Information Paper from the System Operator

Purpose

1. The Authority and Transpower New Zealand Limited (Transpower), in its role as system operator, are seeking to agree and execute a new System Operation Service Provider Agreement (SOSPA) this financial year, to substantively come into effect on 1 July 2016. As part of the new SOSPA Transpower, at the request of the Authority, is to provide information to the electricity industry about:

   (a) the current SOSPA revenue arrangements, and in particular how the capex fee is determined and the reasons for the increase in the period 2009/10 to 2015/16, and the amount of historic capital expenditure to be recovered in the five year period starting 1 July 2016 (see section 1); and

   (b) the key projects comprising Transpower's draft two year capital plan with a high-level capital roadmap of proposed works for years three and four for the system operator service from 1 July 2016 under a new SOSPA, if executed (see section 2).

2. The following information in sections 1 and 2 is being shared with stakeholders for information purposes only and does not comprise part of the consultation documentation the Authority is seeking your feedback on, given the Authority has no decision or approval rights in relation to the matters which are the subject of this information.

Section 1 (Information Paper from the System Operator)

Current system operator service provider agreement revenue arrangements

3. Transpower receives a service fee for providing the system operator services under the current System Operator Service Provider Agreement dated 12 August 2009 (current SOSPA), which was negotiated with the then Electricity Commission. The fee primarily comprises:

   (a) fixed operating expenditure (subject to CPI adjustment annually), which includes staff costs and other operating expenses;

   (b) capital expenditure to acquire, replace or enhance equipment and software such as the technology-related assets – calculated three-yearly based on a capital recovery methodology (explained below).

4. The capital expenditure is forecast and fixed three-yearly in advance on the basis of the known recovery over those three years for existing commissioned assets and the project cost of assets planned to be delivered in that three year funding period (as set out in the capital expenditure plan for the system operator service). Transpower consults with the Authority on the capital expenditure plan on which the fee is forecast and fixed in advance. The Authority provides feedback on the draft capital expenditure plan, but it is Transpower who ultimately determines the final plan.

5. At the end of the three year period there is a comparison of the capital expenditure forecast at the start, and the actual capital expenditure known at the end of that period. The capital expenditure funding is then 'washed-up' with any difference refunded to the Authority if the fee was too high (i.e. if the forecast expenditure exceeded the actual), or recovered from the Authority if the fee was too low (i.e. if the actual expenditure exceeded the forecast). Reasons for the wash-up can be cost differences, commissioning timing differences and any tax or accounting life changes. Transpower and the Authority each have the capital funding model calculations and asset register underpinning that funding model audited by third party auditors when a wash-up is applied.

Current capital expenditure approach to cost recovery and its impact

6. The majority of the capital component of the service fee in any given year is comprised of recovery of the cost of existing commissioned assets and the projected cost of assets planned to be delivered in that year.

7. Transpower applies a deferred recovery approach to recovering capital expenditure similar to the Transmission asset owner. All capital investment made by Transpower in its role as system operator, whether initiated by Transpower or the Authority, is funded by Transpower and then recovered from the Authority over the expected life of the resultant fixed asset.

8. The amount recovered by Transpower includes a return on investment component, which is equal to the Commerce Commission's determined post-tax weighted average cost of capital applied to Transpower's regulated grid business for 5-year regulatory control periods (from 2015/16 it is 6.44%).

9. Transpower also recovers the effect of taxation including through capital tax depreciation benefits to the Authority.

10. This means that Transpower's recovery of its investment is not spread evenly over the asset's life. For illustrative purposes – if a $1.0m asset with an accounting life of five years, and a tax depreciation rate of 50% is commissioned in October the fee in nominal dollars will be $1.227m recovered over six years, with the fee:

    (a) in the first year significantly impacted by the application of the tax depreciation benefit, which is on a diminishing value basis;

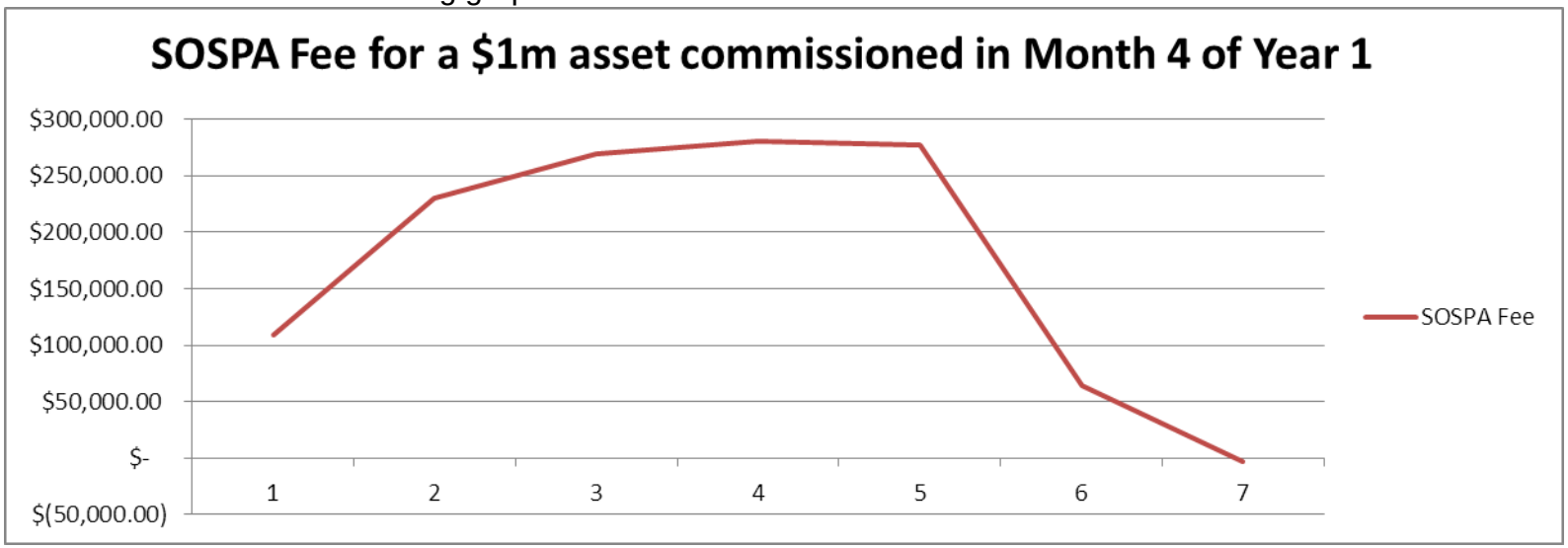
    (b) increasing sharply in the second year, with smaller increases in the third, fourth and fifth years;

    (c) significantly reducing from year 6 (when it is fully depreciated for accounting purposes, but not for tax purposes),

    as illustrated in the table below.

