2018-22
POWERLINK QUEENSLAND REVENUE PROPOSAL

APPENDIX 15.03 - PUBLIC

Powerlink Queensland
Network Capability Incentive Parameter Action Plan

Delivering better value

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Introduction

Powerlink proposes three priority projects to improve its network capability to provide benefits to customers and consumers.

The Network Capability Component (NCC) of the Service Target Performance Incentive Scheme (STPIS) is designed to incentivise Transmission Network Service Providers (TNSPs) to deliver benefits of improved network capability from existing network assets, in order to benefit customers and wholesale market outcomes at times when most needed.

The NCC encourages Powerlink to examine its network to identify suitable low cost one-off operational and capital expenditure projects that improve the capability of its transmission network. While it is normal practice for Powerlink to identify low cost solutions to improve its network capability, Powerlink supports further incentives to deliver benefits to the market and to the customers.

The NCC facilitates improvements in the capability of a TNSP's network which results in:

- Improved capability of those elements of the transmission system most important to determining spot prices; or
- Improved capability of the transmission system at times when Transmission Network Users place greatest value on the reliability of the transmission system.[1]

The NCC was first introduced in the Version 4 STPIS in December 2012.[2] Since then, AusNet Services, TransGrid, TasNetworks, and ElectraNet have commenced their participation in the scheme under Version 4.1.[3] The Australian Energy Regulator (AER) released its Final Determination for Version 5 of the STPIS (hereafter referred to as Version 5) in October 2015[4], which will apply to Powerlink for the first time in its 2018-22 regulatory period, commencing 1 July 2017.

The NCC under Version 5 contains a number of significant changes from the NCC under Version 4.1. Under Version 5:

- The incentive allowance for the NCC is adjusted on a pro-rata basis, linking the incentive to the total expenditure on approved priority projects;
- Considerably higher importance has been placed on quantifying a material benefit and payback period for each priority project; and
- An ex-post assessment of priority projects may be conducted by the AER, as part of annual compliance reporting, to check the latest available information against key assumptions and market benefits for the approved priority projects.

Powerlink consulted with the Australian Energy Market Operator (AEMO) during the development of the proposed priority projects, consistent with the NCC criteria under Version 5.

[1] *Final STPIS Version 5 (corrected)*, AER, October 2015, p.12.
[2] *STPIS Version 4*, AER, December 2012.
[3] *STPIS Version 4.1*, AER, September 2014 amendment.
[4] *Final STPIS Version 5 (corrected)*, AER, October 2015.

Overview

Section 5.2 of Version 5[5] specifies that Powerlink is required to submit, in its Revenue Proposal, a Network Capability Incentive Parameter Action Plan (NCIPAP) as follows:

- Identifying for every transmission circuit and injection point on its network, the basis and cause for the limit for each transmission circuit and injection point.
- Proposing the priority projects to be undertaken in the regulatory control period to improve the limit of the transmission circuits and injection points listed above through operational and/or minor capital expenditure projects. This proposal must include:
  - i. The total operational and capital cost of each priority project;
  - ii. The proposed value of the priority project improvement target in the limit for each priority project;
  - iii. The current value of the limit for the transmission circuits and/or injection points which the priority project improvement target is seeking to improve;
  - iv. The ranking of the priority projects in descending order based on the likely benefit of the priority project to customers or on wholesale market outcomes;
  - v. For each priority project, how the achievement of the priority project improvement target would result in a material benefit being achieved, including an outline of the key assumptions on which this result is based; and
  - vi. In which the average total expenditure of the priority projects outlined in each regulatory year must not be greater than 1 per cent of the TNSP's average annual maximum allowed revenue proposed in its revenue proposal for the regulatory control period.

The scheme also specifies that the priority project must result in a material benefit, and the TNSP must consult with AEMO prior to submitting the NCIPAP about its review of the transmission circuits and injection points in its network, and the potential priority projects which have been identified.

The following sections of this document form Powerlink's NCIPAP:

- The first section summarises the approach that Powerlink employed to identify and rank the proposed priority projects to ensure compliance with the NCC requirements. It also describes Powerlink's framework to respond to the scheme's ex-post assessment requirement as part of its annual compliance reporting; and
- The second section contains a summary of Powerlink's proposed priority projects and project details for each of these proposed priority projects.

[5] *Final STPIS Version 5 (corrected)*, AER, October 2015, pp. 12-13.

1 Approach

Powerlink carried out a rigorous process to identify, review, validate and rank candidate priority projects against the NCC criteria of Version 5, and against the objective of the scheme – to benefit customers and consumers by improving network capability from existing network assets.

AER released its Final Determination for Version 5 in October 2015. The Determination contained a number of significant changes to the NCC compared to Version 4.1 and the AER's draft Version 5. In particular, the final Version 5 places considerably higher importance on quantification of a material benefit and payback period for each priority project. Powerlink has re-validated its candidate priority projects against the final Version 5 criteria, which resulted in a fewer number of proposed projects.

