SPI PowerNet Pty Ltd

Electricity Transmission Revenue Proposal 2014/15 – 2016/17

Supporting Document – Electricity Safety Management Scheme (ESMS)

Submitted: 28 February 2013

SP AusNet
A member of Singapore Power Group

Electricity Safety Management Scheme

Overview for Electricity Transmission Network

SP AusNet
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ISSUE / AMENDMENT STATUS

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Disclaimer

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1 Introduction

SP AusNet owns, operates and maintains the electricity transmission network in Victoria.

It is a requirement of the Electricity Safety Act 1998 that a major electrical company (MEC) design, construct, operate, maintain and de-commission its supply network to minimise as far as practicable the hazards and risks:

- to the safety of any person, and
- of damage to the property of any person

It is also a requirement of the Electricity Safety Act 1998 that a MEC submit to Energy Safe Victoria, an electricity safety management scheme in respect of the design, construction, operation, maintenance and de-commissioning of each supply network.

Energy Safe Victoria may accept an electricity safety management scheme when it is satisfied that the documented scheme is appropriate to the supply network to which it applies, and that it complies with the Electricity Safety Act and Electricity Safety (Management) Regulations.

A MEC must comply with an electricity safety management scheme which has been accepted by Energy Safe Victoria.

2 Electricity Safety Management Scheme

This Electricity Safety Management Scheme (ESMS) complies with Part 10, Division 2 of the Electricity Safety Act 1998 and Electricity Safety (Management) Regulations 2009. This ESMS consists of four elements:

- ESMS 20-01 Overview;
- ESMS 20-02 Formal Safety Assessment;
- ESMS 20-03 Safety Management System; and
- AMS 10-01 Asset Management System

2.1 ESMS 20-01 Overview

ESMS 20-01 Overview contains a summary of the structure of the ESMS for SP AusNet's electricity transmission network. It also outlines the period of application, the location of ESMS records, exemptions and lists officers responsible for the operation of this ESMS.

2.2 ESMS 20-02 Formal Safety Assessment

ESMS 20-02 Formal Safety Assessment contains a description of the assessment of the safety related risks associated with the assets forming the transmission supply network and their design, construction, operation, maintenance and decommissioning. This description includes the assessment methodology, process, results and treatment.

2.3 ESMS 20-03 Safety Management System

ESMS 20-03 Safety Management System contains a description of the assets forming SP AusNet's electricity transmission network, their location and the associated design, construction, commissioning, operation, augmentation, inspection, maintenance, refurbishment, replacement and decommissioning processes. Specifically, ESMS 20-03 Safety Management System contains information on:

- Safety Policy
- Safety Management
- Technical Standards
- Asset Management Strategies and Plans
- Access Authority System
- Emergency Preparedness
- Monitoring, Audit and Review
- Key Performance Indicators
- Incident Recording, Investigation and Review
- Competence and Training
- Record Management
- Reporting of Incidents

2.4 AMS 10-01 Asset Management System

The safety related risks identified in ESMS 20-02 and the safety management system outlined in ESMS 20-03 are managed and implemented via AMS 10-01 Asset Management System, which integrates the detailed analysis, strategies, plans, standards and processes to manage the assets, including their performance and associated risks, of the electricity transmission network. This ESMS and its associated AMS are underpinned by the following management systems:

- Asset Management System – accredited to PAS 55: 2008
- Health and Safety Management System - accredited to AS/NZS 4801;
- Quality Management System - accredited to AS/NZS ISO 9000;
- Environmental Management System – accredited to AS/NZS ISO 14000; and
- Risk Management System – in accordance with AS/NZS ISO 31000

2.5 Revision

This ESMS applies to SP AusNet's electricity transmission network for a period of up to 5 years from the date of acceptance by Energy Safe Victoria or for a period of up to 5 years from the date of acceptance of a formal revision of this ESMS.

2.6 Records

Records relating to this ESMS are retained at the SP AusNet offices located at: Level 31, 2 Southbank Boulevard, Melbourne, Victoria, 3006. Telephone: (03) 9695 6000.

3 Exemptions

3.1 Electricity Safety Act

Under the Order in Council G17 dated 24 April 1999 (part 2 of Order Section 4 (1) (b) of the Electricity Safety Act 1998) electrical installations within SP AusNet terminal stations, communications sites and remote control facilities are considered an integral part of the electricity transmission network and are exempt from compliance with Divisions 1, 2 and 3 (with the exception of Section 43) of part 3 of the Act.

4 Responsible Officers

4.1 Management Control and Safe Operation

The Managing Director, SP AusNet is responsible for the management, control and safe operation of the SP AusNet electricity transmission supply network.

Nino Ficca

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4.2 ESMS Preparation

The Director, Regulation and Network Strategy, was responsible for the preparation and original submission of this Electricity Safety Management Scheme.

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Electricity Safety Management Scheme

Formal Safety Assessment for Electricity Transmission Network

SP AusNet
A member of Singapore Power Group

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2.0	21/2/2013	Updated responsibilities & contacts (below)	D Postlethwaite	D Matassoni

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Managing Director, SP AusNet

Date:

ISSUE/AMENDMENT STATUS 2

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1 Background and Overview

As part of the Electricity Safety Management Scheme (ESMS), a Formal Safety Assessment (FSA) has been carried out consistent with the Electricity Safety Act and the Electricity Safety (Management) Regulations in order to assess risks associated with the electricity transmission network outlined in the ***ESMS 20-01 Overview*** and ***ESMS 20-03 Safety Management System***.

SP AusNet recognises the importance of effective risk management and is committed to improving its risk management processes and capabilities throughout its business. SP AusNet's risk management process enables enhanced decision making, supports effective change management and supports an environment of continuous improvement.

The design of SP AusNet's corporate ***Risk Management Policy*** and ***Risk Management Framework*** is based on AS/NZS ISO 31000:2009 "Risk Management – Principles and Guidelines".

1.1 Formal Safety Assessment Review

Consistent with SP AusNet's ***Risk Management Framework*** a Formal Safety Assessment (FSA) has been completed in ten risk workshops involving more than 50 subject matter experts with comprehensive experience in the design, construction, operation, maintenance and decommissioning of the electricity transmission network.

The ***Risk Management Framework*** also provides a governance structure to ensure risks are continuously monitored and managed, with material risks communicated to Board level.

1.2 Key Performance Indicators

Key performance indicators (KPIs) are utilised to monitor network safety and risk outcomes in accordance with the ***Key Performance Indicators*** procedure. Network safety and risk outcomes that are outside acceptable levels are subjected to formal safety assessments to identify risk control measures that will reduce risk to acceptable levels.

2 Risk Management Methodology

The following sections summarise the key aspects of SP AusNet's Risk Management Framework as utilised in this Formal Safety Assessment.

2.1 Risk Identification

Risk identification is used to generate a comprehensive list of risks based on those events and circumstances that might enhance, prevent, degrade or delay the achievement of objectives. Risks are typically identified at each level in the organisation through workshops, one-on-one interviews, change-management, control self-assessment or actual experience within the business or industry.

Risk identification by experienced personnel can be achieved in a number of ways. Identifying sources of risk and areas of impact provides a basis for risk identification. All significant causes are considered in order that the most effective controls may be implemented to manage the risk. The Risk Management Methodology includes documented internal and external risk categories, which incorporate a list of possible sources or causes of risks.

Control measures for design, commissioning, inspection, maintenance, operation, decommissioning, environment management, training and management are embedded in mature asset management systems certified to ISO9001, ISO14001, AS 4801 and BS PAS 55 (Asset Management) standards in the form of policies, procedures, internal standards and manuals.

2.2 Risk Analysis

Risk analysis develops an understanding of the risk and its nature. It provides an input to risk evaluation and to decisions on whether risks need to be treated and the most appropriate treatment strategies. Importantly, it enables a formal risk conversation to take place amongst personnel in order to obtain a better understanding of the risks.

2.2.1 Consequences

A consequence rating should be chosen on the basis of the **most likely impact** on SP AusNet and its stakeholders after considering the **current control environment**. If there are consequences over a number of different consequence areas, then the highest level of the consequence areas should be chosen as the overall consequence level for the risk. This should be based on an assessment of residual risk only.

Refer to Figure 1 below for the criteria used in determining the consequence rating.

Rating	Health, Safety and People	Environment , Community and Customers	Reputation	Regulation	Legal and Compliance	Financial impact AU$ EBIT	Investment Return AU$ NPV
5	Multiple fatalities Significant irreversible effects to 10's of people	Catastrophic long term environmental harm off-site and/or irreversible impact to cultural heritage area Community outrage- potential large-scale class action Loss of supply >100 system minutes/USAIDI (electricity) or > 200,000 customers (gas) or System Black or Loss of supply to entire CBD	Critical event that the organisation would be forced to undergo significant change. e.g. CEO departs and board is restructured Sustained adverse international / national press reporting over several weeks Total loss of security-holder support who act to divest	Licence to operate is suspended. Regulators control business through directives	Major litigation or prosecution with damages of $50m+ plus significant costs Custodial sentence for company Executive Prolonged closure of operations by authorities	$100m+ loss or gain	$300m + loss or gain
4	Single fatality Severe irreversible disability to one or more persons	Prolonged off-site environmental impact, e.g. significant impact on ecosystems or destruction of area of high cultural heritage High-profile community concerns raised – requiring significant remediation measures Loss of supply >30 system minutes/USAIDI (electricity) or >100,000 customers (gas)	Significant event that would require ongoing management and brings the organisation into the national spotlight Sustained adverse national press reporting over several days Sustained impact on the reputation of Company Loss of security holder	Licence to operate is reviewed by regulators Regulators impose significant corporate fines and issue multiple directives Extensive reporting and audit regimes are imposed	Major litigation costing $10m+ Investigation by regulatory body resulting in long term interruption to operations Possibility of custodial sentence	$10m - $99m loss or gain	$30m - $299m loss or gain

Rating	Health, Safety and People	Environment , Community and Customers	Reputation	Regulation	Legal and Compliance	Financial impact AU$ EBIT	Investment Return AU$ NPV
			support for growth Executive management restructure				
3	Extensive injuries or irreversible disability or impairment to one or more persons Lost time injury	Major event leading to local on and off-site impact on ecology or damage to area of cultural heritage Medium term recovery High potential for complaints from interested parties Loss of supply >10 system minutes/USAIDI (electricity) or >5,000 customers (gas)	Major event that causes adverse local press reporting over several days Manager may be asked to leave	Regulator imposes a fine, issues a specific directive and introduces additional audit and reporting requirements	Major breach of law with punitive fine Significant litigation involving many weeks of senior management time	$1m – $9m loss or gain	$3m – $29m loss or gain
2	Medium term largely reversible disability to one or more persons Medical treatment to one or more persons	Medium term recovery, immaterial effect on environment/ community required to inform Environmental agencies, (e.g.: noise, dust, odour) Loss of supply >3 system minutes/USAIDI (electricity) or >500 customers (gas).	Minor event that can be readily managed but management effort is still required to minimise impact locally Adverse local press reporting Disciplinary action likely	Specific regulatory audit with critical findings and recommended actions	Breach of law with investigation or report to authority with prosecution and/or moderate fine possible	$100k – $999k loss or gain	$300k – $2.9m loss or gain
1	First aid treatment or minor medical treatment	Small, unconfined event, no impact on ecology or area of cultural heritage Short term transient environmental or community impact- little action required Loss of supply >1 system minute/USAIDI (electricity) or >100 customers (gas)	Event that management can readily manage internally No press reporting or external interest Disciplinary action may be taken	Routine regulatory reporting and audits	Minor legal issues, non-compliances and statutory fine	< $99k loss or gain	< $299k loss or gain

Figure 1 – Consequence Criteria

2.2.2 Likelihood

The likelihood of the risk occurring is then derived by determining the chance that SP AusNet or its stakeholders will be affected at the **chosen level of consequence**, in accordance with the likelihood criteria in Figure 2 below.