$1.0m Capex, October Commissioning		Made up of:						
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Year 7 fee history for Project Commissioned								
SOSPA Fee	$ 1,226,574.34	$ 108,665.97	$230,126.74	$269,605.03	$280,399.74	$276,852.65	$ 64,509.66	($ 3,585.45)

This is illustrated in the following graph.



Cost of recovering capital expenditure increased in 2009/10 to 2015/16

11. Transpower's ability to operate the power system and electricity market in real-time, and ensure security of the electricity system is reliant on a number of complex information and management systems[1].

12. As a minimum these systems must be kept functional to enable the operation of the electricity market and power system. This includes the lifecycle maintenance of the systems and new requirements such as addressing cyber-security risks. By their nature these systems are critical to the operation of the electricity market and power system and must have a high level of reliability, redundancy and availability. The market systems support an average of $3.5 billion in electricity market trades per annum.

[1]The market systems cost approximately $70m to develop and commission, under the current SOSPA the Electricity Commission set the accounting value of the system at $33.6m.

13. The increase in system operator costs from 2009/10 to 2014/15 included significant increase in the capital component of the fee as a result of the unwinding of tax benefits earned early in the lifecycle of an asset (explained above in the capital recovery model section and as set out in Schedule 1 of the current SOSPA[2]) and due to capital spend.

14. Capital spend was relatively low in 2009/10 and 2010/11 immediately following the commissioning of the market systems project (since the system was new with no significant maintenance requirements). At that same time the tax depreciation benefits were particularly high that were passed on to the Authority and reduced the fee. Capital spend then grew through both Transpower's projects and implementation of market design projects for the Authority.

15. Lifecycle replacement and cyber-security projects dominate the capital expenditure planned for 2015/16 and 2016/17, with Transpower's planned spend for 2015/16 reduced to $9m and the Authority's forecast spend reduced to $2.5m. From 2016/17 onwards the funding of the system operator service will be covered by a new system operator service provider agreement (new SOSPA) which is currently being finalised between Transpower and the Authority.

Amount of historic capital expenditure to be recovered in the next five years

16. Under the capital recovery approach in the current SOSPA there is $44.0m of residual capital expenditure to be recovered by Transpower from the Authority in the next five years for capital investments underway on, or commissioned on or before, 30 June 2015.

17. The historic capital expenditure for the assets set out below relates to capital assets commissioned or projects underway as at 30 June 2015, the majority of which will be recovered by the end of 2020/21. The building and leasehold improvements of

[2] Clause 2.1 of Schedule 1 of the current SOSPA (available on the Authority's website https://www.ea.govt.nz/operations/market-operation-service-providers/system-operator/what-the-system-operator-does/) sets out the components of the base fee, including tax. It shows the significant tax benefit in 2009/10 and its unwinding:

Description	**2009/10 $000**	**2010/11 $000**	**Subsequent years $000**
Tax	(4,208)	(349)	[As per clause 6 of Schedule 4]
Total base fee received from the EC	25,084	29,500	[Parties to complete when amounts inserted from clause 6 of Schedule 4]

$6.8 million will be recovered over their remaining asset lives, which are up to 33 years in relation to the North Island Control Centre. The difference in recovery periods reflects the difference in accounting lives on these assets.

18. The key assets to which this amount of historic capital expenditure relates are:

Originator	Asset Short Description	Asset Value 30 June 2015	Description
Transpower	Market System Upgrade	$8.5m	Major market system upgrade 2009
Transpower	Building & Leasehold Improvements	$6.8m	System Operations National Co-Ordination Centre & associated assets including water supply, air conditioning & office furniture. Also includes leasehold improvements as relates to System Operations in leased premises.
Transpower	Ongoing Market System Projects	$4.9m	Market System Projects, Enhancements, Upgrades & Replacements
Transpower	Software/System Upgrades	$2.3m	Enterprise Service Bus Architecture & Design Review – the tool used for interfacing between the market systems and other systems, including third party systems.
Transpower	Software/System Upgrades	$2.1m	Market System Server Upgrade – the hardware on which various market systems software runs.
Transpower	Software/System Upgrades	$1.0m	Remedial Action Scheme – the tool used to model remedial action schemes for contingency analysis.
Transpower	Other Software/System Upgrades	$4.7m	Various other software and system upgrades excluding key software and system upgrade items listed above – including AIX System Upgrade, Reserves Management Tool (TSAT), EDF Upgrade, MOI Production & Training
Authority	Market Initiatives	$2.6m	Dispatchable Demand

Originator	Asset Short Description	Asset Value 30 June 2015	Description
Authority	Market Initiatives	$1.4m	Multiple Frequency Keeping (MFK) including MFK South Island.
Authority	Market Initiatives	$0.6m	Demand Side Bidding & Forecasting.
Authority	Market Initiatives	$0.6m	Wind Forecasting & Scarcity Pricing
Transpower	Electronic Data & Equipment	$1.3m	Including Desktop Replacements, Communications Equipment incl Phone System
		$36.8m	**TOTAL**

19. The difference between the 36.8m and the $44.0m is that the $36.8m is the existing accounting net book value of the assets in real dollars. The $44.0m is the remaining revenue that Transpower will derive from these assets in nominal dollars, including Transpower's regulated weighted average cost of capital (WACC) return.

20. The expectation of the Authority and Transpower is that Transpower is kept whole for its investments in these assets, some of which are investments driven by the Authority under its market design work initiatives.