In developing its priority projects, Powerlink received input from all relevant sections of its business. Through its process of review and validation of candidate projects under the NCC criteria, it was identified that there are a limited number of areas in Powerlink's existing network that can be further improved to deliver direct benefits to the market and/or customers.

The following sections summarise the approach that Powerlink took to identify and rank its proposed priority projects, which include:

- Project identification and validation;
- Consultation with AEMO;
- Project ranking;
- Projects considered but not proposed; and
- Consultation with stakeholders.

1.1 Project identification and validation

Powerlink undertook the following actions to identify, review and validate its proposed priority projects:

- Reviewed transmission circuit limits of its network;
- Identified where increased capability would benefit customers and/or supply to loads;
- Obtained input from various relevant parts of the business for potential candidate NCIPAP projects;
- Reviewed AEMO's suggested list of possible NCIPAP projects for Powerlink;
- Undertook studies for market and/or customer benefits;
- Reviewed and validated each of the potential candidate NCIPAP projects against the NCC criteria under Version 5;
- Prepared initial project scopes and concept estimates for market benefit calculation methodology;
- Consulted with AEMO;
- Developed project scopes, with AEMO's technical involvement;
- Re-validated each of the NCIPAP projects against the updated NCIPAP criteria in the final Version 5;
- Finalised market benefit and payback period calculations and reviewed ranking of the priority projects with AEMO; and
- Finalised the ranking of the priority projects with AEMO.

The process occurred over a period of ten months during which the AER's development, consultation and finalisation of Version 5 was undertaken.

Powerlink confirms that the benefits, improved limit values and outcomes for each proposed priority project are solely attributable to the priority project and not from any other work which Powerlink is undertaking, or intends to undertake, on the transmission network.

1.2 Consultation with AEMO

The scheme[6] requires each TNSP to consult with AEMO prior to submitting its NCIPAP about its review of the transmission circuits and injection points in its network, and the potential priority projects which have been identified.

Powerlink engaged with AEMO early in the development of its NCIPAP to understand AEMO's expectations, develop consultation protocols and to ensure both parties were able to meaningfully engage in the consultation process. During this process, Powerlink provided AEMO with the following information that is required under 5.2(j) of Version 5:

- The limit for each transmission circuit and injection point on its network and the reason for the limit;
- A copy of its capital expenditure program for the upcoming regulatory period; and

[6] *Final STPIS Version 5 (corrected)*, AER, October 2015, Section 5.2(h).

- Any other information which was reasonably necessary to understand the nature of the transmission circuit and injection point network limits, and the potential value to consumers of addressing those limits.

Over a period of eight months, Powerlink liaised with AEMO on a regular basis through monthly meetings and a series of in-depth technical discussions. Consistent with the scheme, the discussions covered:

(1) The potential for co-ordinated projects with other TNSPs;

(2) Whether achieving the proposed priority project improvement targets will result in the proposed priority project having a material benefit;

(3) The classification of priority projects based on their likely benefit to consumers or wholesale market outcomes; and

(4) The ranking of the priority projects.[7]

AEMO has agreed with Powerlink that the following three proposed projects should be classified as priority projects:

- Increase design temperature of Bouldercombe to Raglan and Larcom Creek to Calliope River 275kV transmission lines;
- Greenbank System Integrity Protection Scheme (SIPS); and
- Load Model Enhancement and Validation.

Both parties have agreed that the Load Model Enhancement and Validation project complies with the intent of the scheme as an exploratory project. Further, while the benefits of the project may be difficult to quantify, it will reveal important information to assist with future network development.

AEMO's letter of agreement for Powerlink's proposed priority projects is included in Appendix 15.04 of the Revenue Proposal.

1.3 Project ranking

The scheme requires the proposed priority projects to be ranked in descending order based on the likely benefit of the priority project to customers or on wholesale market outcomes. Powerlink must also consult with AEMO regarding the ranking of the projects.

Powerlink has ranked its proposed priority projects in accordance with its regulatory requirements, as shown in Table 1.

1.4 Projects considered but not proposed

Powerlink undertook a thorough and methodical process to identify, review, and validate all candidate projects against the relevant criteria.

Possible projects were put forward from across the organisation at a number of technical workshops where each was clarified, reviewed and validated against the NCC criteria.

[7] *Final STPIS Version 5 (corrected)*, AER, October 2015, Section 5.2(h).

Through this process, a significant number of projects were considered but were removed from the candidate priority project list at different stages of the internal review process.