Rating	Criteria
E	• >99% probability, or • Impact is occurring now, or • Could occur within "days to weeks"
D	• >50% probability, or • Balance of probability will occur, or • Could occur within "weeks to months"
C	• >20% probability, or • May occur shortly but a distinct probability it won't, or • Could occur within "months to years"
B	• >1% probability, or • May occur but not anticipated, or • Could occur in "years to decades"
A	• <1% probability • Occurrence requires exceptional circumstances • Exceptionally unlikely, even in the long term future • Only occur as a "100 year event"

Figure 2 – Likelihood Criteria

2.2.3 Risk Control Effectiveness

The risk control effectiveness (RCE) is an indicator as to whether SP AusNet is doing all that it could or should to manage each risk. It is an assessment of the actual level of control that is currently present and effective compared with that reasonably achievable for the particular risk, in accordance with the Risk Control Effectiveness table shown in Figure 3 below.

SP AusNet's Formal Safety Assessment has facilitated the identification of those risks which can be further reduced through the cost effective implementation of additional control measures that have been documented and form the basis of divisional work plans and continual improvement initiatives.

RCE	Guide	Indicators
Good	Nothing more to be done except review and monitor the existing controls Controls are well designed for the risk, are largely preventative and address the root causes and Management believes that they are **effective** and reliable at all times. Reactive controls only support preventative controls Control is deemed to be operational in excess of 95% of the time	The control is: • Designed appropriately to meet its objectives • Operating as anticipated at all times • Documented and stored in a central location • Communicated to and understood by relevant persons • Reviewed on a regular basis (at least annually) & updated when necessary • Approved by the relevant Committee • Reviewed as part of the Internal Audit (IA) process and no issues were identified
Requires Improvement	Most controls are designed correctly and are in place and effective (i.e. partially effective). Some more work to be done to improve operating effectiveness or management has doubts about effectiveness and reliability Control is deemed to be operational between 75% and 94% of the time	The control is: • Designed appropriately to meet its objectives • Operating as anticipated the majority of the time • Documented and stored in a central location • Communicated to and understood by relevant persons • Reviewed on a regular basis (at least annually) but may not be updated when necessary • Approved by the relevant Committee • Reviewed as part of the IA process and only low rated issues were identified
Poor	Whilst the design of controls may be largely correct in that they treat most of the root causes of the risk, they are not currently very effective (i.e. ineffective) Some of the controls do not seem correctly	The control is: • Designed appropriately to meet the majority of objectives • Operating as anticipated some of the time • Documented and stored in a central location • Communicated to relevant persons

RCE	Guide	Indicators
	designed in that they do not treat root causes, those that are correctly designed are operating effectively Control is deemed to be operational between 50% and 74% of the time	• Reviewed on an ad hoc basis and may or may not be updated when necessary • Approved by the relevant Committee • Reviewed as part of the IA process and medium issues were identified or not reviewed as part of the IA
Very Poor	Significant control gaps. Either controls do not treat root causes or they do not operate at all effectively (i.e. totally ineffective). Controls, if they exist are just reactive Control is deemed to be operational between 25% and 49% of the time	The control is: • Not designed appropriately to meet the majority of objectives • Not operating as anticipated at any time • Documented but not stored in a central location • Not communicated and understood by relevant persons • Not reviewed on a regular basis (at least annually) or updated when necessary • Not approved by the relevant Committee • Reviewed as part of the IA process and medium to high rated issues were identified or not reviewed as part of the IA
Uncontrolled	Virtually no credible control exists to manage the risk Management has no confidence that any degree of control is being achieved due to poor control design and/or very limited operational effectiveness Alternatively, the risk is new and controls are yet to be implemented If any control exists it would be operational less than 25% of the time	The control is: • Not designed appropriately to meet its objectives • Not operating as anticipated at any time • Not documented or stored in a central location • Not communicated and understood by relevant persons • Not reviewed on a regular basis (at least annually) or updated when necessary • Not approved by the relevant Committee • Reviewed as part of the IA process and high rated issues were identified or not in existence

Figure 3 – Risk Control Effectiveness (RCE)

2.3 Risk Evaluation

The purpose of risk evaluation is to assist in making decisions, based on the outcomes of risk analysis, about which risks need treatment and the treatment priorities.

2.3.1 Risk Matrix

The risk matrix is used to determine the relative level of risks following the completion of the risk analysis carried out in accordance with Section 2.2. The matrix should be used to determine the priority of attention to the risk. The risk matrix used is shown in Figure 4 below.

Consequences	A	B	C	D	E
5	II	II	I	I	I
4	III	II	II	I	I
3	III	III	II	II	I
2	IV	III	III	II	II
1	IV	IV	III	III	III
	Likelihood				

Figure 4 – Risk Matrix

2.3.2 Risk Exposure Acceptance

The decision to tolerate a risk should be based on a consideration of:

- whether the risk is being controlled to a level that is reasonably achievable;
- whether it would be cost-effective to further treat the risk; and
- SP AusNet's willingness to tolerate risks of that type.

Risks rated as Level IV (low risks) or tolerable risks may be accepted with minimal further treatment. They will be monitored and periodically reviewed to ensure they remain so. If risks are not judged low or tolerable, they should be treated.

2.4 Risk Treatment

Risk treatment involves identifying a range of options for treating risks, evaluating those options, preparing treatment plans and then implementing them.

One or more risk controls, from the following categories in order of preference, are implemented to control identified risks:

- Eliminate
- Substitute
- Isolate
- Engineering
- Administration
- Personal Protective Equipment (PPE)

3 Formal Safety Assessments

Key SP AusNet personnel have been trained in the corporate risk management methodology (as discussed in Section 2), which provides a structured approach to risk assessment. This approach was then used to identify and assess safety related risks associated with the electricity transmission network.

3.1 Risk Assessment Workshops

To ensure that the best available knowledge and experience was applied to the task, risks were identified and assessed in ten risk workshops involving subject matter experts and technical staff with appropriate expertise. Two risk workshops were held in each of the main disciplines (work areas) of:

- Primary;
- Lines;
- Secondary;
- Communications; and
- Network operations

The scope of each workshop was to identify and assess safety related risks to employees, contractors, customers or the public associated with the planning, design, specification, procurement, installation, operation, inspection, maintenance and retirement of (the relevant) transmission assets.

To assist in the identification of the risks two broad categories were used, these being:

- Asset-related risks; and
- Work process, practice and procedure related risks.

Risks were then identified and assessed in accordance in accordance with SP AusNet's ***Risk Management Framework*** and the results recorded.

A sample of the template that was used to identify, assess and record the risks during the workshops is shown in **Attachment 1**.

3.2 Asset Related Risks

In order to identify asset related risks, the electricity transmission network was divided into the main work areas of primary, lines, secondary and communications.

In each of these work areas, the main assets were considered as shown in Figure 5 below.

Asset Related Risks		
Work Area	**Assets**	
Primary	Power Transformers Instrument Transformers Circuit Breakers Surge Diverters Isolators/Earth Switches Capacitor Banks Synchronous Condensers SVCs Auxiliary Power Supplies Station Earth Grids Station Security	Structures Reactors Civil Infrastructure Diesel Generators Cable trenches Fire Detection and Suppression Station Security Compressed Air Systems Station Lighting Switchyard Surfaces Environmental Containment/Treatment Plant
Lines	Towers Crossarms Termination Assemblies Suspension Assemblies Line Easements Permanent Earthing	Line Conductor Groundwire on Lines Groundwire in Stations Power Cables Cable Easements Rack Structures
Secondary	Analogue Relays Digital Relays Fuses AC Wiring Equipment Cubicles	Batteries Chargers Inverters DC Wiring
Communications	Antennae Tower Attachment Hardware Radio Sites Communications Equipment	Cable clamping devices Civil Infrastructure Diesel Generators Batteries Chargers

Figure 5 – Identification of Asset Related Risks

3.3 Work Process, Practice and Procedure Related Risks

In order to identify work process, practice and procedure related risks, the issues relevant to the main work areas of primary, lines, secondary, communications and operations were considered. These issues are shown in Figure 6 below.

Work Process, Practice and Procedure Related Risks	
Access to Line Easements Access Procedures/Authorities Calibration of Test Equipment Climbing of Towers/Rack Structures COM Review Process Construction and Maintenance Equipment Design process Emergency Communication Ergonomic Issues Explosive Failure of Plant Exposure to Dangerous Materials Exposure to EMF Exposure to Explosive Gases Exposure to Fire Exposure to Laser Radiation Exposure to LV AC and DC Exposure to Noise Exposure to Reduced Oxygen Levels Exposure to RF Fields Human Error Incidents (HEIs) Insulator Washing/Testing JSA Process Lifting Tackle Line Inspections Live Line Work Management of Drawings Management of Vegetation Manpower Resourcing	Manual Handling Multi-skilling “No Go” Zones Operational Alarms and Protection Targets Operational Earthing Operational Interfaces Operational Nomenclature Permanent Earthing of Plant Plant Specification Procurement Protection Settings Safe Approach Distances (SADs) Slips, Trips and Falls Spare Equipment Station Security Switching Procedures and Instructions Testing and Commissioning Third Party Assets Training and Authorisation Use of Contractors Use of Mobile Plant Wearing of PPE Work in Confined Spaces Work in Extreme Weather Working Alone Working at Heights Working at Remote Sites

Figure 6 – Identification of Work Process, Practice and Procedure Related Risks

3.4 Outcomes

The outcomes of the risk assessments are recorded in the following templates:

Risk Register Template – Transmission ESMS (Primary);
Risk Register Template – Transmission ESMS (Transmission Lines);
Risk Register Template – Transmission ESMS (Secondary);
Risk Register Template – Transmission ESMS (Communications); and
Risk Register Template – Transmission ESMS (Operations)

In summary, the formal safety assessment identified over 100 risks. Of these, there were none which were assessed as having a residual risk level of I. There were six which were assessed as having a residual risk level of II and these are summarised in the table in Figure 7 below. All the remaining risks were assessed as having a residual risk level of III or IV.

With reference to a note in the draft version of ESMS 20-02, the risks associated with line conductor drops, working at heights, conductor clearances and safe approach distances were identified but assessed at a residual level of III based on the work programs that have been or are being implemented to address these risks.

Risk Title	Risk Category	Relevant Asset Management Strategy (AMS)	
		Number	Title
Explosive failure of primary plant	Asset related	AMS 10-64 AMS10-54 AMS 10-67 AMS 10-66 AMS 10-73	Instrument Transformers Circuit Breakers Power Transformers Power Cables Surge Diverters
Incorrect protection and control settings	Work process, practice and procedures related	AMS 10-20 AMS 10-68	Process and Configuration Management Protection Systems
Exposure to HV AC during testing	Work process, practice and procedures related	AMS 10-15	Health and Safety Management
Failure of ground-wire in terminal stations	Asset related	AMS 10-75	Transmission Lines
Hazards with aerial inspections of lines	Asset related	AMS 10-75 AMS 10-65	Transmission Lines Line Easements
Exposure to fire	Work process, practice and procedures related	AMS 10-65	Line Easements

Figure 7 – Identified Level II Risks

4 Management of Risks

Once risks have been identified, assessed and evaluated, they are managed in a number of ways as discussed below.

4.1 Controls and Action Plans

Each risk assessment includes the specification of current controls and treatment actions that are required to manage the risk at a level that is as low as reasonably practicable.

4.2 Asset Management Strategies

A suite of asset management strategies have been developed for the electricity transmission network. This includes an overarching ***Asset Management Strategy (AMS 10-01)*** as well as specific strategies for individual plant items and also for asset management processes and systems.

These specific strategies include discussion of failures associated with asset classes for example and actions that are directed at addressing the identified risks.

4.3 Monitoring and Review

Risks are continuously monitored through application of key performance indicators in accordance with the ***Key Performance Indicators*** procedure.

SP AusNet will routinely and whenever a system change occurs, conduct a risk review to establish the extent of any change in perceived network risks outlined in the FSA to maintain risk at a level as low as reasonably practicable.

4.4 Risk Management Information System

The formal safety assessment process recorded all risks identified through the risk workshops, using templates as shown in **Attachment 1**.

Key risks (Level II) are also registered in the corporate risk management information system (CURA). CURA is designed to record and manage identified risks across the business. It enables risks to be assessed, categorised, monitored, reviewed and reported in a systematic and consistent manner. Cura also enables:

- Risks to be prioritised against each other and provides a basis to facilitate decision-making with respect to resource allocation and risk treatment;
- The recording, monitoring and reporting of risk management controls and treatment plans;

- The development of audit plans to audit the management of risks; and
- The development of strategic plans, divisional business plans, asset management plans, statutory and regulatory obligations and insurance renewal strategies with consideration of identified risks.