21. Under the new system operator service provider agreement (new SOSPA) being negotiated with the Authority, Transpower will recover the majority of the amount of this historic capital expenditure over the period from 2016/17 to 2020/21. As mentioned above the fee payable each year by the Authority is based on the depreciating net book value of the asset plus tax and WACC (a regulated amount of return on investment).

Section 2 (Information Paper from the System Operator)

Transpower's draft capital plan and draft capital roadmap for 2016/17 to 2019/20

The Authority and Transpower, in its role as system operator, are seeking to agree and execute a new SOSPA this financial year, to substantively come into effect on 1 July 2016. The new SOSPA, if executed, would require Transpower, in its role as system operator, to have a rolling two year capital plan with a high-level capital roadmap of proposed works for years three and four.

Transpower must finalise its first capital plan and capital roadmap for the period starting in 2016/17 on or before 30 June 2016. At this stage, Transpower has a draft capital plan for the period starting in 2016/17 and draft capital roadmap for the period starting in 2018/19. It has agreed with the Authority to annually provide industry with some high-level transparency on the key projects currently comprising such draft capital plan and draft capital roadmap. There may be some change between the current draft capital plan and draft capital roadmap and the final plan and roadmap determined on or before 30 June 2016.

The following information is being shared with stakeholders for information purposes only and does not comprise part of the consultation documentation the Authority is seeking your feedback on or in respect of which the Authority makes a decision following consideration of your feedback.

Aiming to deliver fit-for-purpose outcomes that are value-for-money

Transpower has undertaken a robust planning process aimed to deliver a draft 2016/17 and 2017/18 capex plan, and draft 2018/19 and 2019/20 capital roadmap that provide fit-for-purpose outcomes representing value-for-money.

Transpower is aware its ability to operate the power system and electricity market in real-time, and ensure security of the electricity system is reliant on a number of critical and complex information and management systems. As a minimum these systems must be kept functional to enable the operation of the electricity market and power system. This includes the lifecycle maintenance of the systems and new requirements such as addressing cyber security risks. By their nature these systems are critical to the operation of the electricity market and power system and must have a high level of reliability, redundancy and availability.

Composition of draft capital plan and draft capital roadmap

The draft capital plan and draft capital roadmap include projects falling within the capex classifications summarised as follows:

- **Service maintenance projects** – capital expenditure where the primary purpose of the project is to maintain the system operator service Transpower provides. In addition to lifecycle and security work, this includes incremental investment in reducing the risk posed by the complexity of critical capabilities by remediating some of the technical debt and improving the non-functional qualities (such as fail-overs, logging, monitoring, and switch-overs etc) to maintain the resilience and reliability of the service. It also includes initiatives to maintain the functional capabilities of the market system to maintain the quality of the system operator service including delivery of the Principal Performance Obligations (**PPOs**) in an evolving industry environment.

- **Building and equipment projects** – capital expenditure in relation to buildings and equipment (excluding market system and associated information and communications technology) where the majority of the cost of the capital project is attributed to Transpower in its role as system operator.

- **Transpower ACAM projects** – capital expenditure initiated by Transpower's regulated transmission business where Transpower in its role as system operator is accountable for the incremental cost of the project under the Avoidable Cost Allocation Method (**ACAM**) methodology set down by the Commerce Commission.

- **Service enhancement projects** – capital expenditure where the primary purpose of the project is to deliver new or materially different capability or services (not being a market design project and not required for the Provider to meet its PPOs as a result of change to the law or Electricity Industry Participation Code) to participants which will result in changing, enhancing or introducing new market system tools and/or interfaces that are directly available to participants.

Transpower determines the projects comprising its capital plan and roadmap

Transpower determines the projects it proposes and carries out under the service maintenance, TP ACAM and building and equipment classifications. If the new SOSPA is finalised and executed, the funding for these projects would be covered by a fixed

fee paid to Transpower by the Authority. Transpower informs the Authority, and in turn through this document, stakeholders as to the key projects comprising its draft capital plan and draft capital roadmap.

Service enhancement projects are also included in Transpower's capital plan and signalled in its capital roadmap. However, before Transpower embarks on any capital expenditure for service enhancement projects it would require the Authority's agreement to seek funding for the projects through the relevant appropriations process, which would be subject to consultation with stakeholders. There are two service enhancement projects proposed for the 2017/18 year on the draft capex plan, and the system operator would consult on these projects prior to, or during, the Authority's appropriation consultation process in the final calendar quarter of 2016.

Strategy-based work programme

Transpower's 2015-2020 Strategic Plan for the system operator service and its ICT strategic roadmap have been applied to the development of its work programme comprising its draft capital plan for 2016/17 and 2017/18 and subsequent draft capital roadmap for 2018/19 and 2019/20.

This information paper sets out a summary of key proposed:

- capital plan projects for 2016/17 and 2017/18; and
- capital programme projects or programmes of work for 2018/19 and 2019/20.

Where possible, indicative timing has been provided for the proposed projects on the draft capital plan and draft capital roadmap.

Key proposed projects comprising draft capital plan for 2016/17 and 2017/18

Key proposed service enhancement projects

Project no.	Proposed project name and description	Why we're doing the proposed project	Timing
E3	**EDF Improvements – Phase III**: Implement alternative network routes for generators to Transpower's datacentres and alternative dispatch protocols based on ICCP and/or web services	EDF is a component of the market system that sends dispatch instructions to generation companies. Generators are currently bound to use GenCo and get support from Realtek. This project aims to standardise the messaging protocol to ICCP and/or to Web Services (which is above the networking layer, VPN etc) so new entrants can procure/develop their own software to receive/process dispatch instructions and select their preferred vendor for connecting with Transpower in case of an emergency. Transpower has been engaging with participants on this project and as it is a service enhancement project participants will be consulted prior to the Authority seeking appropriations from the Crown in relation to the 2017/18 financial year.	Whilst capital expenditure is expected to commence in 2017/18, the assets arising from this project are not expected to be commissioned until September 2018.

