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20 December 2013

Dear Professor Bartlett,

First Quarterly Report – E.S. Cornwall Memorial Industry Scholar – Robyn O'Connor

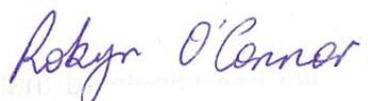
Please find enclosed the first quarterly report for the E.S. Cornwall Memorial Industry Scholarship which is a requirement set out in the scholarship rules. This report outlines my period of employment from 1st October 2013 to 1st January 2014.

This quarter my responsibilities have included:

- Attending and reviewing a PAS-55 audit on best asset management standards and processes.
- The review and implementation of the Criticality Index used in Condition Based Risk Management (CBRM) software by Distribution Network Operators (DNOs) throughout Great Britain. A DNO is equivalent to the Australian Distribution Network Service Provider (DNSP).

I would welcome the committee's feedback and advice on the report.

Yours faithfully,

A handwritten signature in blue ink that reads 'Robyn O'Connor'.

Robyn O'Connor



E.S. Cornwall Scholarship Report

Robyn O'Connor

20/12/2013

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1.0 Background

This report was prepared by Robyn O'Connor as the first quarterly report required under the terms of the ES Cornwall Memorial Scholarship. My tenure of scholarship commenced on in October 2013 and continues until April 2014. My program is aimed at gaining exposure to Condition Based Risk Management (CBRM) developments overseas and the implementation of Publicly Available Standard (PAS) for Asset Management, PAS-55. I am also interested in the development of network investment strategy and the effect of asset management plans on the price of electricity paid by the end customers.

The program consists of one six month placement at Electricity North West Limited, based in Preston, United Kingdom. I will be undertaking a second placement, of my own accord at EA Technology during the period April 2014 to October 2014.

The scholarship was awarded in Australia by the University of Queensland, and therefore comparisons to the Australian electricity industry may be made to provide context for Australian readers.

2.0 Introduction

England, Wales and Scotland are divided into 14 regulated electricity distribution networks economically regulated by Ofgem (the Office of Gas and Electricity Markets). Electricity North West Limited (ENWL) is the Electricity distributor for the North West of England and holds one of the fourteen regulated distribution network licences. Electricity enters the ENWL network from the National Grid at fifteen Grid Supply Points at 132kV.

The ENWL network covers a diverse range of terrain; rural areas such as Cumbria, heavy industry and urban populations including Manchester. ENW own, operate and maintain over 58,000km of cables, 96 bulk supply substations, 363 primary substations and 33,000 transforming points delivering over 24 terawatt hours of electricity annually to 2.3 million domestic and industrial customers. The replacement value of the network assets is greater than nine billion pounds.



Figure 1: ENW geographical distribution area

ENWL is divided into three distribution areas, North, Central and South, shown in Figure 2.