Electricity Safety Management Scheme

Safety Management System for Electricity Transmission Network

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1.0	01/12/2010	Endorsed by A Parker and N Ficca	L Clough	A Parker
1.1	18/02/2011	Update to Appendices A and D	L Clough	D Postlethwaite
2.0	09/12/2011	Inclusion of desalination plant supply network assets & revised NSD org structure.	P Bryant	D Postlethwaite
3.0	21/2/2013	Updated responsibility and contact (below) certification (S4.5.1) & (S6.17.2.3) organisation charts (Appendix E)	D Postlethwaite	D Matassoni

Disclaimer

This document has been prepared by SP AusNet for the sole purpose of guiding employees and contractors in managing the safety of SP AusNet's electricity transmission network, located in Victoria, in accordance with the requirements of the Electricity Safety (Management) Regulations and the Electricity Safety Act of Victoria.

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1 Introduction

SP AusNet owns, operates and maintains the majority of the electricity transmission network in Victoria.

The Electricity Safety Management Scheme (ESMS) complies with Part 10, Division 2 of the Electricity Safety Act 1998 and Electricity Safety (Management) Regulations 2009 in respect of safety in design, construction, operation, maintenance and decommissioning of SP AusNet's electricity transmission network. This ESMS consists of four major elements:

- ESMS 20-01 Overview
- ESMS 20-02 Formal Safety Assessment
- ESMS 20-03 Safety Management System
- AMS 10-01 Asset Management Strategy

2 Purpose

The purpose of this document is to describe the assets forming SP AusNet's electricity transmission network, their location and the associated design, construction, commissioning, operation, augmentation, inspection, testing, maintenance, refurbishment, replacement and decommissioning processes necessary to ensure the safe operation and safety of consumers, the general public, SP AusNet staff and contractors.

Specifically, this document provides information and references to:

- Asset Management Strategies and Plans
- Access Authority System
- Competence and Training
- Emergency Preparedness
- Incident Recording Investigation and Review
- Key Performance Indicators
- Monitoring Audit and Review
- Record Management
- Reporting of Incidents
- Safety Management
- Safety Policy
- Technical Standards

3 Scope

3.1 Assets

The scope of this document and the ESMS covers the *applicable assets*[1] forming SP AusNet's electricity transmission *supply networks*[2] in Victoria including:

- Transmission lines, power cables and associated easements and access tracks
- Terminal stations, switching stations, communication stations and depots including associated electrical plant, buildings and civil infrastructure
- Protection, control, metering and communications equipment
- Related functions and facilities such as spares, maintenance and test equipment
- Asset management processes and systems such as System Control and Data Acquisition (SCADA) and asset management information systems (including MAXIMO)

More specifically, this asset management system relates to electricity transmission sites and facilities that include:

- Listed in the Network Agreement between SP AusNet (then PowerNet Victoria) and VENCorp (then the Victorian Power Exchange) 1994;
- Listed in 1994 Connection Agreements between SP AusNet and connected parties, largely consisting of generators, direct connect customers and distributors;
- Listed in various supplementary network and connection agreements, detailing SP AusNet's unregulated transmission assets; and
- Illustrated on SP AusNet's main transmission system diagram T1/209/84
- Operation of the Rowville Transmission Facility (RTF) owned by others
- Operation and maintenance of the 220kV supply network assets, owned by the state government of Victoria, supplying the Wonthaggi Desalination Plant from Cranbourne terminal station.

3.2 Functions

This document and the ESMS covers the following management functions:

- Design, construction and acquisition of network assets
- Commissioning and energisation of assets

[1] ES (Management) Regulations: **applicable asset** means—(a) a supply network owned or operated by an MEC
[2] Electricity Safety Act: **supply network** means a network consisting of electric lines, substations, circuits and any other thing required for the purposes of the transmission, distribution or supply of electricity

- Operation of the network
- Inspection and testing of assets
- Maintenance, repair, refurbishment and replacement of assets
- Decommissioning, removal and disposal of assets
- Monitoring and audit of network performance including reliability, health and safety, regulatory compliance and security
- Managing network safety including safety policy, technical standards, asset management strategies and plans, access authority system, emergency preparedness, monitoring audit and review, key performance indicators, incident recording investigation and review, competence and training, record management and reporting of incidents, checking and corrective actions, management review and continuous improvement.

3.3 Exclusions

This safety management system excludes the assets and infrastructure owned by:

- Generators
- Electricity distribution network service providers
- HV and EHV customers
- Other companies providing transmission services within Victoria including:
  - Basslink
  - Murray Link
  - Redcliffs to Burronga 220 kV Transmission Line
  - 330 kV Capacitor Banks at Dederang and Wodonga Terminal Stations

It also excludes corporate offices and general business equipment such as computers and motor vehicles.

The ESMS excludes management functions related to the planning of the Victorian Electricity Transmission Network which is the joint responsibility of:

- The Australian Energy Market Operator (AEMO) and
- Connected Parties – including Distribution Companies and Generating Companies

3.3.1 Network Planning

Planning for the Victorian Electricity transmission network is not within the scope of this safety management system. Under Victorian governance, planning functions are separated from the ownership and operation of the transmission network, as discussed below.

The Australian Energy Market Operator (AEMO) is responsible for the operation and development of the wholesale market within the National Electricity Market (NEM). It has specific responsibilities for the maintenance and improvement of power system security and for undertaking the coordination and planning of augmentations to the national electricity system. AEMO provides relevant information via the Annual National Transmission Statement and the Annual Statement of Opportunities. AEMO also has responsibility for the overall coordination, planning and augmentation of the shared transmission network in Victoria. In 2010, AEMO will publish its first National Transmission Network Development Plan (NTNDP). The NTNDP will provide AEMO's view of the efficient development of the national transmission grid for a planning horizon covering the next 20 years under a range of credible scenarios. Principle AEMO information resources include the Victorian Annual Planning Report, Demand Forecasts, Network Planning Criteria and a Vision 2030 plan for energy transmission in Victoria.

In Victoria, connected parties are responsible for the planning and augmentation of their connection assets. The five distribution businesses (DBs) have responsibility for planning and directing the augmentation of those facilities that connect their distribution systems to the shared transmission network. DBs plan and direct the augmentation of the transmission connection network in a way that secures economic outcomes for electricity consumers, taking into account distribution losses and transmission losses that occur within the transmission connection facilities. Other connected parties (major consumers or generators) are responsible for their own connection planning. They can choose to delegate this task to a DB if they wish.

In the event that a new connection or augmentation of an existing connection is required the connected parties must consult with and meet the reasonable technical requirements of AEMO, SP AusNet and other effected parties.

Each year the DBs publish the Transmission Connection Planning Report that assesses network planning criteria, the risks of lost load and options for meeting forecast demand.

Related planning documents include the following:

AEMO "Victorian Transmission Network Planning Criteria"

AEMO "Victorian Electricity Transmission Network Connection Augmentation Guideline"

AEMO "Victorian Annual Planning Report"

Victorian Distributors Joint "Transmission Connection Planning Report"

3.3.2 Other Processes and Systems

Also excluded are SP AusNet corporate processes and associated information technology systems such as business communication, human resources and financial management systems.

3.4 Ownership

Ownership of the electricity transmission network largely resides SPI PowerNet Pty Ltd which is owned by SP Australia Networks (Transmission) Ltd which, together with SP Australia Networks (Distribution) Ltd and SP Australia Networks (Finance) Trust, form the SP AusNet Group of companies.

SP AusNet is Victoria's largest energy transmission and distribution company. It is a publicly listed company on the Australian Securities Exchange (ASX) and the Singapore Exchange (SGX-ST); Singapore Power Ltd is the majority shareholder.

3.5 Management Service Provision

Within SP AusNet; Network Strategy and Development division and Integrated Network Services division have key roles in the implementation of this safety management system.

3.5.1 Network Strategy and Development Division

The Networks Strategy and Development division is focused on SP AusNet's regulated gas and electricity supply networks and is responsible for the stewardship of these assets. Key functions performed by this division include: regulation and network strategy, high level engineering design, detailed project design, program management, asset renewal planning, terminal station and substation technology, lines technology and dedicated customer strategy.

3.5.2 Integrated Network Services Division

Integrated Network Services division delivers all asset related works, including customer projects, as defined by the Network Strategy and Development division in Asset Management Plans for each of the gas distribution, electricity transmission and electricity distribution supply networks.

Key functions performed by this division include: operational project management and planning, works scheduling, execution and delivery of field activities, network operations, and other supporting business services including management of major contracts and procurement and logistics. Other independent service providers are engaged on a case by case basis through the Integrated Network Services division.

3.5.3 Management

SP Australia Networks (Distribution) Ltd and SP Australia Networks (Transmission) Ltd have engaged SPI Management Services Pty Ltd, pursuant to a service agreement, to provide management and administration services and to manage the electricity transmission and electricity and gas distribution supply networks on behalf of SP AusNet.

The executive leadership team and managers within SP AusNet are employed by SPI Management Services Pty Ltd which is a wholly-owned subsidiary of Singapore Power Ltd.

3.5.4 External Service Provision

SP AusNet retains the broad range of skills and resources to deliver the operational service requirements of the business with the exception of vegetation cutting and removal which are provided by contract service providers

SP AusNet manages asset design, standards, performance monitoring and strategies and supplements its internal resources with external service providers for the following:

- Asset design
- Asset construction and maintenance

4 Network Description

Description of transmission assets operated under SP AusNet's ESMS includes the following key supply networks;

1. SP AusNet Network – Victoria transmission network owned and operated by SP AusNet,
2. Rowville Transmission Facility – Terminal station assets owned by ??? and operated and maintained by SP AusNet, and

3. Wonthaggi Desalination Plant Network – 220kV underground supply network owned by the state government of Victoria and operated and maintained by SP AusNet.

4.1 SP AusNet Network Configuration

SP AusNet's electricity transmission network interconnects generators, distributors, high voltage customers and the transmission systems of neighbouring New South Wales, South Australia and Tasmania. It serves an estimated five million Victorians living in an area of approximately 227,600 square kilometres.

A 500 kV network backbone runs from the Latrobe Valley to Melbourne and across the south-western part of the state to Heywood. This 500 kV network facilitates the transfer of power between the coal and gas-fired generators in Gippsland, hydro-electric generators in the Victorian Alps and the significant load centres of Melbourne, Geelong and the Portland aluminium smelter.

As illustrated in Figure 4.1 below, the 500 kV network is reinforced by a 220 kV network around Melbourne, two 220 kV rings in rural Victoria and interconnections to neighbouring states.

Figure 4.1 – Victorian Electricity Transmission Network (Nov 2010)

4.1.1 Metropolitan Melbourne

The 500 kV and 220 kV networks serving metropolitan Melbourne are shown in Figure 4.2 below.