Key service maintenance proposed projects

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
		Service maintenance – IT lifecycle	
M4	**Citrix Migration to Market System Virtual Infrastructure**: Separation of market system environment from the enterprise citrix environment and migration to the market system virtual infrastructure.	The market system citrix solution delivers remote desktop sessions for market operator interface and other administrative functions. Currently the market system (which is classified as a Critical System) shares the citrix service with Transpower's enterprise system. This means the security implemented for the enterprise system (which has a lower security classification) may not be appropriate for the market system citrix solution, and market system availability and reliability via the citrix solution is impacted by the high volume of enterprise system changes. The cyber security risk is such that this citrix environment will be separated from the enterprise citrix environment and migrated to the market system virtual infrastructure. In addition to improving security, this will also improve market system availability and reliability.	This project is inflight and the assets from this project are expected to be commissioned in May 2017.
M5	**Market System Oracle Upgrade and OS/Infrastructure Replatform**: Lifecycle refresh for Oracle 11gR2 database server and replatform of	This project relates to the Oracle database server and the platform for the market system. The Oracle database for the market system has been in extended support since January 2015. Beyond January 2018 the Oracle 11gR2 software will be unsupported, unless Transpower procures sustained support. Transpower does not consider sustained support	This project commences in 2016/17 and assets arising from this project are expected to be commissioned in December 2017.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
	the market system from a P7 Platform to the most cost effective solution.	for critical market system database servers to be a feasible option. This project involves upgrading the database to a more recent version of Oracle that offers optimal release stability and maximum lifecycle value. It will also involve upgrading associated connection tools and software. The project also provides for a like-for-like replacement of the platform for the market system, although the replacement hardware is likely to have greater functionality given technology advances over the last seven years. The platform would be replaced in June 2017 – at a time when it would have been used for seven years and would be out of extended support two months later. Failure to replace the platform at that point brings a greater risk of hardware failure and the risk and cost of sustained support.	
M11	**Fileshare scripts replacement**: Lifecycle replacement with functionality that can be readily sourced from a commercial product.	Market fileshare scripts are a component of the market system created to manage file transfers between the market system and external systems, between market system's internal components, and to perform archiving and purging of data. Fileshare scripts are written using software (Active Pearl and VB6) that is unsupported. This project is about refreshing the current fileshare scripts and moving the scripts to a supported version of software. It makes sense to take advantage of the Enterprise Service Bus (**ESB**) project currently underway in 2015/16 and move the files to	This project commences in 2016/17 and the assets arising from this project are expected to be commissioned in September 2017.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
		this single platform. Doing so simplifies the technology footprint, and reduces capital refresh costs in future.	
M12	**SAT Replatform**: Replatforming the Situational Awareness (**SAT**) tool to a supported platform, and putting the pilot into production.	The SAT tool was developed as a pilot to run in parallel with the constraints visualisation tool that was implemented into the real-time environment in 2004. Since the pilot began the constraints visualisation tool is no longer used and the SAT tool is in operational-use 24 hours a day, 7 days a week, 365 days a year in the real-time environment. It is a security focused application using current SCADA and bids and offers information. The SAT tool is also used by Transpower's markets team in the system operations division to provide the team with visualisation of constraint effects on pricing and increased situational awareness of the power system. The tool is currently situated on an unsupported platform. This project is simply about moving it to a supported platform.	This project commences in 2015/16 and the assets arising from this project are expected to be commissioned in June 2017.
M13	**NCC Desktop Refresh**: Refresh existing desktop and monitor hardware in Wellington and Hamilton National Control Centres (**NCC**) and training rooms.	This project is the like-for-like replacement of existing hardware in the NCCs for the system operator service. The hardware is on a 4 year replacement cycle. Transpower leverages industry practice guidance and vendor guidelines when determining replacement periods. This hardware is used 24 hours, 7 days a week and 365 days a year. Guidance and guidelines for such hardware used in normal	This project commences in 2016/17 and the assets arising from this project are expected to be commissioned in December 2016.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
		business hours is 4 to 6 years depending on the risk profile. As NCC use is at the higher end of the risk profile and the hardware is used 3 times as much as normal business hours, then Transpower has determined a 4 year replacement. The cost of the replacement includes hardware, software and professional service costs to build, test and deploy the desktops and monitors and dispose of the old hardware.	
MSICT01	**ESB Upgrade (Fuse) #1**: Upgrading the Fuse Enterprise Service Bus (**ESB**) Platform.	The Fuse ESB Platform for the market system will be unsupported, unless Transpower procures sustained support. Transpower does not consider sustained support to be a feasible option for the platform on which the software providing for communication between the market system and third party systems runs. This project is to upgrade the Fuse ESB Software Platform to a supported version.	This project commences in 2016/17 and the assets arising from this project are expected to be commissioned in June 2017.
Service maintenance – IT security			
M8	**Active Directory Segregation**: Dedicated Active Directory (**AD**) for market system to improve availability and resilience.	AD is a centralised system service that acts both as a repository for market system user information and provides authentication and authorisation to access critical functions within the market system. The market system currently shares this service with Transpower's enterprise system, which has a lesser security classification. The market system availability and reliability is impacted by the high volume of changes to the enterprise systems and the security implementation for the enterprise system may not be sufficient for	This project commences in 2015/16 and the assets arising from this project are expected to be commissioned in April 2017.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
		the market system, which has a security classification of Critical System. This project separates the critical AD services from the enterprise AD services and consequently improves the security of the market system in accordance with its classification.	
M9	**EDF Improvements – Phase II**: Migration of Electronic Dispatch Function (**EDF**) to the most secure IST network.	EDF is a component of the market system that sends dispatch instructions to generation companies. This critical component is currently located in a network domain within Transpower's IST network. The classification of this network domain is such that it currently has insufficient maintenance and security monitoring. This project migrates the EDF component to the Critical Gateway Zone in Transpower's IST infrastructure, improving the security of the market system and reducing the number of vulnerability risks and system security breaches. Transpower has been engaging with participants in relation to this project.	This project commences in 2015/16 and the assets arising from this project are expected to be commissioned in June 2017.
M27	**User Access Controls**: Migration of market system users to use the new security infrastructure set up by Transpower's regulated grid business.	Security controls for user access to the market system are not sufficient for a system classified, for security purposes, as being a Critical System. This project reviews the misalignment in security measures and controls and implements appropriate measures and controls to ensure better security for the market system.	This project commences in 2016/17 and the assets arising from this project are expected to be commissioned in June 2017.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
Service maintenance – IT reliability and resilience			
M19	**Market System Simplification Stage #1**: Simplification of the most critical and complex areas of the market system database.	This is the first of four market system database simplification projects comprising a simplification programme. The aim of this programme of work is to simplify the most critical and complex areas of the market system database to remove the embedded application and workflow logic to the new platform. This will modularise 15 of the most critical functional area(s) within the market system database, which in turn makes future business change relatively simpler to implement. This programme is about mitigating the risk of having to replace the market system by investing in the current system to ensure reliability and resiliency of the system is maintained, given the medium to moderate change being applied to the system. It also contributes to minimising the cost of otherwise increasing technical debt. Simplification also enables Transpower, in its role as system operator, to be more agile in resolving issues and implementing market system changes and market developments.	This project commences in 2017/18 and the assets arising from this project are expected to be commissioned in May 2018.
Service maintenance – IT operational improvement			
M14	**Centralised logging system**: Implementing a centralised logging system.	These two projects (M14 and M15) are about enabling more time efficient identification and more effective monitoring of, and insight to, issues with the market system. Transpower is steadily encountering more issues with the market system. If it does not improve the tracking of issues then it risks an	This project (M14) commences in 2017/18 and the assets arising from this project is expected to be commissioned in February 2018.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
M15	**Centralised insight and monitoring**: Centralised mechanism for analysing and reporting of logged market system event data and app log messages.	event that takes an unacceptable period of time to identify and restore the market system. Transpower has delayed the implementation of these projects to leverage deliverables from the ESB and PRISM projects currently underway in 2015/16.	This project (M15) commences in 2017/18 and the assets arising from this project is expected to be commissioned in March 2018.
M28	**Environment Automation Programme**: Increasing levels of automation of market system environments, environment provision and management.	Due to the high volume of market system change, initiated by Transpower and the Authority alike, there is a need to release software frequently into production. Transpower's current approach relies heavily on manual processes, which are inefficient and prone to error. For example, a recent proposal to establish a new test environment estimated an implementation would take more than a month. This project aims to reduce this to days. This project would focus on automating the provisioning and set-up of market system environments, environment management and establishing a project self-service portal for environmental provisioning and management. Accordingly, it is expected to contribute towards reducing costs for future capital projects (such reduction being a one-off reduction) but will only be approved for delivery in the event it is justified with a cost benefits analysis at Transpower business case stage.	This project commences in 2016/17 and the assets arising from this project are expected to be commissioned in June 2017.
M29	**Regression test suite automation**: Implementing test suite	Transpower currently has manual regression testing for market system projects. The manual system, which provides a repeatable	This project commences in 2016/17 and the assets arising from this project are expected