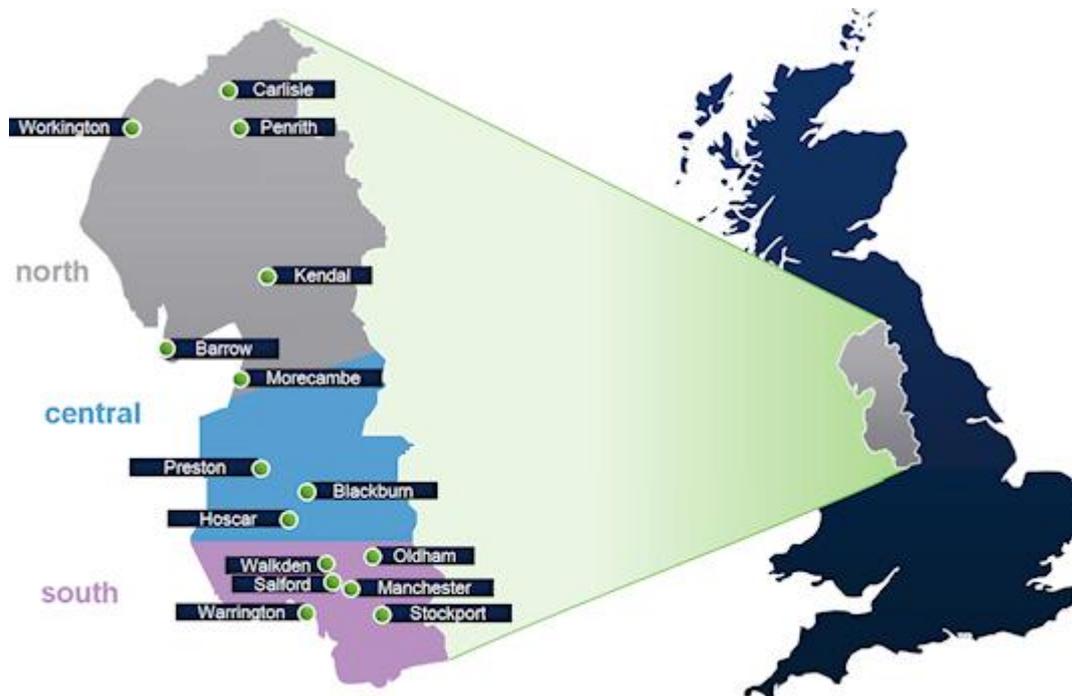


Figure 2: Map of distribution network areas

3.0 Company Vision and Structure

ENWL's vision to be the leading electricity delivery business and their core values are Customers, People, Safety, Performance and Innovation. Their purpose and goals are to understand and influence the market, deliver sustainable growth with robust financial performance, understand and deliver for customer and stakeholders and develop a high performance organisation.

- Customers - to delight our customers in everything that we do
- People - To work together openly, honestly and in a professional manner to achieve exceptional results
- Safety - to protect our people, our customers and our environment
- Performance - to exceed expectations in how we perform, today tomorrow and in the future
- Innovation - to constantly challenge and improve how we do things.

The company is structured to reflect specialised and crucial functions, called directorates. The directorates are: Business Services, Company Secretary and General Counsel, Customer, Finance, Networks Strategy and Technical Support, Operations and Regulation. Across all of the directorates, ENW have approximately 1600 staff. My role as an Asset Management Engineer falls under Networks Strategy and Technical Support under the Asset Management Manager. See Figure 3 for a detailed breakdown.