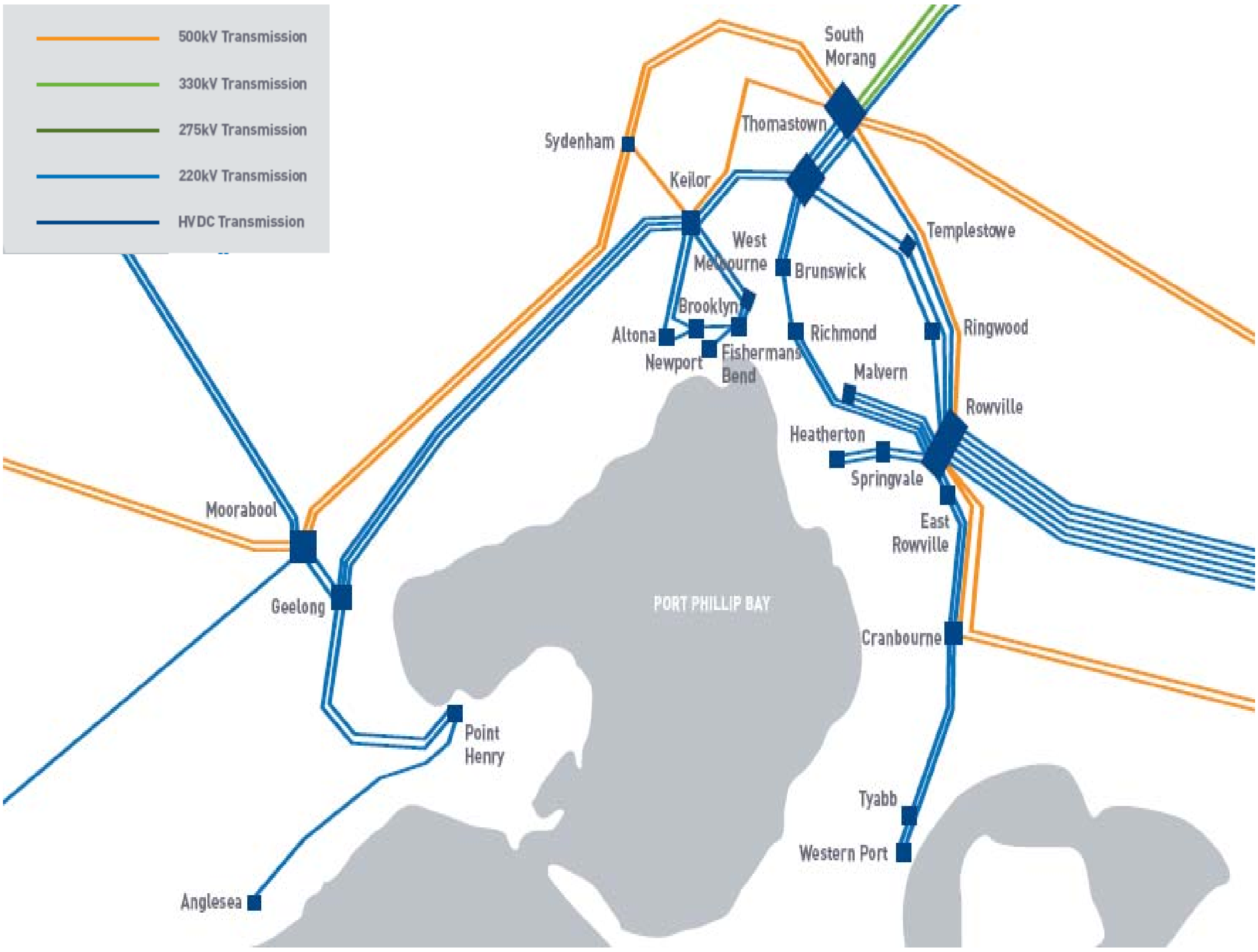


Figure 4.2 – Metropolitan Melbourne Electricity Transmission Network (Nov 2010)

The transmission link from the Latrobe Valley to Melbourne comprises four 500 kV lines and six 220 kV lines. The 500 kV network supplies power from the Loy Yang and Hazelwood power stations to South Morang, Rowville and Cranbourne Terminal Stations. The 220 kV network transfers power from the Hazelwood and Yallourn generators to the Rowville Terminal Station in the eastern metropolitan area.

4.1.2 Regional Network

Regional Victoria is supplied via a 220 kV network from terminal stations at Geelong, Terang, Ballarat, Bendigo, Shepparton, Glenrowan, Kerang, Horsham and Red Cliffs. This network is energised by 500 kV to 220 kV transformations at Moorabool, Keilor and South Morang Terminal Stations. Morwell Terminal Station provides supply to Gippsland and the Latrobe Valley.

A 500 kV connection supplies the single largest regional load – the Portland aluminium smelter in the states' far west.

4.1.3 Interstate Connections

The NEM interconnections include:

- Two 330 kV lines from Dederang Terminal Station to the Murray Switching Station (NSW)
- One 330 kV line from Wodonga Terminal Station to Jindera (NSW)
- One 220 kV line from Red Cliffs Terminal Station to Buronga (NSW)
- Two 275 kV lines from Heywood Terminal Station to South East Substation (SA)
- Murraylink interconnector between Victoria and South Australia
- Basslink interconnector between Victoria and Tasmania

4.2 Rowville Transmission Facility Configuration

The Rowville Transmission Facility (RTF) is owned by an investment fund. The assets consist primarily of the A1 500/220kV 670MVA transformer and six 500kV circuit breakers within the 500kV yard at Rowville Terminal Station (RTS) as illustrated in figure 4.3.

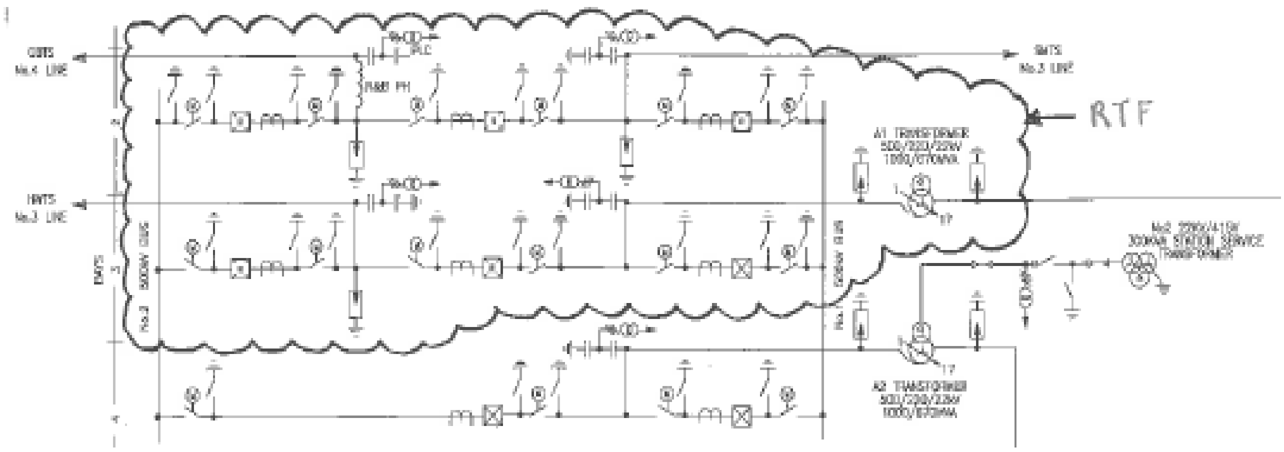


Figure 4.3 Rowville Transmission Facility

4.3 Wonthaggi Desalination Plant Network Configuration

Commencing the 2 December 2011, SP AusNet is responsible for operating and maintaining the supply network assets for the Wonthaggi Desalination Plant. The supply network assets are owned by the state government of Victoria and consist of a 220kV AC underground cable system comprising a single circuit connecting Cranbourne Terminal Station (CBTS), the Booster Pump Station and the Wonthaggi Desalination Plant. The underground cable shares a common easement with the the water pipeline and broadband fibre optic cable as shown in figure 4.4

The first section of cable runs from Cranbourne Terminal Station (CBTS) to the Northern Reactive Compensation Station (NRCS). Transformers at NRCS feed the adjacent Booster Pump Station (BPS). The second section runs from NRCS to the Southern Reactive Compensation Station (SRCS). The final section runs from SRCS to the Desalination Plant Terminal Station (DPTS) as illustrated in figure 4.5.

Figure 4.4 – Wonthaggi Desalination Plant Underground 220kV Cable Route

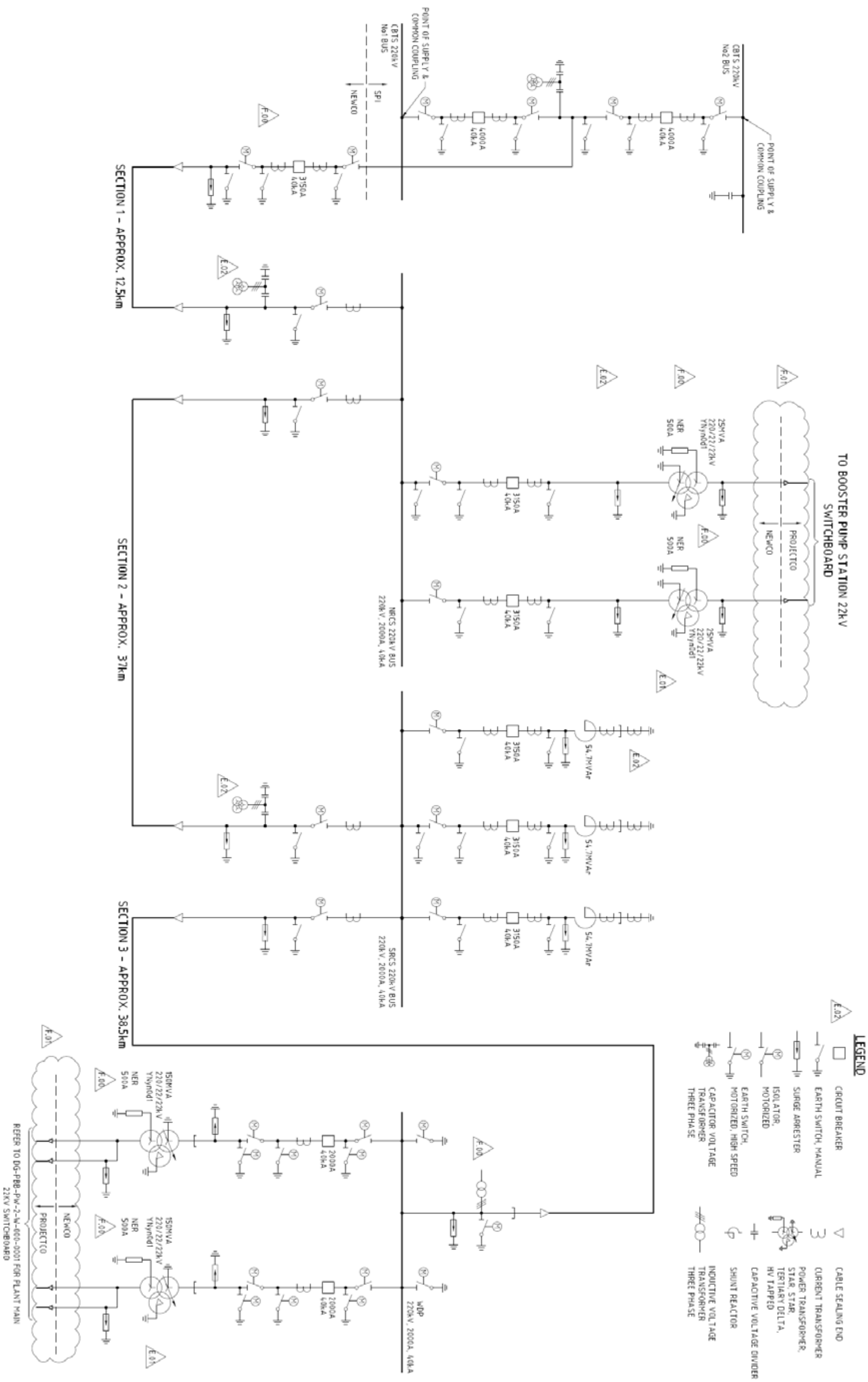


Figure 4.5 Wonthaggi Desalination Plant Supply Network

4.4 Asset Types

Figure 4.3 below summarises the major facilities, assets and systems of the Victorian electricity transmission network.