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
	automation for regression tests.	process and testing framework for regression testing, is inefficient. This regression test suite automation project would increase efficiencies associated with regression testing. Transpower expects it to be an enabler to ensure regression testing cost of future projects remains constant. The project would only be approved by Transpower for delivery in the event it is justified with a cost benefits analysis at Transpower business case stage.	to be commissioned in April 2017.
		Service maintenance – system operator maintain services	
M7	**TTSE Upgrade**: Upgrading/replacing the training simulator for the system coordinators with appropriate functionality.	This project is due to commence in 2015/16 and has two limbs to it. The first limb is that the training simulator for the system coordinators need to be brought in-line with the updated real-time system (e.g. to adequately represent HVDC controls and other assets now forming part of the national grid). The second limb deals with existing operational issues with the TTSE tool itself, which need to be resolved to ensure it has appropriate functionality.	This project commences in 2015/16 and the assets arising from this project are expected to be commissioned in June 2017.
M25	**System Operator non-market system support tools 16/17**: Upgrades to non-market system tools.	There are a number of non-core market system tools supporting Transpower's system operator processes. Over time such tools require replacement and/or functional enhancement to ensure Transpower could continue to deliver a competitive electricity market with security.	This project commences in 2016/17 and the assets arising from this project are expected to be commissioned in June 2017.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
		In 2016/17 Transpower intends, at this stage, to enhance the functionality of the asset capability database, the system operator events database and to integrate the contracts database.	
M26	**System Operator non-market system support tools 17/18**: Upgrades to non-market system tools.	There are a number of non-core market system tools supporting Transpower's system operator processes. Over time such tools require replacement and/or functional enhancement to ensure Transpower can continue to deliver a competitive electricity market with security. At this stage Transpower has a range of non-core market system tools that may be included in this project, such as upgrading the system operations modelling database, the dispensations database, the system operator rule map, the corporate PI and operational improvements to data warehouse and Oracle Business Intelligence Enterprise Edition. The scope of the project would be finalised closer to 2017/18.	This project commences in 2017/18 and the assets arising from this project are expected to be commissioned in June 2018.
MSICT21	**MS Service Level Optimisation to Support Functional Growth**: Increasing compute capacity and/or tuning for performance of the application.	As business capability and functions continue to be implemented the scale and volume of demand on the market system increases. This means system performance can be stressed and deteriorate, with existing performance limitations magnified. This project is consistent with best practice and aims to proactively address known performance limitations and procure additional compute (storage, memory and server) capacity to accommodate organic growth of business driven change.	This project commences in 2017/18 and the assets arising from this project are expected to be commissioned in November 2017.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
E6	**Enhancement Information Displays**: Upgrade or replace the current control room visualisation tool to increase visibility of forecasts and market situations.	This is the first step in a journey of greater situational awareness. This tool would provide increased visibility of forecasts, data and the market situation in real-time, including real-time bids and pricing. It would enhance the co-ordinators ability to foresee and accommodate increased power system complexity (e.g. further special protection schemes) and market complexity (e.g. reduced gate closure, national reserves etc). The aim of enhanced information display is to reduce the occurrence of system events, including high-price system events.	This project commences in 2017/18 and the assets arising from this project are expected to be commissioned in June 2018.
E7	**Scenario Analysis**: Systems enhancing visibility of input data sensitivity through sensitivity analysis.	The NCCs require a high-level of situation awareness to ensure the co-ordinators are prepared for unexpected system changes. A key factor of situation awareness is knowledge of the impacts of system events and understanding their effect on generation dispatch. At present, unexpected changes in output can result in sub-optimal dispatch of more expensive generation. This project aims to enhance co-ordinator's visibility of input data through the use of scenario analysis, and introduce systems enabling ad hoc scenarios to be run with all input parameters modified. The project, once completed, would provide co-ordinators with immediate knowledge of possible system outcomes, enabling time to prepare suitable mitigations prior to the occurrence of an event.	Whilst capital expenditure is expected to commence in 2017/18, the assets arising from this project are not expected to be commissioned until June 2019.
E8	**Sensitivity Analysis**:	The NCCs require a high-level of situation awareness to ensure the	Whilst capital expenditure is