Following this broad review of potential opportunities, Powerlink identified 20 credible candidate priority projects for extensive analysis and assessment. However, based on available information and internal analysis done by Powerlink, the majority of these projects were ultimately not included in the final NCIPAP proposal. These excluded projects are described below along with the reason for their eventual exclusion:

- Projects that involve Distribution Network Service Provider (DNSP) protection and control scheme were reviewed by engaging with the relevant DNSP. However, projects proved difficult to quantify the market benefit;
- Projects that involve Powerlink's customers and/or assets of the customers were assessed closely by engaging with the relevant customers. While those projects appeared to increase efficiency, the market benefit was not sufficiently justified;
- Projects that improve network operational response and restoration times. While these projects could improve customer benefits, the market benefit and payback period was not justified; and
- Powerlink identified several transmission line limitations based on historical credible contingency reclassifications due to intense storm activity in North and Far North Queensland. While these projects could improve customer reliability, the market benefit and payback period was not justified.

1.5 Consultation with stakeholders

During the development of its STPIS proposal, Powerlink engaged with a number of stakeholders to expand its understanding of the challenges facing customers and consumers. Powerlink also provided stakeholders with an overview of its past performance under the STPIS and of Version 5.

1.6 Capital and operating expenditure

Clause 5.2(r) of Version 5 states that the cost of the proposed priority projects must not be included:

(1) In the total forecast operating expenditure proposed by the TNSP in its revenue proposal to meet the operating expenditure objectives under clause 6A.6.6 of the National Electricity Rules (Rules); or

(2) In the total forecast capital expenditure proposed by the TNSP in its revenue proposal to meet the capital expenditure objectives under clause 6A.6.7 of the Rules.

Powerlink confirms that the cost of its proposed priority projects is not included in either forecast capital or operating expenditure for the 2018-22 regulatory period.

1.7 Annual compliance reporting

Clause 5.2(s) of Version 5 requires Powerlink to report, as part of its annual STPIS compliance review submission, on the steps it has taken towards reaching the priority project improvement target against each project in the NCIPAP approved by the AER for each year or part year of the regulatory control period. The TNSP must include in this report:

(1) The current value of limit of the transmission circuit and/or injection points which each priority project seeks to address;

(2) Up-to-date actual operational and capital expenditure for each priority project;

(3) The expected completion date for each priority project; and

(4) For priority projects which the TNSP intends to proceed with prior to the next annual STPIS compliance review, verification that the assumptions used to justify the material benefit of undertaking the priority project have not materially changed resulting in the priority project no longer having a material benefit (as defined in clause 5.3(d)(2)). This includes whether it sought verification from AEMO or another third party that the key assumptions on which the material benefit of undertaking the priority project is based are still valid.

Powerlink confirms that it will incorporate the scheme's NCIPAP ex-post assessment requirement into its annual STPIS compliance review reporting.

1.8 Information on Powerlink Network

Clause 5.2(b)(1) of Version 5 requires Powerlink to identify the basis and cause for the limit for each transmission circuit and injection point, as part of its NCIPAP.

The Information on Powerlink Network document is provided in Attachment 1 to this Appendix as confidential information.

2 Powerlink's Proposed Priority Projects

2.1 Summary

Table 1 below shows a summary of Powerlink's proposed priority projects.

Table 1: Powerlink's proposed NCIPAP priority projects ($m, real 2016/17)

Category	Project title	Estimated cost (opex)	Net market benefit per annum	Market benefit per annum	Pay-back period (years)	Rank
Limitations involving minor primary plant or secondary equipment	Increase design temperature of Bouldercombe to Raglan and Larcom Creek to Calliope River 275kV transmission lines	0.51	0.06	0.15	3.5	1
Outage Management/non-credible contingencies	Greenbank System Integrity Protection Scheme (SIPS)	1.82	0.16	0.43	4.2	2
Operational Issues and operational flexibility	Load model enhancement and validation	0.88				3
Estimated total cost of projects		**3.20**				

2.2 Increase design temperature of Bouldercombe to Raglan and Larcom Creek to Calliope River 275kV transmission lines

Project Classification Group: Limitations involving minor primary plant or secondary equipment

Bouldercombe to Raglan and Larcom Creek to Calliope River 275kV circuits form part of a transmission corridor enabling power flows between Central West and Gladstone. These feeders are currently rated to summer emergency ratings of 541MVA due to the ground clearance. Increasing the ground clearance on 14 of the 204 spans between Bouldercombe and Calliope River will allow the operation of the feeders at higher temperatures and hence allow greater power transfers whilst maintaining ground clearances. The conductor will be able to be operated at 90°C resulting in an increase of 8°C from the present design temperature.

This modification will allow an increase in the summer emergency rating to 593MVA providing additional flexibility of dispatch. The existing tower structure and associated line hardware has been assessed as being adequate for the increased loading.