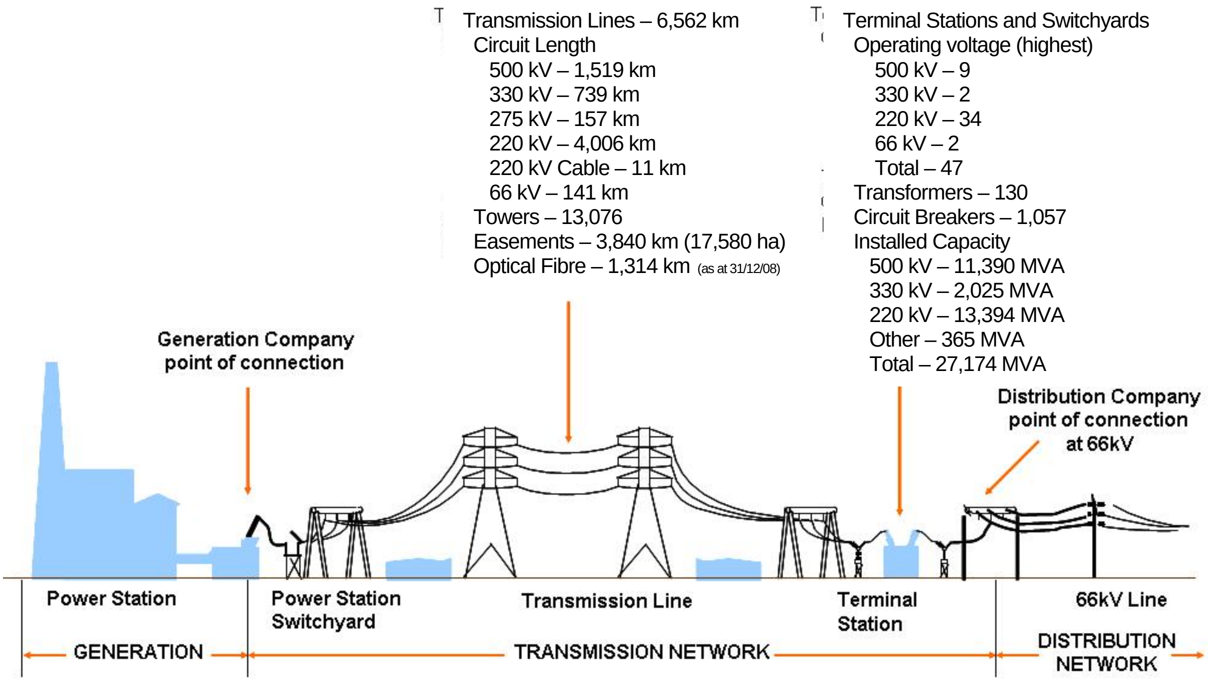


Figure 4.3 – Summary of Facilities and Assets in the Victorian Electricity Transmission Network (Nov 2010)

4.4.1 Transformers

This section summarises the issues and asset management strategies associated with the 117 main tie and connection power transformers, 19 oil-filled reactors, 1852 current transformers (CTs), 991 inductive and capacitive voltage transformers, and 85 station service transformers.

The average age of power transformers is 36 years, with the oldest unit being 56 years. The allocated technical life ranges from 40 to 60 years, depending upon suitability for 'mid-life' refurbishment. The ITOMS 2005 report[3] indicates that SP AusNet power transformers are on average 19% older than Australian peers and 39% older than international peers. Notable is the large number of old single-phase transformer banks in service. These units have high losses compared with their three-phase equivalents.

Similar in construction to power transformers, the oil-insulated reactors range in capacity from 15 to 121 MVAR and have operating voltages of 500 kV, 220 kV, 66 kV and 22 kV.

Inductive type Voltage Transformers (VTs) predominate up to 66 kV and capacitive type VTs are principally used for voltages of 220 kV and above. The VT fleet has an even age profile but notable is the 47% of units with a service life in excess of 35 years.

[3] ITOMS 2005 Report - International Transmission Operations and Maintenance Study – Revision 6 May 2006

In general, the condition of power transformers is good with few incipient faults or major defects. The failure rate (requiring major repair) is comparable with CIGRE averages. Principle technical issues are associated with power transformers that are subject to extended periods of high operating temperatures, high numbers of operating cycles, and high system fault levels, include:

- Low dielectric strength of both solid and fluid insulation due to high moisture content, oil degradation and sludge restricted cooling;
- Excessive noise and low resistance to electro-mechanical forces of fault currents due to loose windings and deteriorating mechanical strength of solid insulation;
- Environmental, explosion and fire risks arising from insulating oil leaks from bushings, main tanks and ancillaries due to deteriorating seals and corroding radiators;
- Increasing maintenance requirements of tap changer contacts and drive mechanisms
- Rising winding temperature indicator (WTI) calibration errors and secondary wiring degradation; and
- Non-scheduled PCB contamination of insulating oils

The explosive failure mode of some instrument transformers presents some safety risks to field staff working in the vicinity, risk of collateral damage to nearby equipment and unplanned network outages with attendant availability penalties. The frequency and sophistication of the condition monitoring, testing and analysis regime has been increasing to ensure insulation degradation rates are assessed accurately and units are replaced prior to failure.

Since 2005, SP AusNet has replaced 92 three-phase sets of current transformers and nine sets of capacitive VTs among fleets that have exhibited signs of insulation degradation in its ongoing replacement program to manage this risk. These replacements are in addition to the instrument transformers that have been replaced during SP AusNet's ongoing station rebuilds program since 2002.

For further information please refer to the detailed plant strategies: Power Transformers and Oil-filled Reactors and Instrument Transformers.

4.4.2 Transmission Lines

SP AusNet owns and manages more than 6,500 km of transmission lines, operating at voltages of 500 kV, 330 kV, 275 kV, 220 kV and 66 kV and supported by more than 12,700 towers located on 3,800 km (21,500 ha) of easement. The assets include conductors, insulators, line hardware, towers, rack structures, access tracks and bridges and represent 60% of the Victorian electricity transmission network's total asset value. Mainly constructed between the early 1950s and late 1980s, 65% of towers have now reached their technical half-life. The emerging asset management issues which may have a safety implications are:

- Legislative change in the areas of worker safety, unauthorised access and electromagnetic radiation limits such as
  - Fall Arrest Systems
  - Anti climbing devices
- Mechanical failure of insulators due to bonding cement failure, mechanical wear or corrosion of fittings and electrical failure due to insulator cracking from excessive loading or lightning strike
- Galvanised steel ground wire corrosion and ACSR conductor corrosion, metal fatigue and mechanical abrasion due to wind initiated vibration

- Ground clearances (legacy assets)
- Climbing clearances (legacy assets)
- Loosening, corrosion, metal fatigue and wear erosion of line hardware, dampers and spacers, particularly in coastal and wind incident areas
- Corrosion of tower and rack structure foundations, steel work and fasteners
- Soil erosion of access tracks and bushfire damage to bridgeworks

For the most part asset deterioration is progressive with localised exceptions determined by site-specific environments. Reliability events due to failure of insulators, spacers and mid-span conductor joints have occurred in 220 kV circuits with service lives of approximately 50 years.

Enhanced condition assessment has been initiated and replacement programs for selected insulator types and selected conductors in coastal environments are under way. To date, remedial monitoring and maintenance programs have not had a material impact on circuit availability.

For further information refer to the detailed plant strategies: Transmission Lines and Line Easements.

4.4.3 Circuit Breakers, Disconnectors and Surge Diverters

The Victorian electricity transmission network includes more than 980 circuit breakers, 1970 disconnectors, 1250 earth switches, and 1800 surge diverters operating at voltages from 22 kV to 500 kV.

Circuit breaker (CB) types include air-blast (9%), bulk-oil (42%), minimum-oil (21%) and SF_6 (28%).

Vertical break and hook - stick operation disconnectors predominate (87%) but the fleet also includes SF_6, rotary double-break and semi-pantograph styles.

Two-thirds of surge diverters are of zinc oxide construction (age <20 years) and the remainder are of silicon carbide construction (20 <age< 45 years).

In summary, the principal technical issues are:

- CB fleet is mature by comparison with Australian and international TNSPs[4];
- Failure rate of CBs is greater than the average of international TNSPs[5];
- CB full-refurbishment costs are approaching replacement costs;
- Shortages of skilled and experienced technicians;
- High cost of severely limited technical support from original equipment manufacturers;
- Corrosion induced SF_6 gas insulation leakage rates;
- Excessive air-blast CB operating noise; and
- Insulating-oil leakage rates and hydraulic operating mechanism leakage rates

[4] ITOMS 2005 Report - International Transmission Operations & Maintenance Study – Revision 6 May 2006

[5] G Mazza, R Michaca, “The First International Enquiry on Circuit Breaker Failures and Defects in Service” Electra No. 79 Dec 1981.

SP AusNet has been progressively replacing the disconnector fleet through its terminal station rebuild projects and circuit breaker replacements programs. These works are reducing the portion of the fleet that are manually operated and prone to stiction when idle for extended periods.

Silicon carbide type surge diverters are prone to seal degradation, moisture ingress and explosive failure; they offer inferior protection when compared with zinc oxide units. SP AusNet has been progressively replacing the silicon carbide units since 2003 and expects to complete this program in 2012.

Reliability events due to circuit breaker, disconnector and surge diverter failures have occurred at all voltages. Risk mitigation monitoring and remedial maintenance programs are expensive and have a material impact on future OPEX and circuit availability.

For further information please refer to the detailed plant strategies, Circuit Breakers, Disconnectors and Earth Switches and Surge Diverters.

4.4.4 Gas Insulated Switchgear

SP AusNet Network

SP AusNet operates and maintains 28 circuit breaker bays of gas-insulated switchgear (GIS) across four of its terminal stations. In addition, there is a section of gas-insulated line (GIL) at a fifth terminal station.

SP AusNet's 500 kV GIS is located outdoors at South Morang (SMTS), Sydenham (SYTS) terminal stations and the 220 kV GIS is located indoors at the Newport D Power Station (NPSD) and West Melbourne Terminal Station (WMTS). The 66 kV GIS is located indoors at WMTS. The 500kV GIL is located at Rowville terminal station (ROTS).

The GIS and GIL population falls into two age brackets. The majority are between 23 and 27 years old and include the switchgear installed at SMTS, SYTS, NPSD and ROTS. The GIS at WMTS is under ten years old.

The GIS has experienced few failures and has performed well in comparison to international installations. However, the number of major failures on the older outdoor GIS has increased in recent years. The main issues are:

- Increasing number of major CB interrupter failures, resulting in internal flashover, at SMTS and SYTS. Many of these failures are due to design and manufacturing problems. Repairs are protracted and expensive due to the requirement for significant plant outages, highly skilled manpower resources and specialised tools and clean-room facilities;
- Increasing requirement for effective condition monitoring techniques;
- Leaks in the drive mechanism hydraulic system of the CBs at SMTS and SYTS;
- Availability of spares and manufacturer support; and
- Corrosion of flanges, resulting in moisture entry and increasing SF_6 gas leaks, especially evident at SMTS and SYTS

Wonthaggi Desalination Plant

SP AusNet is responsible for the operation and maintenance of 220kV GIS associated with the Wonthaggi Desalination Plant supply network. These assets were commissioned in 2011.

For further information on focused refurbishment and replacement projects please refer to the detailed plant strategy Gas Insulated Switchgear.

4.4.5 Reactive Plant

SP AusNet Network

Increasing maximum demand on the Victorian electricity transmission network has increased the operating duty of the 90 capacitor banks installed to provide steady-state voltage support, and the four Static VAR Compensators (SVCs) and the three synchronous condensers installed to provide dynamic reactive capacity.

In total, there are more than 13,000 capacitor cans operating in the 90 banks at seven voltages ranging from 4.5 kV to 330 kV. The capacitor cans are up to 27 years old with an expected life of 40 years. The SVCs have ratings of +50 -25 MVar and +100-60 MVar and are 18 and 22 years old respectively, with a technical life of between 40 and 60 years. The synchronous condensers have ratings of +110-64 MVar and +125-75 MVar and are 36 and 40 years old respectively, with a technical life of between 40 and 50 years.

Capacitor cans are generally in good condition. However, rising network utilisation requires more frequent and longer operation of reactive plant. This increased the switching duty on capacitor cans such that increasing failure rates resulted in falling capacitor bank availability. Recent maintenance and capacitor can replacement activities has arrested the decline in availability and is returning availability above target levels.

Recent replacement of thyristor cooling systems to restore capacity and address corrosion and circulation pump deterioration has overcome the tripping of SVCs at times of high ambient temperature. Thyristor failures due to control system malfunctions have been exacerbated by the absence of spare parts and diminishing OEM support. This is raising the priority of control system refurbishment and replacement proposals.

Deterioration of rotor pole insulation has led to shorted rotor turns on all synchronous condensers and partial discharge is evident on some stators. Defects in automatic voltage regulation, impulse exciters and other auxiliary systems have increased the frequency and complexity of maintenance activities.

Maintenance and half-life refurbishment activities in recent years have restore availability of capacitor banks, synchronous condensers and SVCs above target levels. Ongoing Thermo-vision scanning coupled with electrical testing of higher-risk capacitors and the preventative replacement of deteriorating cans will retain the availability of capacitor banks above target levels.

Close monitoring of the performance of SVC thyristor control systems is necessary to determine the timing of a progressive refurbishment and replacement program that will include air conditioning of thyristor halls to moderate ambient operating temperatures.