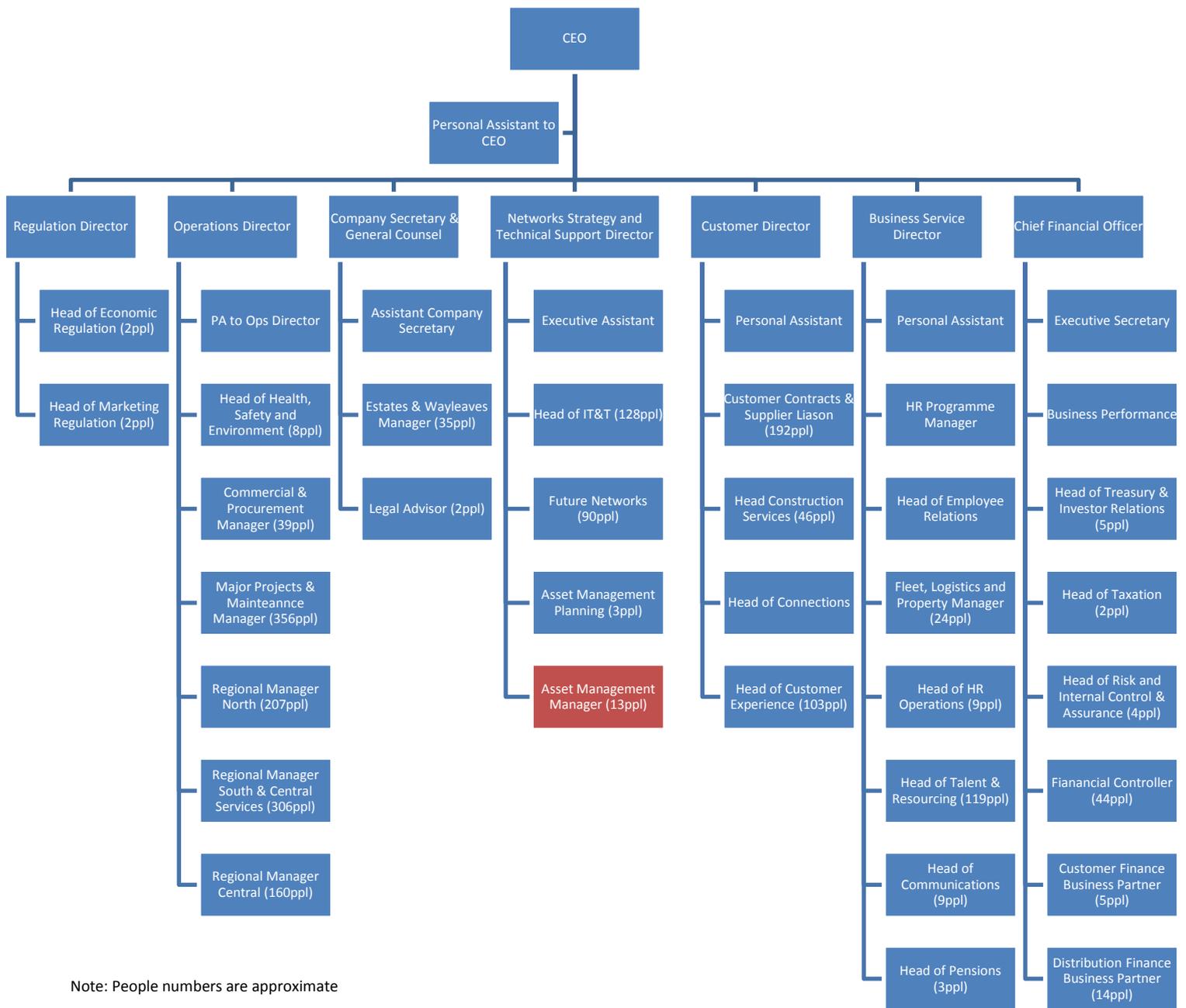


Figure 3: ENW company structure

4.0 Regulation

Ofgem has developed RIIO-ED1 (Revenue using Incentives to deliver Innovation and Outputs - Electricity Distribution), a new performance based model for setting network companies' price controls for the eight-year period from 1 April 2015 to 31 March 2023. Built on the success of the previous RPI-X regime, RIIO-ED1 is designed to promote smarter gas and electricity networks for a low carbon future.

RIIO-ED1 is designed to encourage network companies to:

- Put stakeholders at the heart of their decision-making process
- Invest efficiently to ensure continued safe and reliable services
- Innovate to reduce network costs for current and future consumers

- Play a full role in delivering a low carbon economy and wider environmental objectives.

The RIIO-ED1 regulatory submission has been the first submission to involve minimal negotiation or feedback from Ofgem through the submission process. ENWL had to submit a pricing structure and business plan for the full eight year pricing period with minimal discussion with Ofgem, a different approach from the previous five price control periods which have been an iterative negotiation process with Ofgem.

Since the submission of their business plan in June, ENWL has had no feedback from Ofgem until the decision as to if their submission would be fast tracked in November. ENWL have had several opportunities to present to Ofgem and other relevant stakeholders and bodies in the months since the submission deadline in mid-July; however these did not result in any feedback. ENWL received only 86 questions as part of the submission review, this is substantially less than previous price review submission periods.

The submission ENWL provided to Ofgem was much more detailed than previous submissions and provided over 800,000 data points in Excel which included data about finance, CBRM, options analysis for projects and all aspects of the business. After the submission, the 14 Distribution Network Operators (DNO's) made a decision to share the data points so that companies could compare data, for example the unit rate of costs and projects in their programs.