Figure 1: Central West to Gladstone transmission network (part)

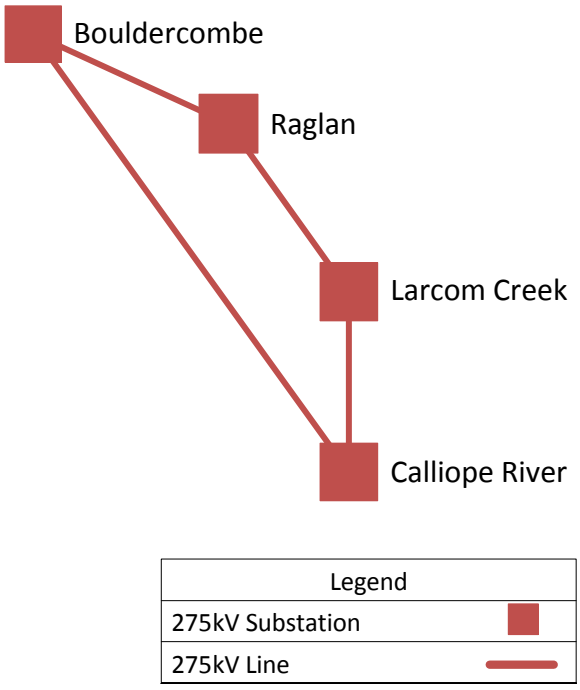


Table 2: Increase design temperature of Bouldercombe to Raglan and Larcom Creek to Calliope River 275kV transmission lines project details

Project	Increase design temperature of Bouldercombe to Raglan and Larcom Creek to Calliope River 275kV transmission lines
Transmission circuit / injection point	Bouldercombe to Raglan and Larcom Creek to Calliope River 275kV.
Project ranking	1
Scope of works	Increase ground clearance of 11 limiting spans on Bouldercombe to Raglan 275kV and 3 on Larcom Creek to Calliope River 275kV transmission lines to increase the design temperature of these circuits from 82°C to 90°C.
Reasons to undertake the project	Bouldercombe to Raglan and Larcom Creek to Calliope River 275kV circuits form part of a transmission corridor enabling power flows between Central West and Gladstone. The capacity of this corridor leads to network constraints. AEMO's NEM Constraint Report 2014[8] reported 3.3 hours of constraints amounting to marginal values of $30k for the 2014 year. These constraints are forecast to increase in the medium term. The utilisation of this corridor can increase with: • Committed increases in compression loads in the Surat Basin; • Reductions in Gladstone Power Station generation; • Reduction in gas generation in the Braemar area in line with expected increases in gas prices; and • Increases in generation in the North and Central West zones (e.g. renewables). Undertaking works to increase ground clearance on 14 of 204 spans increases the summer emergency cyclic rating by approximately 10% providing additional flexibility of dispatch. Assessment based on system conditions over the past year accounting for different levels of supply of committed increases in LNG load and different reductions in Gladstone power station generation (up to 1) unit supplied by Central West and/or North Queensland generators results in expected net market benefit of $64k p.a. and payback period of 3.5 years. **Key assumptions on which this result is based:** • 2014/15 conditions (loads, generation dispatch, and network topology). • Expected portions of increased Surat load and/or reduction in Gladstone generation supplied from Central West/North.
Current value of the limit	Bouldercombe to Ragland and Larcom Creek to Calliope River 275kV circuits design temperature is 82°C (495/541MVA normal/emergency rating).
Priority project improvement target	Increase in rating of Bouldercombe to Raglan and Larcom Creek to Calliope River transmission lines in line with a design temperature of 90°C (545/593 MVA normal/emergency rating).
Completion date	2018/19
Capital cost	$0 (real, 2016/17)
Operating cost	$506k (real, 2016/17)
Market benefits	$146k p.a. (real, 2016/17)
Net market benefits	$64k p.a. (real, 2016/17)
Pay-back period	3.5 years

[8] *NEM Constraint Report 2014 Supplementary Data*, AEMO, April 2015.

2.3 Greenbank System Integrity Protection Scheme (SIPS)

Project Classification Group: Outage management/Non-credible contingencies

[redacted]

This NCIPAP project establishes a system integrity protection scheme to detect these conditions and shed appropriately located loads sufficiently fast to avoid the thermal overloads and possible stability issues. Such a scheme can also serve as a safety net for pre-defined non-credible events.

A system integrity protection scheme installed at Greenbank, communicating with remote substations and integrated with the Energy Management System, would manage the post-event tripping of key 275kV circuits and radialising of 110kV substations to reconfigure the network, and minimise potential load curtailment on the 110kV Gold Coast network.

The scheme will enable the 275kV and 110kV networks to be operated without the networks radialised pre-emptively, providing a more robust and reliable transmission network for credible contingencies, whilst managing the occurrence of a non-credible bus outage.