Increased condition monitoring in the form of vibration analysis (shorted rotor turns), online partial discharge monitoring (stators), analysis of main exciter brush wear and exciter currents as well as main bearing lubricating oil will determine the timing of rotor and possibly stator refurbishment, necessary for each synchronous condenser to reach its nominal technical life.

SP AusNet's synchronous condenser refurbishment program has already refurbished the Brooklyn unit and planning for the refurbishments of the Templestowe and Fisherman's Bend synchronous condensers is underway.

Wonthaggi Desalination Plant Network

The Wonthaggi Desalination Plant supply network includes the Southern Reactive Compensating Station (SRCS) which contains three 54.7MVAR compensating reactive devices (CRDs). These devices were commissioned in 2011.

For further information refer to the detailed plant strategies: Capacitor Banks, Static VAR Compensators and Synchronous Condensers.

4.4.6 Power Cables

SP AusNet Network

SP AusNet owns significant quantities of HV and EHV underground power cables arranged in 97 circuits and operating at voltages of 220 kV, 66 kV, 22 kV, 11 kV and 6.6 kV. Mass impregnated paper is the main insulation type but there are XLPE and oil-filled insulation cables predominantly located within terminal station sites. An 11 km circuit of 220 kV, three x single-core XLPE insulated cable is located on public property between the Richmond (RTS) and Brunswick (BTS) terminal stations.

The majority of 220 kV and 66 kV cable terminations are of air-insulated, out-door configuration. However, there are also some SF_6 and oil-immersed terminations. Lower voltage terminations are of compound-filled, outdoor configuration. Only the Brunswick Terminal Station (BTS) to Richmond Terminal Station (RTS) and the cable section within South Morang Terminal Station (SMTS) of the Eildon Power Station (EPS) to Thomastown Terminal Station (TTS) 220 kV Line have cable joints.

The 220 kV cables were installed between 1979 and 1992, while the 66kV cables were installed between 1981 and 2001. The lower voltage cables were mostly associated with equipment installation as part of station developments between 1951 and 1998. Underground cables have been allocated a technical life of 60 years.

In general, the condition of power cables is good. In the immediate future the main investment drivers will be related to addressing deficiencies in the management of power cables including availability of:

- Materials (including spares)
- Specialised equipment; and
- Maintenance expertise, in particular to carry out repairs of EHV cables after failures

For further information refer to the detailed plant strategy: Power Cables.

Wonthaggi Desalination Plant

The Wonthaggi Desalination Plant approximately 88km of 220kV 3 x single phase 400 & 500mm XLPE Cu cable supplying the Wonthaggi Desalination Plant from the Cranbourne Terminal Station. The cable was designed and supplied by Olex Cables with a design life of 40 years. Subject to the correct installation, Olex expect the cable to have no special maintenance requirements as stated in their manual provided to SP AusNet titled 'Olex Operation and Maintenance Manaual' for the 220kV Underground T/L Cranbourne Terminal Station to Victorian Desalination Plant'.

SP AusNet inspection and monitoring program consists of annual sheath insulation tests, cable bonding tests and cable accessory inspections during planned annual shutdowns of the desalination plant. Frequency of these inspection and test programs will be adjusted in accordance with test results.

The cable is installed in some sections as direct buried and others in conduit with a minimum cover of 1100mm. Both installation methods include slabbing and maker tape to protect the cable from third party 'dig-ins'. Additional precautions against third party damage are provided through above ground identification of the cable easement with marker signs and periodic patrols of the easement.

SPI PowerNet is a member of the Dial before you Dig service and provides detailed information through its T1/195 series of drawings and Cable route plans for underground electricity assets.

4.4.7 Station Auxiliaries

Station auxiliaries include diesel generators, compressed air systems, fire detection and suppression systems, secondary cables, AC and DC power supplies and earth grids.

Seventeen diesel generator sets provide emergency 415 V AC supplies at 15 critical terminal stations and communications sites in the event of the total loss of auxiliary power supplies. Ranging in age from 12 to 35 years, the diesel-fuelled generators are a low cost contingency measure to facilitate rapid restoration of supply during large unplanned outages. Operation is confined to regular test start and run sequences. Although the assets are quite old there are few issues of significance.

For further information refer to the detailed plant strategy: Diesel Generators.

Station air systems can be duplicated high pressure, high capacity and high quality for air-blast circuit breakers and some 'CB close' mechanisms or low pressure, low air quality for general purpose, workshop or fire service purposes.

There are 62 air systems containing 81 compressors. The majority were installed between the mid 1950s and mid 1960s and the last was installed in 1970. Air receivers are registered and inspected in accordance with statutory provisions. These systems are being progressively removed as part of the station rebuild and circuit breaker replacement programs when all air blast type circuit breakers are removed from service at a site.

Galvanised pressure vessels have performed well and have a long life. Safety valves seal well until operated, after which sealing can deteriorate. High-pressure hard drawn copper or stainless steel air pipes remain in good condition. However, compressors require a significant level of planned maintenance to ensure inlet and outlet valves remain reliable. After 15 years of operation, compressor breakdowns increase and replacement becomes an economic option. For further information refer to the Station Air Systems detailed plant strategy.

Fire detection and suppression systems protect key transformers and protection, control and communication facilities to minimise fire damage and resultant outages, availability restrictions and network constraints. HALON fire suppression systems were removed from terminal stations during the 1990s.

Since 2000, VESDA fire detection systems have been installed in critical locations within all terminal stations to supplement less sensitive smoke and heat detectors.

Water-deluge fire suppression systems have protected the 500 kV and 330 kV network transformers since their installation. INERGEN gaseous fire suppression systems have been recently installed to protect communications, protection and control facilities at South Morang, Hazelwood and Rowville Terminal Stations. FM200 suppression systems have been recently installed at the back-up Network Operations Centre (NOC) and back-up Data Management Centre (DMC). Installation of fire barriers between power transformers and in cable ducts to defend the protection, control and communications facilities has recently commenced. The water deluge and gaseous fire suppression systems are in good condition with periodic maintenance, as per the Australian Standards, essential for continued reliable operation.

In recent years environmental and occupational health and safety legislations have driven investment. Increased security and risk management approaches may enhance coverage of existing detection systems and precipitate further installation of suppression and barrier systems.

For further information refer to the detailed plant strategy, Fire Detection and Suppression.

More than 43,000 secondary cables totalling more than 6000 km in length interconnect primary plant such as circuit breakers and power transformers with low-voltage AC and DC power supplies, protection relays, control systems and measurement systems located in control and relay buildings. By length, 91% of secondary cables are associated with switch bays, 8% with transformers and 1%

are installed in control or relay rooms. Four and eight core construction predominates and there are more than 260,000 individual cores in service.

More than 90% of secondary cables are insulated and sheathed with PVC and have installation dates from the early 1950s to 2005. An estimated 7% (420 km) of secondary cabling is of vulcanised rubber construction. It is now more than 50 years old and can be found in significant quantities in older stations such as Brooklyn, Mount Beauty, Malvern, Morwell, Richmond and West Melbourne terminal stations and Yallourn Power Station. PVC insulated and sheathed cabling is in good condition with no significant deterioration and only isolated examples of damage where inadequately protected by cable ducts or trenching. PVC insulated and sheathed cables have proven reliable and are expected to remain serviceable for 20 to 30 years attaining a service life in excess of 60 years.

However, the vulcanised rubber cabling has deteriorated to the extent that battery earth faults and short circuits have occurred in older installations (such as Malvern Terminal Station) following heavy rainfalls. In some locations it has been necessary to run temporary cabling across switchyard surfaces as all existing cable cores were utilised and cable ducts and trenches were full. The vulcanised rubber cables have reached the end of their reliable life and care is required to ensure they remain undisturbed until their replacement.

The transition from copper secondary cabling to fibre-optic cabling and digital communications within terminal station switchyards is expected to be driven by the standardisation of interfaces on secondary equipment, availability of interfaces on primary equipment and the commercial viability of interfacing with existing primary equipment. The use of fibre optic communication circuits is expected to progressively grow from Asset Data Gathering Networks into instrumentation, control systems and finally protection systems.

For further information please refer to the detailed plant strategy, Secondary Cabling.

Duplicated AC systems supply transformer tap changers and cooling, battery chargers, station lighting, air compressors, air conditioning, computer servers and general-purpose outlets at 415 V.

AC supplies date from the station’s inception with progressive augmentation and refurbishment only during major station re-builds. Conceptually sound and generally in reasonable condition, AC supplies and changeover schemes are not remotely monitored. Some failures have occurred and there have been problems related to cable insulation and asbestos in distribution panels.

The AC system supplies to transformer tap changers and cooling is critical to power transformer rating. Inadequate AC supplies can precipitate outages, restrict availability or constrain the network.

Station DC power systems[6] supply protection, SCADA, instrumentation, metering, communications equipment, CB controls, auxiliary power, emergency lighting and alarm systems. Prior to 1995, two 48 V communications batteries, a single 250 V protection and control battery, and a single 48 V control battery were standard.

Since 2000, 27 key, new and refurbished stations have received duplicated 250 V battery chargers and batteries of lead acid, flooded cell construction. 48 V supplies are derived from DC-DC converters. Battery condition is monitored and so too is abnormal voltage and earth faults.

There are 17 DC systems that date from station commissioning, they are generally in good condition, but the age and condition of batteries varies widely. Batteries are subject to regular maintenance and planned replacement of cells after the expected life. Chargers are replaced on failure or as required by station augmentation. Older distribution and monitoring boards contain asbestos.

On-load maintenance of batteries that form the sole power source for protection, control or SCADA facilities present risks to the safety of personnel and the security of the network. The older stations have large distribution boards that contain asbestos and are fitted with exposed, copper knife

[6] Batteries, battery chargers and associated wiring and switchgear

switches with attendant health and safety risks. For further information refer to the detailed plant strategy, Auxiliary Power Supplies.

4.4.8 Earth Grids

Earth grids are installed below ground in all terminal stations and communication sites. Typically, the grids comprise stranded copper conductor welded at connection and crossover points. Vertical copper risers (typically flat-copper conductor) are then welded to the grid and either welded or bolted to the installed plant and equipment items. The switchyard surface material placed over the grid is an integral part of this earth grid system.

Ground wires, connected to the station earth grid via termination hardware and plant structure steelwork, are strung above switchyard plant in all terminal stations to provide protection from direct lightning strikes. These ground wires are 'slack strung' compared with transmission line ground-wires.

Transmission line towers (including those inside terminal station boundary fences) do not normally have an installed earth grid but rely on the tower foundations. In the few cases where this footing resistance is not adequate, the tower foundations have counterpoise (earth conductors) installed. Ground wires are strung between the tops of towers above the line conductors. This ground wire is connected to the steelwork of each tower and also to the rack structure steelwork at the line termination point in terminal stations.

Earth grids were installed when the terminal station switchyards and communication sites were originally established. They have been progressively augmented as additional plant was installed. The ground wires above transmission lines were installed at the time the lines were constructed.

The condition of the belowground earth grids can generally be regarded as good. This is due to comparatively neutral Ph soils, low salinity water tables, and the use of long-life materials with high-reliability welded joints. Some of the station ground wires are showing deterioration due to surface corrosion, but testing has shown acceptable tensile strengths.

Corrosion problems have been identified in the footings of towers with grillage-type foundations, located close to terminal stations. This is caused by currents circulating between the line ground wire and the station earth grid. The installation of insulators to prevent circulating currents also helps the calibration of station earth grid current-injection tests in that the station earth grid and ground wire may then be separated from the line ground wire. A recent failure of termination fittings for a ground wire (installed between a tower inside a station and the station rack structure) due to overheating from circulating currents has led to the implementation of a program bridging the termination hardware to make a solid electrical connection between the ground wire and tower steelwork in such situations.

SP AusNet employs portable earthing devices in order to earth plant items to the station earth grid or tower steel work to ensure safe access for personnel. These devices usually comprise a flexible copper conductor with plug or clamp fittings and are applied to electrically isolated plant using insulated switch-sticks in most cases.

The main investment driver is the requirement to ensure the ongoing integrity of existing earth grids from both an electrical safety and plant operation limit viewpoint. This is achieved by a program of station earth grid current injection tests, establishing the best switchyard surface material and checking the condition of foundations for some at-risk transmission line towers. For further information please refer to the detailed plant strategy, Earth Grids.