The focus of the submission was on customer engagement, finding out what customers want and how to deliver the network, asset and customer promises to meet customer expectations. For the first time in the RIIO-ED1 submission, ENWL provided a focus on customer outcomes rather than first and foremost a business financial projection.

Ofgem released its decision on which DNO's business plans for RIIO-ED1 would be fast-tracked on 22nd November 2013. A fast-tracked business plan would allow the company to maximise the returns from the next regulatory period as their plans were approved one year earlier than the start of the next pricing period. Ofgem made the decision not to fast-track ENWL, only four of the fourteen DNO's were fast tracked, an organisation called Western Power Distribution. Whilst ENWL were not fast tracked, the feedback provided by Ofgem was positive and ENWL only missed out on fast tracking by one area category, Resources – efficient costs. The following quote from Ofgem details some of their initial feedback from the submission:

“ENWL's plan is clearly written and very easy to navigate. It provides clear evidence of stakeholder engagement, and a strategy for long term delivery. ... ENWL proposed a higher cost of equity than other DNOs without a compelling justification, and we have factored this into the cost efficiency benchmark.”

After reviewing what ENWL are required to resubmit to Ofgem in March it has been determined that ENWL are not required to resubmit their plan for asset replacement and refurbishment.

5.0 Asset Management Standard

Ofgem's policy is to not become involved in the day to day asset management of each network company. Following a number of high profile failures and accidents within UK infrastructure companies, Ofgem sought a process by which it could gain assurance about the practices and procedures being used by the network companies. Ofgem, in conjunction with British Standards Institute and the Institute of Asset Management developed PAS-55 (Publicly Available Specification) in 2004 and revised in 2008. PAS-55 demonstrates to Ofgem that the network companies are responsible long term custodians of their assets. In April 2006, Ofgem asked network companies to become certified to PAS-55.

PAS-55 is a "Specification for the optimised management of physical infrastructure assets". The key components of PAS-55 include: The cycle of asset management activity: Plan-Do-Check-Act and the 'line of sight' from top to bottom – any activity on an asset should relate to a higher level business objective. The alignment of what every person is doing in the organisation towards the overall business strategy and plan.

United Utilities Electric (UUE), a precursor of ENWL applied for PAS-55 accreditation in December 2006 and received accreditation in January 2007. Surveillance audits are held annually and a re-certification is required every three years. The November 2012 audit was the second re-certification audit and re-certification was achieved in January 2013.

The auditor, SGS in ENWL's case, check that the Business Plan translates into policies and strategies which can be followed through to actual work carried out on the network and that these documents and processes are recorded correctly. For the re-certification audit, SGS send one member of staff for a five day period. Three days is spent in the office and two days in the field to check processes and speak to staff.

The SGS auditor talks to around 25 different people across a range of sessions looking at different clauses of the specification. Each session will demonstrate some aspect of the clause and there is no set format for each session. Sessions usually take the form of a discussion with pieces of evidence, presentations or documents being provided before or during the session. SGS are not an endorsed auditor for the institute of Asset Management however they are certified to issue accreditation for PAS-55.

Through the implementation of PAS-55, ENWL have learnt to use a common language throughout the business and to align all work with the business strategy and plan. For example if a person goes to perform a relay check at a substation site. If additional substation maintenance or tidying of the site is required, these works are only completed if in alignment with the business plan. ENWL have established a Customer directorate including a centralised customer contact centre. This brings a focus to the customer facing activities including customer interruptions, connections and stakeholder engagement in both planning and delivery. As part of the general requirement 4.1 required under PAS-55, ENW revised the company business plan document, now defined under Asset Management Policy EPD215.

In March 2008, Ofgem announced that they would no longer monitor the certification status of companies, but there is a strong expectation that companies should retain certification. ENWL has

decided to retain their certification as it is found to be a beneficial process for the organisations procedures and does not require significant additional work.

A three day PAS-55 surveillance audit was completed by Rob Blackett from SGS on 19th to 21st November 2013. ENWL received feedback at the conclusion of the audit that there were no PAS-55 non-conformances and ENWL would be assessed at the next re-surveillance audit due to be completed in twelve months.