Figure 2: Greenbank area transmission network

[redacted]

Table 3: Greenbank System Integrity Protection Scheme (SIPS) project details

Project	Greenbank System Integrity Protection Scheme (SIPS)
Transmission circuit / injection point	Greenbank 275kV Substation.
Project ranking	2
Scope of works	Commission a SIPS to address a potential high impact event.
Reasons to undertake the project	[redacted] A SIPS is proposed to detect such conditions and act to avoid consequent severe overloads and/or instability. [redacted] The likelihood of such an event has been estimated at approximately 0.0024 events per annum, resulting in customer reliability benefits of $433k per annum. **Key assumptions on which this result is based:** • Current topology and Greenbank substation layout; • Planned outage rates, durations and unplanned outage rates based on fleet level averages; and • Value of Customer Reliability (VCR) of $41k (real 2016/17).
Current value of the limit	[redacted]
Priority project improvement target	Commissioning of a SIPS to reduce unsupplied energy in South East Queensland for the loss of Greenbank buses.
Completion date	2018/19
Capital cost	$0 (real 2016/17)
Operating cost	$1,822k (real 2016/17)
Market benefits	$433k p.a. (real 2016/17)
Net market benefits	$157k p.a. (real 2016/17)
Pay-back period	4.2 years

2.4 Load Model Enhancement and Validation

Project Classification Group: Operational Issues and operational flexibility

Due to the distance that the Powerlink transmission system traverses, the maximum secure power transfer capabilities through the main transmission corridors are rarely limited by the thermal capability of plant. Power transfer capability into major load zones and between zones is limited predominately by transient and voltage instability. Determining these maximum secure power transfer limits requires prudent models of the power system. Models of the network and generation are reasonably well established. However, models that predict the behaviour of the load to major and minor voltage and frequency disturbances require enhancement.

Analysis shows that transfer limits are sensitive to the structure and parameters of the load model. The nature of the consumer load is also changing with the penetration of PV and other inverter based load. The composite consumer load will also vary depending on the season and time of day.

Load models inform operational and investment decisions. The periodic maintenance of models ensures decisions are based on an accurate representation of the studied parameters.

This NCIPAP project will:

- Install high speed monitoring equipment with synchro phasor capability at key connection points to monitor large system disturbances;
- Update existing load models with robust and validated load models representing the characteristics of contemporary loads;
- Produce a report detailing load models validated against disturbance records of key power system quantities;
- Include the methodology undertaken, learnings and potential improvements in the report which will be made available to other TNSPs and AEMO;
- Support planning decision making, specifically with respect to Central Queensland to South Queensland and North Queensland reinvestments;
- Result in increased accuracy in the representation of the secure technical envelope used by AEMO to drive the most efficient market outcomes whilst maintaining customer reliability; and
- Provides additional system data which may be used for other purposes such as post event analysis.

These new models will supersede existing load models and will be used to understand the secure operating envelope and for prudent operational, investment and re-investment decisions.

This proposed project is an exploratory project. While benefits are difficult to quantify, it will reveal important information for efficient planning and operation of the power system.[9]

[9] *Explanatory statement, Draft Electricity Transmission Network Service Providers Service Target Performance Incentive Scheme*, AER, June 2015, p. 23.