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
	Systems enhancing visibility of input data sensitivity through sensitivity analysis.	co-ordinators are prepared for unexpected system changes. A key factor of situation awareness is knowledge of the impacts of system events and understanding their effect on generation dispatch. At present, unexpected changes in output can result in sub-optimal dispatch of more expensive generation. This project aims to enhance co-ordinator's visibility of input data through the use of sensitivity analysis, and introducing sensitivity analysis functionality into Scheduling Pricing and Dispatch cases to provide greater understanding of the sensitivity of schedule inputs. The project, once completed, would provide co-ordinators with immediate knowledge of possible system outcomes, enabling time to prepare suitable mitigations prior to the occurrence of an event. Generators and price sensitive loads would be able to utilise the same schedules to efficiently plan their scheduling.	expected to commence in 2017/18, the assets arising from this project are not expected to be commissioned until June 2019.

Key proposed building and equipment projects

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
B1	**NCCN Building Upgrade Phase 2 – Remainder** Refurbishing the interior and exterior of the	Following a number of building services failures at various Transpower critical sites, a risk review of all of Transpower's critical sites was carried out by BECA in 2011. This included Transpower's control centre for the system operator service in Hall Road in Hamilton. This review found an accumulation of upgrade work was	This project is inflight and the assets arising from this project are expected to be commissioned in December

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
	premises.	required for the relevant services to operate reliably to support the continued, uninterrupted operations of this control centre. This accumulation of work has been carried out over a period of time, with the most critical and urgent work carried out first. This project provides for refurbishing the interior and exterior of the premises.	2016.
B3	**NCCN Building Upgrade Phase 4a**: Upgrading the boundary security fence for the premises.	See B1 for the reason why Transpower is doing this proposed project. This project provides for upgrading the boundary security fence for the premises.	This project commences in 2017/18 and the assets arising from this project are expected to be commissioned in June 2018.
B4	**NCCN Building Upgrade Phase 4b**: Replacing the glass in the building and its water supply, as well as refurbishing the road and car park surfaces.	See B1 for the reason why Transpower is doing this proposed project. This project provides for replacing the building glass and its water supply, as well as refurbishing the private road and car park surfaces.	This project commences in 2016/17 and the assets arising from this project are expected to be commissioned in June 2018.

Key proposed Transpower ACAM projects

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
TP2	**Wellington office relocation – system operator componen**t: Relocation to new building in Boulcoutt Street in 2017.	Transpower's existing lease at 96 The Terrace is coming up for renewal in October 2017. At that time Transpower will relocate to 22 Boulcott Street in Wellington. The new building is highly energy efficient and meets 100% of current seismic ratings for commercial buildings (with some areas rated at 130%). Most of the cost of the relocation will be met by Transpower's regulated grid business. However, the incremental costs arising as a result of the system operator team being part of Transpower will be met by Transpower in its role as system operator. This project relates to the system operator's component of the office relocation.	The assets arising from this project are expected to be commissioned in October 2017.

Key proposed projects/programmes of work comprising draft capital roadmap for 2018/19 and 2019/20

Key proposed service enhancement projects/programmes of work

Project no.	Proposed project name and description	Why we're doing the project	Proposed Timing
E3	**EDF Improvements – Phase III**	*Note: As this project is not expected to commission until September 2018 it currently spans and appears on both the draft capital plan and draft capital roadmap.* EDF is a component of the market system that sends dispatch instructions to generation companies. Generators are currently bound to use GenCo and get support from Realtek. This project aims to standardise the messaging protocol to ICCP and/or to Web Services (which is above the networking layer, VPN etc) so new entrants can procure/develop their own software to receive/process dispatch instructions and select their preferred vendor for connecting with Transpower in case of an emergency. Transpower has been engaging with participants on this project and as it is a service enhancement project participants will be consulted prior to the Authority seeking appropriations from the Crown in relation to the 2017/18 financial year.	Whilst capital expenditure is expected to commence in 2017/18, the assets arising from this project are not expected to commission until September 2018.
MS121	**Medium Term Load Forecasting (MTLF)**: Improved MTLF integrated into the market system.	This project introduces cost effective improvements to the MTLF tool (which is a critical input to the market schedules). It is expected to result in significant improvements in forecast accuracy (where possible), and the ability to accommodate more intermittent generation and demand side initiatives.	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2019/20.

Key proposed service maintenance projects

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
Service maintenance – ICT lifecycle			
MSICTO3#1	**MS Server Upgrade – Next generation converged infrastructure #1**: Replacing all market system servers, save for the market database platform, to the next generation virtualised converged infrastructure.	This project replaces all market system servers, save for the market database platform, on to a next generation virtualised converged infrastructure. It is best practice to replace servers every 5 years, where such servers are being used for critical services. At the time these servers are replaced the servers will have been used for 5 years. This project procures the server hardware and associated software licensing. It also provides for the infrastructure to be fully tested and commissioned in the datacentres. The migration of relevant applications to the new platform happens as part of other capital projects.	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2019/20.
MSICTO4#1	**EDF Upgrade #1**: Upgrading EDF software to versions supported by the relevant vendors.	EDF is the component of the market system that provides for dispatch instructions to be sent to generation companies. The operating system for EDF would be going out of support. This project upgrades the EDF software to run on a supported, fit-for-purpose, application runtime and operating system.	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2019/20.
MSICTO5#1	**MOI Upgrade #1:** Upgrading the Market	The MOI provides the interface between the market system and the system operation co-ordinators managing the power	This project commences in 2019/20 and the assets arising