4.4.9 Protection Systems

There are 456 main protection relays that are supplemented by 1000 trip relays, interposing relays and remote trip receive relays providing duplicate protection for 122 EHV lines (220 kV and above). There are 23 different types of main relays including electro-mechanical pilot wire relays, electro-mechanical, electronic and microprocessor type distance protection relays and microprocessor based current differential relays.

The oldest electro-mechanical relays have delivered 40 years service and 26% of electro-mechanical relays and electronic relays are older than 20 years.

A total of 277 biased differential relays, differential relays, over-current relays and high impedance zone protection relays provide duplicated protection for the 105 transformer banks. Buchholtz, trip and auxiliary relays totalling more than 1000 additional items complete these protection schemes. Main protection relay technologies include electro-mechanical (57%), electronic (14%) and microprocessor types (29%). A total of 48% of main protection relays are electro-mechanical types over 30 years old. Electronic relays range from 10 to 30 years in age and microprocessor relays are less than 10 years old.

There are 457 schemes with a total of 555 main relays that provide duplicated protection for 227 off 66 kV feeders. Auxiliary relays including trip relays, interposing relays and remote trip receive relays add 2000 items to these schemes.

A recorded 42 different types of main relays include electro-mechanical pilot wire protection, electro-mechanical, electronic and digital microprocessor type distance protection, electro-mechanical and microprocessor types, over-current protection, and microprocessor based digital current differential protection. Further, 53% of relays are electro-mechanical, 6% are electronic and 41% are digital.

Electro-mechanical relay age is up to 40 years. It is calculated that 46% of electro-mechanical and electronic relays have provided more than 20 years service.

Of the 354 bus-zone protection systems, 77% are electro-mechanical high-impedance differential schemes with the balance being mainly differential over-current or low/medium impedance differential schemes. A few installations are also protected by busbar overload schemes.

Most of the high impedance schemes are in good condition and do not require attention.

Some low impedance differential and over-current schemes however have electro-mechanical relays with rotating induction discs and these are in need of replacement due to component wear, stiction, and large operating and maintenance costs as they are no-longer supported by the manufacturers. From a system security and protection dependability perspectives, the ‘unstabilised’ and single scheme installations are being progressively replaced with digital relays to minimise system operational risks.

Reactive plant protection systems (with the exception of the old synchronous condensers) are mainly of electronic design. These relays are generally in good condition and most relay types are still supported or have compatible replacement products. The electro-mechanical relays that make up the balance of installed assets are also sound, with the exception of capacitor bank current balance relays that are exhibiting non-operation and measurement error. The D21SE relays that protect reactors at the Horsham and Redcliffs terminal stations are prone to inrush tripping. Protection on the synchronous condensers at Fisherman’s Bend, Templestowe and Brooklyn terminal stations would benefit from installation of relays with recording facilities to assist in the analysis of network transients.

Principal issues associated with protection systems include:

- Bearing wear, stiction, corrosion, loss of magnetism and insulation breakdown in electro-mechanical relays
- Component failure caused by thermal stress and auxiliary voltage variation in electronic relays
- Slow operation of the Duo Bias relays

- Inrush tripping on the D21, D202 and D203 relays
- High number of relay types and unique relays protecting major transformers
- Lack of fault logging information
- Software and firmware management of the microprocessor based relays

The main drivers of investment in protection systems include:

- Network reliability - replace schemes prone to failure and mal-operation
- Lower OPEX costs - replace schemes requiring intensive maintenance
- Increased functionality - monitoring and disturbance recording capabilities
- Functional integration – standardised integrated protection, controls, instrumentation and serial communication systems reduce accommodation, installation and maintenance costs

For further information refer to the detailed plant strategy, Protection Systems.

4.4.10 Control and Monitoring Systems

Control and monitoring systems refer to the control and monitoring of station plant (particularly circuit breakers) both locally and remotely from the Network Operations Centre (NOC). This includes instrumentation (volts, amps, frequency, watts and VARs) and CB status and station alarm reporting. Local control is by hard-wired switches and analogue indicating instruments in Remote Terminal Unit (RTU) stations and via a Human Machine Interface (HMI) in Station Control and Information Management System (SCIMS) equipped stations. Remote control from NOC is either by hard-wired RTU or by a SCIMS.

More than 100 RTUs dating from 1974 are located at 53 sites. SCIMS equipment dating from 2002 has been installed at 15 locations. General controls (re-close relays, potential selectors and instruments) range in age up to 40 years. RTU and SCIMS systems are operating satisfactorily. However, repair of faulted cards is becoming increasingly difficult due to technical obsolescence and the need to match new components with existing ones.

Some failures have occurred in older general controls where mechanical relays (timers) in re-close circuits can run fast or slow and cause non-operation. Similarly, electronic relays may have component failures, be inoperative and only found on a six-year maintenance interval or by not re-closing after a fault. The remaining electro-mechanical voltage regulating relays are suffering bearing wear and are no longer repairable.

RTU equipment has undergone huge technological change over the past 30 years and the older RTUs are now completely outmoded and no longer supported by the makers.

The SCIMS concept is a developing technology and migrating station controls from the old configurations to the new in a coherent and cost effective way is a major challenge.

For further information refer to the detailed plant strategies, Control and Monitoring - SCADA and Control and Monitoring - General.

4.4.11 Revenue Metering

There are approximately 410 revenue and 50 check meters installed at connection points with distribution customers. There are approximately 20 meters at connection points with generator customers and 10 meters at bulk supply and interstate connections to monitor energy flows, to calculate losses and facilitate invoicing amongst NEM participants.

The design, installation and maintenance requirements associated with these metering installations are defined within chapter seven of the NER. The main drivers for investment would be changes to the NER or new technologies providing superior outcomes at reduced cost.

For further information please refer to the detailed plant strategy, Revenue Metering.

4.4.12 Communication Systems

Communications equipment is installed at more than 100 SP AusNet transmission sites to provide:

- Electrical protection signalling between generating stations and terminal stations
- Electrical protection signalling between terminal stations
- Monitoring and control signalling between the NOC, generators, terminal stations and the National Electricity Market Management Company (NEMMCO)
- Operational voice and business communication between NOC, offices, depots, terminal stations, generating stations, distribution zone substations and VENCorp

The communication system includes more than 200 links/nodes formed from fibre-optic cables, radio, power line carrier and copper supervisory cables as well as operational and corporate telephone networks. At an average age of 25 years, SP AusNet communication assets are 25% older than their Australian peers and 38% older than international peers.

Optical Fibre in Ground Wire (OPGW) and underground fibre-optic cables are now less than 20 years old. In good condition, with few incipient issues and a technical life of 40 to 45 years, little replacement is expected in the next 20 years. All Dielectric Self Supported (ADSS) fibre-optic cables are predominantly installed on distribution company poles in metropolitan Melbourne. Most ADSS is now more than 10 years old and has suffered relatively high accidental damage rates. Carrying high priority EHV line protection and terminal station SCADA traffic and with a predicted life of 20 years, significant replacements of ADSS are forecast.

A majority of the electronic components forming the digital microwave-radio communications system were installed less than 10 years ago. However, with a short life expectancy of seven to 15 years, significant replacement rates are expected over the next 20 years. Most radio towers are less than 30 years old and associated antennas are less than 10 years old. Having expected lives of 40 to 70 years, few replacements are expected in the planning period.

Some of the Power Line Carrier (PLC) equipment, carrying protection signals for the220 kV, 275 kV, 330 kV and 500 kV lines, does not meet the redundancy requirements of the NER. Most of this equipment has been in service over 30 years. Manufacturers no longer provide support and there are few or no spares available for critical components. Recent failures have resulted in prolonged equipment outages while re-design and assembly workarounds were implemented. Performance tests also indicate that operating times are slower than Code specifications.

Like ADSS, aerial copper supervisory cables in metropolitan Melbourne are predominantly located on poles managed by others. Carrying system frequency and voltage control signals, industry operational traffic and 66 kV protection signals, most has been in service for 25 years. With a predicted life of only 30 years significant replacements are forecast. In the Latrobe Valley, SP AusNet owns the aerial copper supervisory cables carrying generator operational traffic and pilot wire protection signals. Most of the supervisory cable is more than 30 years old and in acceptable condition but failures are rising due to the ingress of water and broken cores.

The Operational Telephone Network (OTN) is being progressively replaced as failure rates increased on 20-year-old exchanges that were unsupported by manufacturers and limited spares were available through second hand distributors.

Voice Frequency (VF) tele-protection systems, comprising discrete analogue electronic components have been protecting generator connections for more than 30 years. Failure rates are rising and no manufacturer support is available. A seven-stage replacement program is under way.

The following is a list of investment drivers for plant:

- Higher standards of moisture, dust and temperature control are required for digital microprocessor based communication equipment. At several locations, accommodation, including cable trays and ducts, is fully utilised with insufficient room for new equipment or maintenance
- Security of remote location radio sites is compromised by past access key management practices
- The progressive replacement of tele-protection and PLC systems by microwave radio links, and optical fibre bearers ensure compliance with NER mandated performance
- The progressive replacement of ADSS fibre-optic cables and copper supervisory cables with OPGW or underground optical fibre cables to maintain network reliability and plant availability
- Compliance with communications availability standards specified in the AEMO Standard for Power System Data Communications
- Provision of fall restraint devices and safe working procedures for radio antenna support structures and associated training to comply with occupational health and safety legislation. Refer to the Health and Safety Management process and system strategy
- Increasing demands for digital bandwidth and digital multiplexed signalling to efficiently integrate protection, SCADA and conditioning monitoring communications needs. Refer to the plant strategy Asset Data Gathering Networks for further information

For further information please refer to the detailed plant strategy, Communication Systems.

4.4.13 Asset Data Gathering Networks

Various online monitoring devices now available are capable of being periodically polled to get a snapshot of equipment's condition over time. The devices can either be retrofitted to existing equipment or integrated with new equipment.

Asset data gathering equipment falls into three distinct categories, communications equipment, IT equipment and engineering devices:

- The main communications equipment assets are the fibre-optic links and associated equipment that provide network connectivity to most sites
- Associated with the fibre-optic links are the switches and routers used to construct the WAN
- The third and most broad category of devices is engineering devices. These range from simple weather monitors to online transformer or circuit breaker monitors that also provide certain control functions (for example, fan control in the case of a transformer). Other prominent devices include Closed Circuit TV cameras (CCTV), building security devices, system disturbance recorders and protection relays

There are currently 46 condition-monitoring connections to equipment located in terminal stations. This number is increasing rapidly with a conservative forecast of 160 connections by 2008/2009. With the increase in devices, network infrastructure must evolve to accommodate the bandwidth, protocols, connection and other system requirements that these devices demand. Much of the data collected requires some sort of processing and storage for historical analysis. Historically, devices for asset data gathering have not been present on the power system. As such, many of the existing documentation, cataloguing and equipment spares systems have not been set-up to accommodate these devices.

The data from engineering devices allows maintenance and replacement strategies to be optimised, equipment availability to be maximised and equipment failures to be minimised. For further information refer to the detailed process and system strategy, Condition Monitoring.

A high-bandwidth digital network allows rollout of advanced security measures including CCTV cameras and intelligent intrusion detection devices. Refer to the plant strategy Infrastructure Security for further information.

Network upgrades are required to support increased bandwidth needs from devices. Refer to Communication Systems for further information.

4.4.14 Civil Infrastructure

Assets within the classification of civil infrastructure include buildings, roads, surfaced areas, foundations, support structures, cable ducting, drains, fences, and water and sewerage pipes. These generally date from the time of original construction of the terminal station, depot or communication site.

About 56 km of security fencing encloses more than 532 ha of land at more than 100 individual sites. An area of 133 ha has been graded, drained and surfaced for the installation, operation and maintenance of electrical equipment in all weather conditions. Approximately 13 km of reinforced roads provide transport for heavy equipment and a further 29 km provide all weather access to electrical equipment. A total of 216 buildings provide all weather housing for control equipment, protection relays, communication facilities, batteries, rotating machinery, generators, compressors, switchgear, stores, workshops, laboratories, warehouses, worker amenities and office equipment.