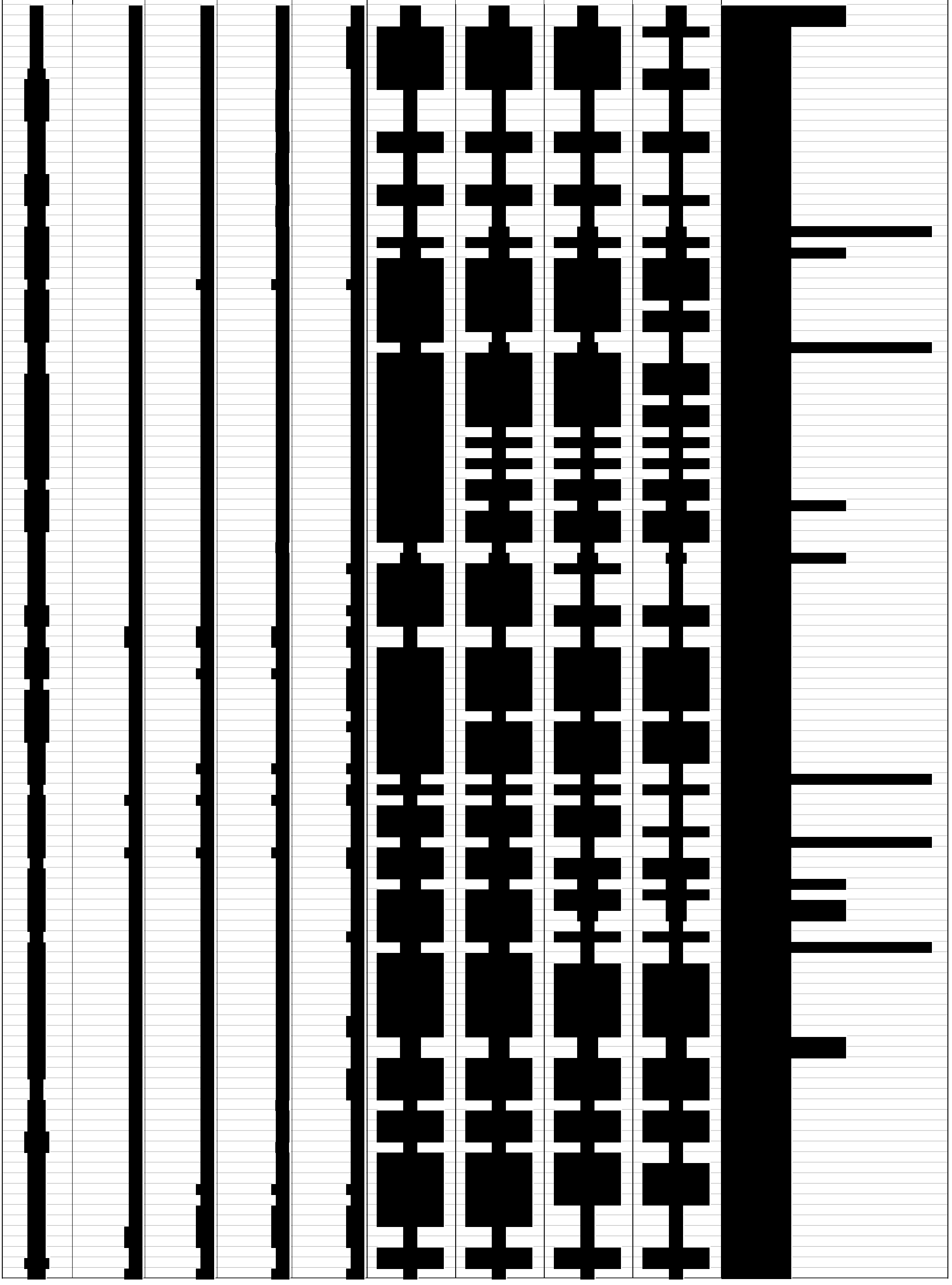
Table 4: Load model enhancement and validation project details

Project	Load model enhancement and validation
Transmission circuit / injection point	Network wide.
Project ranking	3
Scope of works	Install high speed monitoring equipment with synchro phasor capability at select connection points. Develop and validate models for load characteristics connected to the Powerlink network.
Reasons to undertake the project	As transmission lines reach end of technical life, Powerlink determines optimum network configurations. Re-investment decisions are informed by calculations of network capability which may involve dynamic load models. The use of outdated, non-predictive load models could lead to sub-optimal re-investment decisions. Impending decisions potentially affected by dynamic load models include: • Eastern Central Queensland to South Queensland corridor; and • Strathmore to Ross corridor. Powerlink provides limit advice to AEMO so it can fulfil its system security responsibilities. AEMO performs due diligence with load models in line with Powerlink's recommendations. The accuracy of the modelling is tested when the critical credible event coincides with power transfers at the calculated limits. These events are rare and therefore the assessed limits are rarely put to the test. The Rules require the system to be able to withstand such events. Accurate load models are necessary to ensure this design standard is met. Increased accuracy of network limits avoids: • Overinvestment due to calculated limits being lower than real limits; and • Underinvestment due to calculated limits being higher than real limits. In order to develop load models Powerlink will install high speed monitoring equipment with synchro phasor capability at key connection points to monitor large system disturbances. The locations identified for installation allow the following load models to be developed and validated: • Brisbane CBD and neighbouring major bulk supply point; and • Major regional centre in Far North Queensland. Equipment will be installed to record the behaviour of loads to system frequency and voltage disturbances. This exploratory project is not amenable to upfront quantitative justification. **Key assumptions on which this result is based:** • Currently applied load models require to be enhanced to better represent the load characteristics of contemporary loads.
Current value of the limit	Network capability limited by voltage and transient instability is assessed using voltage dependent load models developed over 20 years ago. These models do not fully replicate the physical and changing nature of the load. As a result, there is uncertainty in the level of accuracy of the assessed network capability using these models.
Priority project improvement target	High speed monitoring equipment provides ongoing monitoring and disturbance records of key power system quantities which may be used to develop and update robust and validated load models. This project will result in a report detailing methodology, learnings and recommended load models to use by all TNSPs and AEMO when modelling faults in the Queensland Region, validated against disturbance data.