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
	Operator Interface (MOI) to ensure it and its underlying technology components are supported on fit-for-purpose platforms.	system and running the electricity market. The operating system for the MOI would be going out of support. This project ensures the MOI and its underlying technology components are upgraded to a supported, fit-for-purpose, platform.	from this project are expected to be commissioned in 2019/20.
MSICTO6#1	**SAD Upgrade #1**: Upgrading the Stand Alone Dispatch (SAD) application to a vendor supported platform.	The SAD application enables system operations coordinators to dispatch instructions when the market system is unavailable in its entirety. The operating system for SAD would be going out of support. This project ensures this critical application is upgraded to a supported, fit-for-purpose, application runtime and operating system.	This project commences in 2019/20 and the assets arising from this project are expected to be commissioned in 2020/21.
MSICTO9#1	**Genco Tutor Upgrade #1**: Upgrading the Genco Tutor application and supporting technology components to vendor supported versions.	The Genco Tutor application provides simulation for the system operator to test dispatch schedules and scenarios, given there is no test environment connecting the market system to generators. The operating system for Genco Tutor would be going out of support. This project ensures the Genco Tutor application and supporting technology components are upgraded to a supported, fit-for-purpose, platform.	This project commences in 2019/20 and the assets arising from this project are expected to be commissioned in 2019/20.
MSICT11#1	**Migrate Servers (Physical / Virtual) #1**: Migration of the contents	This project follows on from project MSICT03#1 and shares the same purpose.	This project commences in 2019/20 and the assets arising from this project are expected

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
	of the current physical and/or virtual servers on to the new generation converged infrastructure implemented in project MSICT03#1.	It provides for the migration of the contents of the current physical and/or virtual servers on to the new generation converged infrastructure implemented in project MSICT03#1.	to be commissioned in 2020/21.
MSICT15#1	**Market Systems Firewall Upgrade #1**: Five year refresh to upgrade the hardware and software for the security enforcement points for the market system.	The market system Security Enforcement Points (SEP) hardware will be almost end of life, unless extended support is procured. Procuring extended support is uneconomical. This project provides for an upgrade of the hardware and software for the SEPs for the market system to ensure it is supported.	This project commences in 2019/20 and the assets arising from this project are expected to be commissioned in 2019/20.
MSICT16	**RedHat Enterprise Linux Upgrade (Market System Scope Only)**: Upgrading the Red Hat Enterprise Linux Servers to supported versions.	This project ensures the Red Hat Enterprise Linux Server software is upgraded to supported, fit-for-purpose, versions.	This project commences in 2019/20 and the assets arising from this project are expected to be commissioned in 2020/21.
SOToolsICT01#1	**SO Website Upgrade #1**: Refreshing the existing SO website to a supportable Drupel	The System Operator website runs on the Drupel platform. The supported life of Drupel is four years. The System Operator website is due to be refreshed on to an up to date version of Drupel in 2018/19. This project provides for the refresh of the existing website to	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2018/19.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
	version.	the supported, fit-for-purpose, Drupel platform.	
SOToolsICT02#1	**POCP Database Migration/upgrade #1**: Refreshing the industry outage coordination system (**POCP database**) to ensure it is supported.	The POCP database provides Transpower as system operator with an industry outage coordination system, which is critical to the reliable operation of the power system and electricity market. The POCP database is required to be updated four-yearly to maintain the application in a supported state. This project provides for the refresh of the POCP database application to a supported, fit-for-purpose, version.	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2018/19.
SOToolsICT06#1	**Power Tech Tools Upgrade (SO Scope Only)**: Upgrading the Power Tech Tools to ensure the applications remain in a supported state.	The Power Tech Tools are used to monitor the power system with data connections to SCADA/EMS systems. The tools are important for ensuring the reliable and efficient operation of the power system and electricity market. This project provides for an upgrade of the Power Tech Toolset to ensure it is a supported, fit-for-purpose version.	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2019/20.
SOToolsICT03#1	**QuestionMark Tool Upgrade**: Upgrading the QuestionMark tool to ensure the software is up to date and in a supported state.	The QuestionMark Tool is used to create and deliver training modules and assessments associated with co-ordinators initial and ongoing training. This project provides for a technology refresh to ensure the QuestionMark software is a supported, fit-for-purpose, version.	This project commences in 2019/20 and the assets arising from this project are expected to be commissioned in 2019/20.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
Service maintenance – security			
MSICT34#1	**Market System Security Application #1**: Remediating existing application level security risks and ensuring ongoing compliance with the Government's cyber security requirements.	It is important to ensure our critical market system remains secure and such security levels are consistent with the Government's cyber security requirements. This project has two limbs to it. The first limb is to remediate existing application security risks that need to be fixed. The second limb is to ensure Transpower's security remains consistent with the then cyber security requirements of the Government.	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2018/19.
Service maintenance – IT reliability and resilience			
MSICT20#2	**Market Systems Simplification #2**: Simplification of the most critical and complex areas of the market system database.	This is the second of four market system database simplification projects. The simplification programme has been broken into four phased projects to manage risks better and realise benefits iteratively. Please refer to M19 above for detail.	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2018/19
MSICT20#3	**Market Systems Simplification #3**: Simplification of the most critical and complex areas of the market system database.	This is the third of four market system database simplification projects. The simplification programme has been broken into four phased projects to manage risks better and realise benefits iteratively. Please refer to M19 above for detail.	This project commences in 2019/20 and the assets arising from this project are expected to be commissioned in 2019/20.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
Service maintenance – system operator maintain services			
E7 (MS124)	**Scenario Analysis**: Systems enhancing visibility of input data sensitivity through sensitivity analysis.	*Note: As this project is not expected to commission until June 2019 it currently spans and appears on both the draft capital plan and draft capital roadmap.* The NCCs require a high-level of situation awareness to ensure the co-ordinators are prepared for unexpected system changes. A key factor of situation awareness is knowledge of the impacts of system events and understanding their effect on generation dispatch. At present, unexpected changes in output can result in sub-optimal dispatch of more expensive generation. This project aims to enhance co-ordinator's visibility of input data through the use of scenario analysis, and introduce systems enabling ad hoc scenarios to be run with all input parameters modified. The project, once completed, would provide co-ordinators with immediate knowledge of possible system outcomes, enabling time to prepare suitable mitigations prior to the occurrence of an event.	Whilst capital expenditure is expected to commence in 2017/18, the assets arising from this project are not expected to commission until 2018/19.
E8 (MS128)	**Sensitivity Analysis**: Systems enhancing visibility of input data sensitivity through	*Note: As this project is not expected to commission until June 2019 it currently spans and appears on both the draft capital plan and draft capital roadmap.* The NCCs require a high-level of situation awareness to	Whilst capital expenditure is expected to commence in 2017/18, the assets arising from this project are not expected to commission until

