definition of excellence in asset management is risk-based asset investment management. The GB DNOs community has provided a good example of regulatory architecture on how the philosophy can be used to ensure electrical assets can be maintained in a safe, reliable manner, and at the lowest possible cost. CNAIM quantifies risks to the business in understandable financial terms and empowers technical engineering, business and financial business functions to collaborate and make best decisions based on tangible evidence through a "common language", i.e. monetised value of network asset risk.

f) The implementation of CNAIM offers the industry an essential framework which aims at encapsulating all the elements of value that are important to the network operators. These elements are all aligned to a common scale through the concept of monetised risk in the case of the GB electricity supply industry. Thus, the framework enables comparison to be made across different projects, network operators and potentially across sectors. This approach ensures consistent decisions on the most appropriate assets to invest in, based on the value those assets will bring to the organisation.

Moving forward to the 4th and final quarter of my scholarship placement, I will be transitioning to work for EA Technology Limited, a leading global asset management consultancy and service provider. During the next quarter, I plan to gain deeper insights into the world of asset management and learning through the wealth of experience from their asset management consultants. I look forward to evaluating good asset management approaches used by other DNOs with the view to provide useful recommendations to the Australian power community.

7. Acronyms

ACRONYMS	DESCRIPTIONS
AM	Asset Management
ARO	Asset Risk Optimisation
BEIS	Business, Energy and Industrial Strategy
CBRM	Condition Based Risk Management
CDC	Condition Data Capture
CIGRE	International Council on Large Electric Systems
CLASS	Customer Load Active System Services
CNAIM	Common Network Asset Indices Methodology
COF	Consequence of Failure
COP	Code of Practice
DNO	Distribution Network Operator
DSO	Distribution Services Operator
EATL	EA Technology Limited
ENWL	Electricity North West Limited
FTES	Full-Time Employees
GB	Great Britain
GEMA	Gas and Electricity Markets Authority
GWH	Gigawatthour
HSE	UK Health and Safety Executive
IEC	Internatinal Electrotechnical Commission
ISO	International Organization for Standardization
KM	Kilometer
KV	Kilovolt
LV	Low Voltage
MV.A	Megavolt amperes
NAW	Network Asset Workbook
NIA	Network Innovation Allowance

ACRONYMS	DESCRIPTIONS
NTTS	Network Strategy & Technical Service
OFGEM	Office of Gas and Electricity Markets (Great Britain)
OHL	Overhead Line
PEA	Provincial Electricity Authority of Thailand
POF	Probability of Failure
POW	Programme of Work
RIIO	Ofgem's price control framework first implemented in 2013
RIIO-ED1	1st price control for electricity distribution companies under the RIIO framework
SLC	Standard Licence Condition
UGB	Low Voltage Underground Board (Link Box)

8. Bibliography

[1] I. McCormack, “Strategic Asset Management Plan,” Electricity North West Limited, 2015.

[2] B. S. Publication, “BS ISO 55000 Series Asset Management,” British Standards, 2014.

[3] “DNO Common Network Asset Indices Methodology Version 1 (01/08/2016),” Office of Gas and Electricity Markets, United Kingdom, 2016.

[4] “Project Materials and Business Processes,” Electricity North West Limited, 2016.

[5] “Office of Gas and Electricity Markets,” 2016. [Online]. Available: https://www.ofgem.gov.uk/.

[6] “EA Technology Limited,” 2016. [Online]. Available: https://www.eatechnology.com/.

[7] “Electricity North West Limited,” 2016. [Online]. Available: http://www.enwl.co.uk/.

[8] “International Council on Large Electric Systems,” [Online]. Available: http://www.cigre.org/.

[9] Intentionally left blank

[10] Intentionally left blank

[11] Intentionally left blank

[12] E. D. vision, “Electricity North West Limited,” Jan 2017. [Online]. Available: http://www.enwl.co.uk/docs/default-source/about-us/enwl-dso-vision-jan-2017-(2).pdf?sfvrsn=0.

[13] E. Technology, “AIM platform and its benefits,” Jan 2017. [Online]. Available: https://www.eatechnology.com/consultancy-software/asset-investment-management/asset-investment-management-aim/.

[14] The Royal Academy of Engineering, Living without electricity – One city’s experience of coping with loss of power, Febuary 2017. [Online]. Available: http://www.raeng.org.uk/publications/reports/living-without-electricity.