Project	Load model enhancement and validation
Completion date	2021/22
Capital cost	$0 (real, 2016/17)
Operating cost	$877k (real, 2016/17)
Market benefits	Unquantifiable - exploratory project
Net market benefits	Unquantifiable - exploratory project
Pay-back period	Unquantifiable - exploratory project

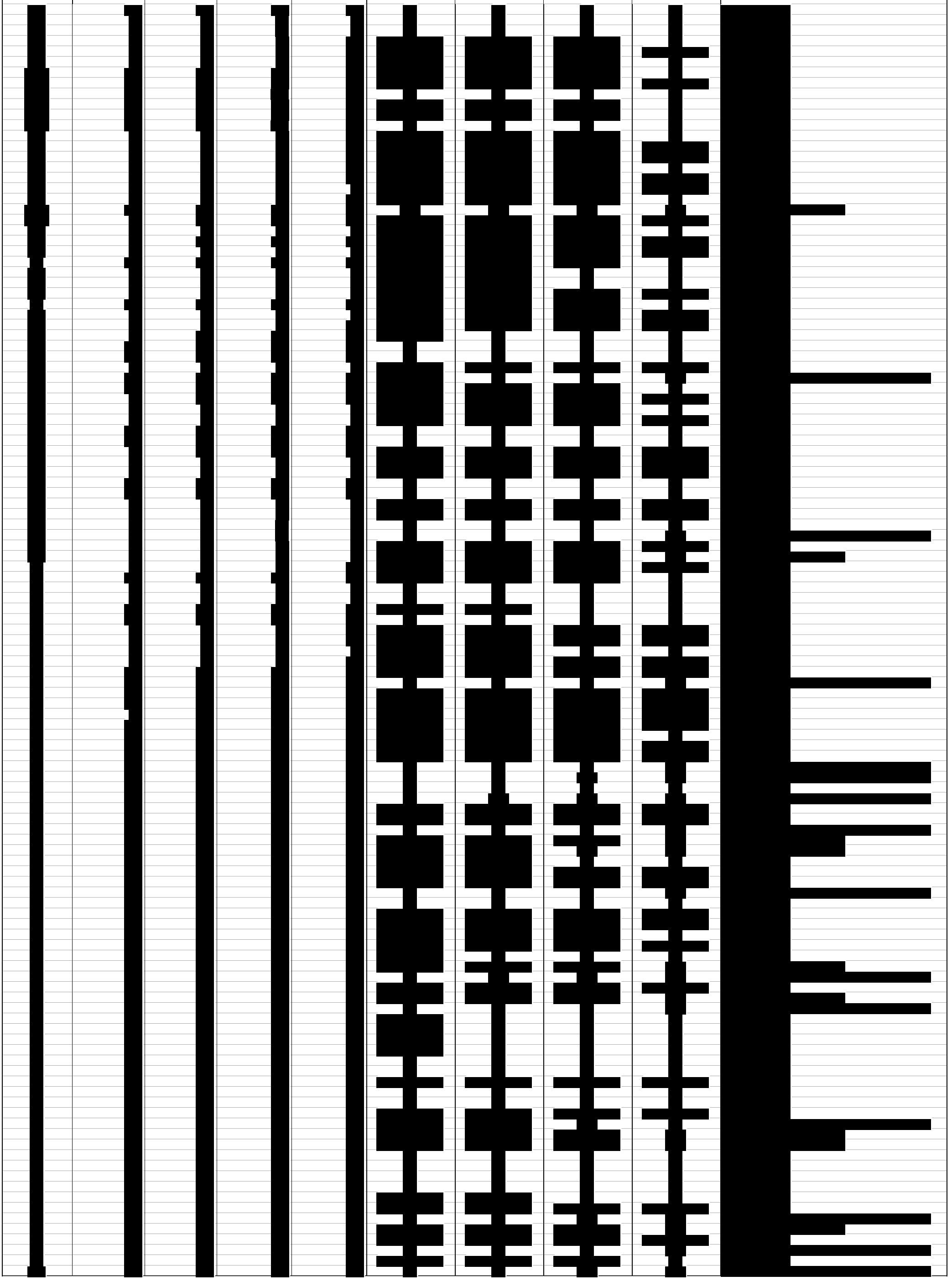
Powerlink Feeders

Feeder Number	Ratings				Limitations				Summary of Limitations
	Summer 1m/s Rating (Amps)	Shoulder 1m/s Rating (Amps)	Winter 1m/s Rating (Amps)	Winter Emergency Rating (Amps)	Summer	Shoulder	Winter	Winter Emergency	