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
	sensitivity analysis.	ensure the co-ordinators are prepared for unexpected system changes. A key factor of situation awareness is knowledge of the impacts of system events and understanding their effect on generation dispatch. At present, unexpected changes in output can result in sub-optimal dispatch of more expensive generation. This project aims to enhance co-ordinator's visibility of input data through the use of sensitivity analysis, and introducing sensitivity analysis functionality into Scheduling Pricing and Dispatch cases to provide greater understanding of the sensitivity of schedule inputs. The project, once completed, would provide co-ordinators with immediate knowledge of possible system outcomes, enabling time to prepare suitable mitigations prior to the occurrence of an event. Generators and price sensitive loads would be able to utilise the same schedules to efficiently plan their scheduling	2018/19.
MS201	**System Operator non-market system support tools 18/19**: Upgrades to non-market system tools.	There are a number of non-core market system tools supporting Transpower's system operator processes. Over time such tools require replacement and/or functional enhancement to ensure Transpower can continue to deliver a competitive electricity market with security. At this stage we have a range of non-core market system tools that may be included in this project. The scope of the	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2018/19.

Project no.	Proposed project name and description	Why we're doing the proposed project	Proposed Timing
		project will be finalised closer to 2018/19.	
MS201	**System Operator non-market system support tools 19/20**: Upgrades to non-market system tools.	There are a number of non-core market system tools supporting Transpower's system operator processes. Over time such tools require replacement and/or functional enhancement to ensure Transpower can continue to deliver a competitive electricity market with security. At this stage we have a range of non-core market system tools that may be included in this project. The scope of the project will be finalised closer to 2019/20.	This project commences in 2019/20 and the assets arising from this project are expected to be commissioned in 2019/20.
MS212	**2nd Generation System Stability Tools (Offline)**: Maintenance of current offline system stability assessment tools to manage future stability issues, including the impact of a lower inertia power system.	Within the next eight years the generation mix of the power system is expected to change with solar and wind generation increasing and thermal generation decreasing. This mix will impact the amount of system inertia available as reserves. System-ride through to unplanned events is currently supported by the high physical inertia of large spinning thermal turbines. This is not the case with solar and wind, which have low physical inertia. This project is about maintaining and refreshing existing current offline system stability assessment tools to manage future stability issues, including the impact of a lower inertia power system. It aims to enable Transpower to maintain reliability and security of a low inertia power system.	This project commences in 2019/20 and the assets arising from this project are expected to be commissioned in 2019/20.

Key proposed building and equipment projects/programmes of work

Project no.	Proposed project/programme of work name and description	Why we're doing the proposed project/programme of work	Proposed Timing
B4	**NCCN Building Upgrade Phase 5**: Replacing Uninterruptible Supply (**UPS**) and UPS batteries and replacing the cooling unit in the UPS.	See B1 above for details of the purpose of this project. This project provides for replacing UPS and UPS batteries, and replacing the cooling unit in the UPS.	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2019/20.

Key proposed Transpower ACAM projects/programmes of work

Project no.	Proposed project/programme of work name and description	Why we're doing the proposed project/programme of work	Proposed Timing
ACAMICT 01#01	**SCADA Upgrade #1**: Upgrading Supervisory Control and Data Acquisition (**SCADA**).	The SCADA system is used by Transpower in its role both as system operator and in operating the grid. SCADA is critical for the operation of the electricity market and power system. SCADA's underlying operating system is Windows 2008. This operating system reaches the end of its life in July 2020. After that time it will be out of support. This project ensures SCADA is upgraded to run on a supported, fit-for-purpose, Windows Operating System.	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2020/21.
ACAMBuild#1	**Building Project 2018/19**: Final building move work – incremental costs for system operator only.	Transpower's existing lease at 96 The Terrace is coming up for renewal in October 2017. At that time Transpower will relocate to 22 Boulcott Street in Wellington. This project relates to the system operator's component of the final building move work that occurs post relocation to the new building.	This project commences in 2018/19 and the assets arising from this project are expected to be commissioned in 2019/20.

Glossary

AIX	Advanced Interactive eXecutive, which is an open operating system designed for large server hardware platform.
Corporate PI	Is a data management system that can extract real-time and historical information from a number of other tools and systems.
EDF	Electronic Dispatch Function, which is a protocol translator that allows dispatch instructions to be sent to the generators from the market system.
EMS	Energy Management System, which is a suite of tools for real-time operation and management of the grid. It includes data acquisition, control, alarming and various automation and network-analysis functions.
MOI	Market Operator Interface, which is the operator interface to the market system applications.
POCP	Planned Outage Co-ordination Process, which is the process through which asset owners submit an outage plan.
PRISM	The project name given to Transpower's Project to Refresh Infrastructure for SCADA and Market Systems. It relates to the installation of an updated version of Alstom's SCADA/EMS application to ensure Transpower continues to operate a fully supported SCADA platform.
SCADA	Supervisory Control and Data Acquisition, which is part of the EMS that deals with measurements made at substations and is capable of controlling certain grid equipment (such as circuit breakers).
Technical debt	This is an intellectual technology term. At a simplistic level

	technical debt means the software architecture and code quality is not ideal. For example, underlying performance and reliability issues may put business at risk. If the debt is not repaid then it will keep on accumulating interest, making it hard to implement changes later on and resulting in increasing maintenance costs and cost of change.
TSAT	Transient Security Assessment Tool, which is a full time-domain simulation tool designed for comprehensive assessment of dynamic behaviour of complex power systems.