The surveillance audit outcomes were detailed by the auditor during the first audit session and highlighted what SGS requirements were as part of the PAS-55 asset management standard. The audit investigated specific aspects of PAS-55 as well as the overall PAS-55 process in the organisation, Plan – Do – Check – Act. ENWL maintain an open and honest relationship with SGS to ensure that ENWL achieve the most benefit from the auditor's feedback.

The introductory session from ENWL covered the strategic level direction of the organisation, the company business plan, objectives and the RIIO-ED1 submission. As the audit progressed, the sessions became more detailed. Each session aimed to provide a direct link between the corporate objectives and the day to day work being undertaken by the departments across the business. The link between the departments and processes was also highlighted throughout the audit.

ENWL staff brought relevant process and procedure documents to meet with the auditor of which a copy was retained by the auditor during the course of the audit for reading and documentation. The documents included risk management strategies, codes of practice and a range of project management documents including: project initiation documents, Gantt charts, risk and action logs as well as progress achieved on particular projects. Each document provided, showed a clear link to the top down approach of PAS-55 and how each section fitted into the organisation business plan.

There was a focus on the change management processes and documents throughout the audit to show the complete project lifecycle development. ENWL discussed data collection, data quality issues and assurance processes to show an on-going commitment to collating information systems and processes to improve data quality.

I found the audit process very informative; it provided an excellent overview of all areas of the business in a lot of detail. As part of each audit, the auditor is taken out to site to discuss processes and projects with field staff. These checks included checking authorisation to work on site, the calibration of site equipment and site induction processes in place.

At the conclusion of the audit, SGS and ENWL discussed the possible changes required as part of the release of ISO55000 expected in early 2014. SGS mentioned that ENWL would have approximately twelve months to roll over to the new standard. The current policies and procedures in place will be reassessed as part of a transitional audit to the new standard. There are some initial thoughts at this stage that the new standard might require a link to the user requirements, however this cannot yet be confirmed. It was concluded that when the new standard is released, SGS and ENWL will meet to discuss any possible new requirements.

6.0 Condition Based Risk Management (CBRM)

The development of CBRM at ENWL has evolved since early 2002 when a need was identified to replace assets based on condition and an estimate of future performance rather than calendar age. In order to quantify the risk associated with the operation and management of mature assets, an understanding of the probability of failure and the consequences of failure need to be well understood. The results of CBRM can be used to quantify the risk related to the assets and evaluate the effect (in terms of risk) of different management options.

More recently, ENWL have used CBRM 2.0, software developed by EATL, to develop their regulatory submission for RIIO-ED1. The CBRM model is made up of two main components, the Health Index (HI) and Criticality Index (CI). The HI and CI of asset categories are combined to form a risk matrix, example shown in Figure 4. Ofgem will use the risk matrix shown to determine the amount of funding granted to DNOs to fund their asset refurbishment and replacement program during RIIO-ED1. The decision as to how the funding is spent is on replacement and refurbishment is up to the management of the DNO.

Health Index is a measure of the degradation a piece of equipment, the HI value is calculated on an assets calendar age and condition. In order to define the current condition of assets and to understand their ongoing degradation, the failure processes and degradation that affect different types of assets must be well understood. Assets are classified into groups and health indices are populated for an asset group based on the assets condition and future performance. The health index is related to the probability of failure to determine an expected end of life (EOL). End of life is defined as when the probability of failure is higher than the asset owner is prepared to accept.

Criticality is a comparative measure of the consequence of an asset failing. It is a measure of the effect of the loss of a piece of equipment on the business in terms of Network Performance, Safety, Cost (Opex & Capex) and Environment consequences. Criticality has only recently become an integral part of the regulatory submission with the process being more formally established by Ofgem in late 2012.