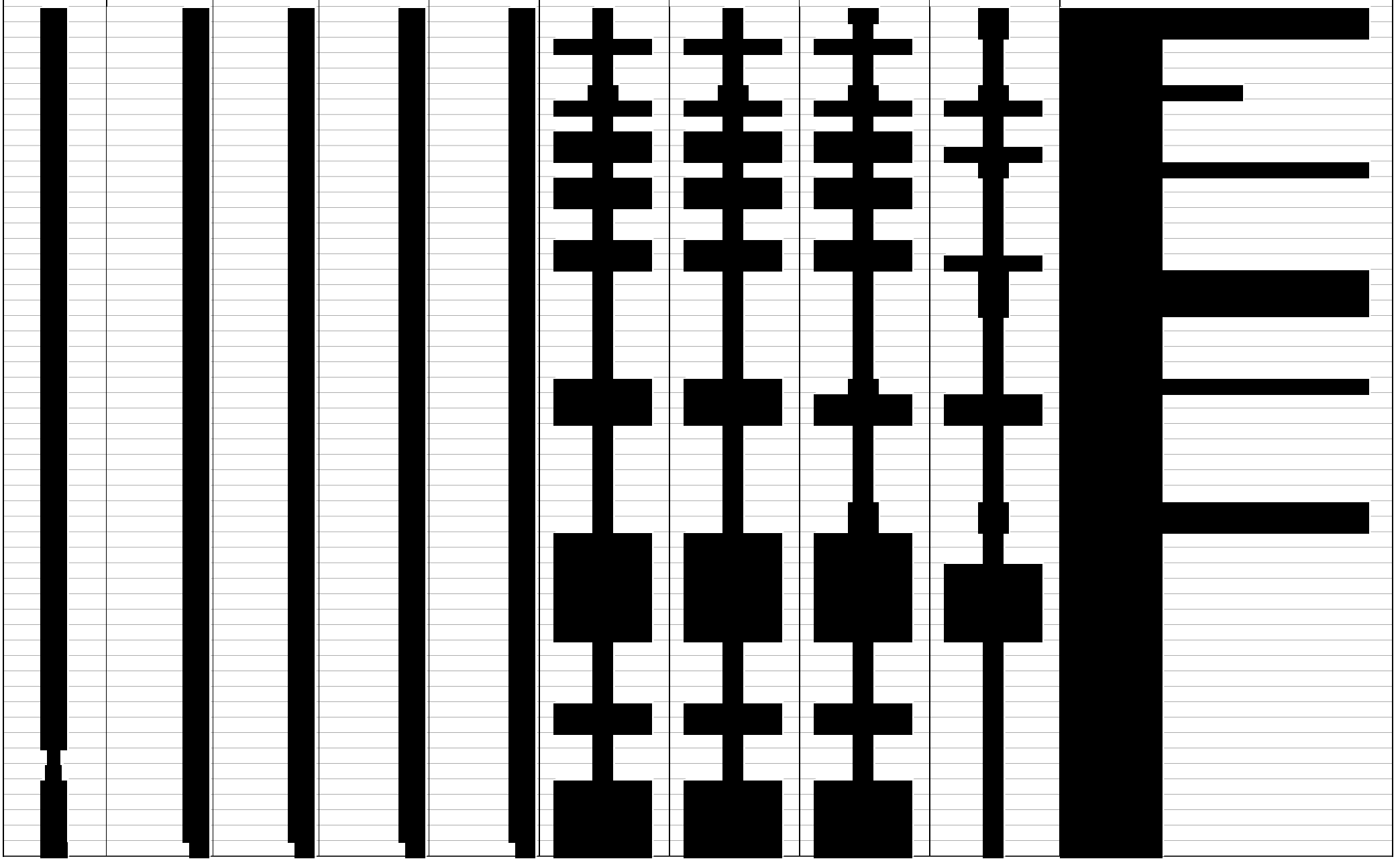


Powerlink Feeders

Feeder Number	Ratings				Limitations				Summary of Limitations
	Summer 1m/s Rating (Amps)	Shoulder 1m/s Rating (Amps)	Winter 1m/s Rating (Amps)	Winter Emergency Rating (Amps)	Summer	Shoulder	Winter	Winter Emergency	



Powerlink Feeders

Feeder Number	Ratings				Limitations				Summary of Limitations
	Summer 1m/s Rating (Amps)	Shoulder 1m/s Rating (Amps)	Winter 1m/s Rating (Amps)	Winter Emergency Rating (Amps)	Summer	Shoulder	Winter	Winter Emergency	
									

Powerlink Transformers

Description			Ratings			Limitations			Summary of Limitations
Substation Name	Transformer Name	HV (kV)	Normal Cyclic (MVA)	2 hour Emergency (MVA)	10 Minute Emergency (MVA)	Normal Cyclic (MVA)	2 hour Emergency (MVA)	10 Minute Emergency (MVA)	

Powerlink Transformers

Description			Ratings			Limitations			Summary of Limitations
Substation Name	Transformer Name	HV (kV)	Normal Cyclic (MVA)	2 hour Emergency (MVA)	10 Minute Emergency (MVA)	Normal Cyclic (MVA)	2 hour Emergency (MVA)	10 Minute Emergency (MVA)	