Asset Type	Criticality Index Category	Criticality Index Criteria*	Average Overall Consequence of Failure	Asset Health Index			
				HI1	HI2	HI3	HI4
	CI1						
	CI2						
	CI3						
	CI4						

*expressed as % of Average Overall Consequence of Failure

Figure 4: Ofgem’s framework for reporting Criticality and Health Indices

As part of my work at ENWL I will be involved in the development and refinement of criticality and the inclusion of additional assets in the CBRM model. This work will involve refining the data CBRM uses to calculate criticality, evaluating the impact of different factors such as network performance and safety on criticality and determining what factors can be obtained from ENWL network data in

order to provide input to the criticality component of CBRM. This work will involve working closely with EA Technology to refine sections of the CBRM model and understand how data is collected, imported and outputted from the model.

The submission to Ofgem for CBRM asset profiles and asset investment strategy included a criticality index for each asset as a percentage banding of the average criticality. The criticality was broadly defined by Ofgem, and is made up of different consequence categories, factors and asset specific parameters in a hierarchical view as shown in Figure 5.

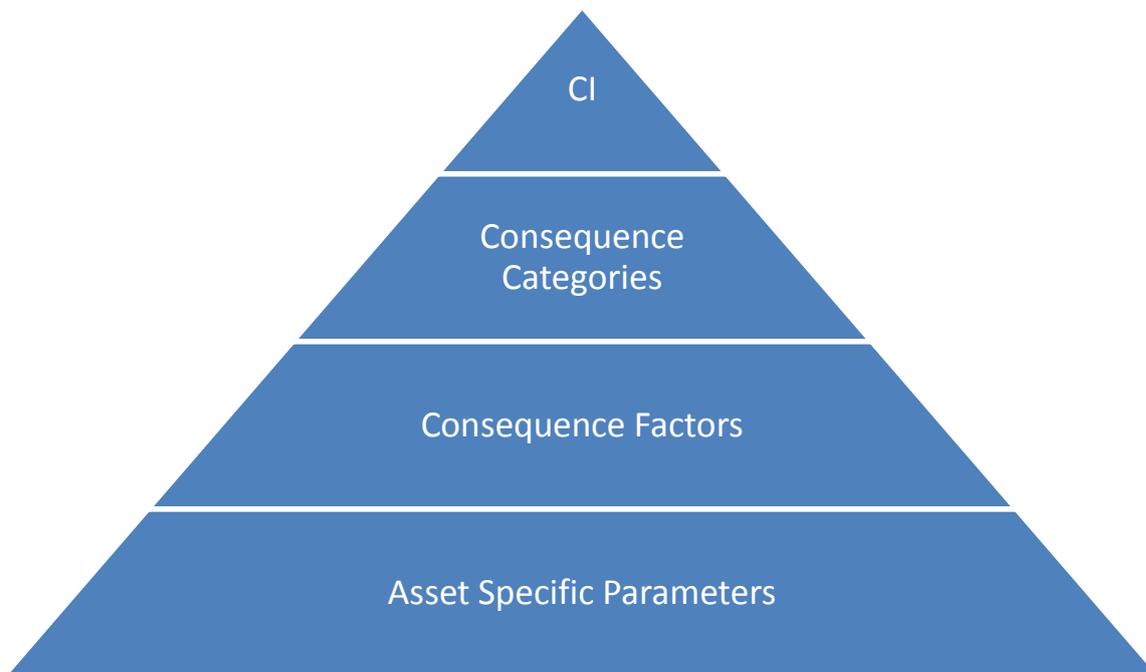


Figure 5: Tiered criticality breakdown

Criticality is expressed as a percentage of the average consequence of failure of an asset type. There are four criticality bands C1: less than 75% of the average overall consequence of failure, C2: 75% to 125%, C3: 125% to 200% and C4: over 200% of the average overall consequence of failure. The consequence of failure is determined based on a sum of the consequences of network performance consequences, safety consequences, financial consequences and environmental consequence.

Within each consequence category, consequence factors are defined by each DNO. An example of consequence factors under network performance could include: Number of customers supported, network configuration and vital customers supported. Safety: Population density, schools within a set radius, recreational areas within a set radius, equipment insulation type, location of equipment and asset type. Cost: Asset type, accessibility, location, population density. Environment: Site environmental assessment, insulation type, asset type.

As part of my project to deliver improvements to CBRM through criticality, these factors and their corresponding influence on the CBRM model are being revised. In preparation for ENWL's engagement with EATL, developments on the criticality project have involved detailed discussions of user requirements with internal stakeholders. Prior to engaging EATL for the review and development of the software, ENWL have identified a key list of improvements and modifications to

CBRM. This project is still in its early stages and user requirements are being defined the next month or so, an update as to the progress of this project will be discussed in further detail at the conclusion of my placement with ENWL.

7.0 Asset Investment Strategy

Investment in the network has increased significantly in recent years as eighty-five percent of assets in the ENWL electricity network are first generation, i.e. they were installed to support the initial load growth in the 1950s and 1960s and have never been replaced. The current price control period from 2015 – 2023 requires a 25% increase in investment from the previous price control period.

Electricity distribution costs make up 16% of a typical domestic customers electricity bill. The cost of maintaining the cables, transformers, substations and everything else involved in the distribution of electricity is about £100 a year, less than £2 a week which represents excellent value. With an average DNO proposed price reduction of approximately 11 percent from 2015, hopefully these cost efficiencies will be reflected in customers' bills.

In order to determine an asset investment strategy based on CBRM, ENWL uses the asset risk value (Health Index × Criticality Index) to determine their investment program. Asset risk only exists on the failure of an asset. In order to compare asset risk across different asset categories, a methodology for comparing asset risk was established, several options detailed below.

ENWL determine the level of asset investment based on an assessment of network risk. The first methodology for risk assessment is to choose an acceptable future level of asset risk. If the existing risk level as determined across the asset base is 'x', then at the end of the regulatory submission period an overall risk level across the network will remain the same, 'x'. Then the appropriate investment strategy is developed based on ensuring the level of network risk is maintained.

The second methodology is to have a constraint driven strategy for asset investment, i.e. how much asset replacement can be delivered for a certain monetary value or other constraint and then use this as a driver to determine the asset investment program and consequently the amount of risk the company is prepared to accept. A third risk assessment investment strategy was the methodology adopted by ENWL: the process involved modelling an asset by asset risk profile and determining the optimum replacement strategy for each asset type. These risk profiles then determined the overall risk profile.

The third strategy for risk assessment and consequently asset investment does not constrain the outputs and inputs of the investment model. In order to quantify the amount of risk a detailed view of each asset group needs to be understood to find the optimum replacement strategy, a balance between probability of failure and consequence of failure. This strategy resulted in ENWL accepting a risk profile at the conclusion of the RIIO-ED1 period of 103% of the risk profile determined at the start of the period.

8.0 Summary

My time at ENWL has been very productive and I have enjoyed being a part of the Asset Management department working with CBRM. I enjoyed participating in the PAS-55 audit and learning about asset investment and risk management strategy. The development of criticality and the CBRM project is on-going. Working within the Asset Management team provides me with a great understanding of EATL's CBRM 2.0 tool and the business practices and processes in place to ensure that asset data is captured correctly and in a timely manner.

Over the coming months I will be developing my knowledge of network regulation and pricing to understand the effect of network investment on the user end bill. Living and working in the UK has been a great experience so far and I greatly appreciate the opportunity I have been given by the E.S. Cornwall Scholarship. I welcome any feedback from the committee as to my findings or requests for further information.

9.0 Glossary

Term	Description
Capex	Capital Expenditure
CBRM	Condition Based Risk Management
CI	Criticality Index
DNO	Distribution Network Operator
EATL	EA Technology Limited
ENWL	Electricity North West Limited
EOL	End Of Life
HI	Health Index
Ofgem	Office of Gas and Electricity Markets
Opex	Operational Expenditure
PAS-55	Publicly Available Standard 55
RIIO-ED1	Revenue, Incentives, Innovation and Outputs. Electricity Distribution price control one, period 2015- 2023
Risk	Function of CI and HI
RPI	Retail Price Index
UK	United Kingdom