Security fencing made from chain-wire mesh and topped with barbed wire varies from ‘serviceable’ to ‘new’ condition. However, increasing security standards and neighbouring land usage changes frequently mean that security fencing becomes inadequate before reaching its nominal service life.

The return to average rainfall after a prolonged drought and the increasing volume of augmentation works has placed greater construction traffic in switchyards with a negative impact on switchyard and access road condition. Large investments over the last five years have maintained switchyards and access roads in serviceable condition, but forecasts of increasing augmentation works over the next decade suggest continuing investment will be required.

Heavy vehicle transport roads were infrequently used at their load bearing capacity in the last decade. However, with utilisation now nearing 100% and transformer age and condition suggesting increasing refurbishment works, the next decade will involve more frequent movement of heavy equipment with consequent road augmentation and repairs necessary.

Approximately 15% of the buildings are in discrete communication sites constructed within the last 45 years. These brick walled and steel roofed buildings are in good condition with little maintenance or augmentation needs. However, the remaining buildings (mainly located in terminal stations and depots) vary widely in age, construction materials and condition. These buildings range from multi-storied brick and masonry construction to single storied timber and asbestos cement sheet construction. Many are in need of augmentation, refurbishment or replacement to provide adequate ambient temperature, dust and humidity control for an increasing volume of digital protection, control and communications equipment.

The main issues associated with civil infrastructure can be summarised by:

- Compliance with environmental legislation such as oil spill control, site water run-off and noise

- Compliance with occupational health and safety legislation such as working at heights, confined spaces and asbestos
- Extended periods of non-availability of key plant (inefficient maintenance and refurbishment, due to complex operational risk mitigation processes)
- Infrastructure security – to reduce risks of unauthorised persons in close proximity to electrical equipment, terrorist acts, theft and damage to equipment
- Provision of adequate environmental housing for the increasing volume of digital equipment that requires the superior control of dust, humidity and ambient temperature

Please refer to the following documents for further information:

Environmental Management
Health and Safety Management
Civil Infrastructure

4.4.15 Infrastructure Security

The state and federal governments have designated selected electricity transmission sites as 'critical infrastructure'.

The SP AusNet Integrated Response and Contingency System (SPIRACS) contains the framework for preventative and responsive measures to infrastructure security threats. It has classified credible threats as:

- Safety – untrained persons in the vicinity of energy containing equipment
- Malicious – motivated by revenge, fame, association or challenge
- Criminal – profit driven, includes theft, fraud, sabotage or extortion
- Terrorism – use or threat of force or violence to influence government or public through fear or intimidation

The main drivers of investment in security controls at more than 100 terminal stations, remote communication installations, depots and offices are to:

- Ensure that only authorised and trained people have access to key assets
- Identify, respond to and minimise the impact of security events
- Prevent loss of assets or functionality for the community and customers

Security risks have been quantified using a purpose built Infrastructure Security Risk Assessment Tool (ISRAT) that integrates the principles of AS/NZS 4360, National Guidelines for the Prevention of Unauthorised Access to Electricity Infrastructure[7] within SP AusNet's risk assessment methodology.

The Terminal Station and Communication Site Physical Security Policy[8] provides the context and rationale in support of the progressive improvement, introduction and integration of security

[7] National Guidelines for Prevention of Unauthorised Access to Electricity Infrastructure – ENA DOC 015-2006

[8] Terminal Station & Communication Site Physical Security Policy – SP AusNet 2006

measures including fencing, electronic access controls, intrusion detectors, CCTV, security lighting, building exterior hardening and remote alarm monitoring in the NOC. Improvements include security event investigation and reporting, control measure audits and network and site-specific contingency plans.

For further information please refer to the detailed plant strategy, Infrastructure Security.

4.5 Asset Life Cycle

The National Electricity Rules and the supplemental Victorian Electricity System Code establish regulations for the provision of transmission network services so that they are undertaken in a safe, efficient and reliable manner.

4.5.1 Asset Management

Electricity transmission network asset management practices were first accredited to PAS 55 (2004) in 2008. Re-accreditation to PAS 55 (2008) was achieved in 2011.

PAS 55 is a Publicly Available Specification for the optimised management of physical infrastructure assets that was developed in the United Kingdom and may be applied to any organisation where physical assets are a key or critical factor in achieving its business objectives and in achieving effective service delivery.

PAS 55 defines asset management as 'systematic and coordinated activities and practices through which an organisation optimally manages its assets, and their associated performance, risks and expenditures over their lifecycle for the purpose of achieving its organisational strategic business plan.'

PAS 55 complements and supports other existing asset management systems which SP AusNet has implemented.

Whilst not currently an Australian, British or International Standards Organisation (ISO) standard, the format of PAS 55 is such that it will be converted to an ISO standard in the future. The current format permits organisations to assess their asset management systems in a similar manner to those that may be carried out for other management systems e.g. ISO 14001.

Gaining PAS 55 accreditation has many benefits including:

- Recognition of best practice in asset management
- Identification of asset management good practice and improvement areas
- Clarification and communication of asset management objectives and processes
- Credibility of the asset management process
- Validate the asset management practices and processes that support the ESMS
- Transparency of asset management decisions
- Enhancement of the risk management approach
- Establishment of a sustainable performance framework
- Alignment with and building on existing ISO accreditations
- Independence of business models

4.5.2 Design

SP AusNet appoints competent external engineering design service providers to its design service panel and retains the services of internal design resources. These design service providers are responsible for delivering designs in accordance with SP AusNet's Station Design Manual.

One of the key general design requirement documents in the Station Design Manual is entitled "Safety in Design" and requires SP AusNet's design resources to utlilise a "Safety in Design" process to ensure new and existing risks associated with the design are identified and articulated for ongoing risk management.

All designs are reviewed by independent internal engineering resources to ensure the designs are consistent with SP AusNet's design standards and quality expectations. This process encourages continuous improvement in design as designs provided by multiple external and internal resources can be compared and the best design approaches selected over time and established as design standards and captured in SP AusNet's Station Design Manual.

The station design manual is continuing to evolve as design issues arise and are addressed.

The design process is carried out in accordance with the NSD Business Process Model

SP AusNet's design drawings are managed within OBJECTIVE, utilising the process outlined in the NSD Business Process Model F4 Drawing Management.

The specifications for plant and equipment are in accordance with the appropriate Australian standards with minimum performance specifications consistent with SP AusNet's Station Design Manual, Protection and Control Design Manual and AEMO's "Protection and Control Requirements" and "Primary Plant Functional Requirements" documents.

SP AusNet complies with the National Electricity Rules and the supplemental Victorian Electricity System Code when designing new construction on its system.

An important component of the project delivery process is the Constructability, Operability and Maintainability (COM) reviews that are designed to test and confirm the appropriateness of technical decision making at key stages in the development and execution of major network augmentation, refurbishment and replacement projects.

SP AusNet has increased the emphasis on its design and COM review processes with broader and more frequent involvement of service providers, contractors and field staff.

Field staff, design and construction contractors are integral members of formal design and COM reviews, undertaken for each major project. Where relevant, COM reviews are conducted on site to ensure relevant factors are considered in the construction planning process. For further information please refer to the process and system strategy Program Delivery.

A key challenge with the project delivery process as well as operations and maintenance of the network is the ability to engage, train and retain employees and contractors with appropriate levels of skills and experience to safely perform the necessary work. Refer to the process and system strategy Skills and Competencies and also HSP 01-04 "OH & S Training and Competency" for further information.

4.5.3 Construction

SP AusNet utilises a mixture of internal and external resources for construction activities and typically takes on the responsibilities of the principle contractor. The occupational safety aspects of construction of transmission assets are managed according to the Occupational Health and Safety Regulations 2007 Part 5.1 as described in the Health and Safety Procedure document HSP 02-07 entitled "Safe Work Method Statements and Health and Safety Co-ordination Plans".

A significant proportion of construction activity is carried out in existing operating sites and this requires close co-ordination between operating personnel and construction personnel.

SP AusNet has a comprehensive set of electrical safety instructions, called transmission field work procedures (FWPs), the implementation of which ensure that the requirements of the "Code of Practice of Electrical Safety On or Near High Voltage Electrical Apparatus" (Blue Book) are at least met and in many cases exceeded. These field work procedures cover all aspects of electrical safety for all field related activities on transmission assets including construction, commissioning, operations, maintenance, testing and retirement.

Job Safety Assessments (JSAs) must be completed by the work parties each day for every job for all field related works including construction, operations and maintenance. HSP 04-03 "JSA Guidelines" specifies the general requirements and there are specific JSA proforma documents for each of the main work groups including lines, field switching, primary, secondary and communications.

The engagement and management of contractors is important from a health and safety perspective and is specifically addressed in HSP 02-08 "Contractor Management – Risk Evaluation and Rating Model", HSP 02-03 "Contractor HSE Evaluation" and FWP 01-10 "Use of Contractors".

Physical security of transmission assets is also an important issue, in particular when construction, operations and maintenance activities are being performed at sites. SP AusNet has implemented physical security improvement measures to reduce the likelihood of physical intrusion and the possible safety implications for employees, contractors and the general public. The scope of these measures for each terminal station and communications site is determined by the use of the Infrastructure Security Risk Assessment Tool (ISRAT).

Refer to the asset management strategy Infrastructure Security for further information.

4.5.4 Commissioning

SP AusNet thoroughly inspects, checks and tests all assets for conformance to their performance requirements prior to the asset entering service.

The field work procedures associated with commissioning activities are:

- Sanction for Testing (FWP 01-05)
- Work on Out of Commission Electrical Apparatus (FWP 01-06)
- Clearance to Place High Voltage Electrical Apparatus Into Service (FWP 01-07)

For projects of significant size and complexity, a pre-commissioning inspection is held, either as part of, or in addition to the COM review process. This inspection focuses on the operability and maintainability of newly installed assets and includes the relevant safety considerations. It is held once construction is mostly completed, but still well before commissioning to ensure there is sufficient time to address any problems that arise before the plant goes into service. Refer to the process and system strategy Program Delivery for further information.

4.5.5 Operations

Operation of the overall system and individual assets is a key to asset management and to ensuring that system performance targets are achieved. Successful operations management ensures that the integrity of the assets is not compromised and that safety and environmental requirements are met.

For further information please refer to the process and system strategy Operations Management.

The Standard Operating Procedures (SOPs) are used by the control centre (CEOT) and the various FWPs used for field switching activities and the issue and cancellation of electrical access and work authorities. This includes the use of written switching instructions for communication of electrical plant switching requirements between CEOT and field operators.

For operational emergency response management refer to Section 6.10

4.5.6 Maintenance

Recurrent works are activities of a regular and ongoing nature and include scheduled, unscheduled, and breakdown maintenance. Scheduled maintenance programs are derived from SP AusNet's asset management information system database (MAXIMO). A maintenance plan that lists all of the scheduled maintenance (OMS) tasks for the following 12 months is produced as part of the budget process leading up to the new financial year. Forecasts of scheduled maintenance for future years are obtained by generation of virtual work orders in MAXIMO.

SP AusNet has in place "plant guidance information" (PGI) documents and "standard maintenance instructions" (SMIs) for primary assets, "lines practices and procedures (LPP)" and "live line procedures" (LLP) for lines assets and "test instructions" for secondary assets installed in the transmission network.

These are written procedures and instructions for the use by field personnel to carry out the required scope of maintenance on these assets in a safe manner.

Non-recurrent works are those that cannot be capitalised and have scopes that are too large or specialised to be included in the maintenance plan (for recurrent works). They are not time or operation based and are generally non-repetitive, one-off programs put in place to address specific problems. Examples include tower-corrosion mitigation works and condition assessment programs.

For further information please refer to the process and system strategy Plant and Equipment Maintenance.

4.5.7 Inspection and Condition Monitoring

Periodic inspections are carried out on SP AusNet's network assets and sites. These inspections are intended to identify issues before they threaten the operability of the assets.

SP AusNet utilises both online and offline condition monitoring techniques to establish plant condition and as input into the asset management strategies. New equipment is installed with facilities for online condition monitoring in accordance with the Policy on condition monitoring requirements for new plant items. Refer also to the process and system strategy Condition Monitoring.

4.5.8 Asset Retirement

Asset retirements are typically associated with construction works that are replacing the asset being retired. The planning for asset retirements becomes part of the construction work plans.

In addition to the typical risks associated with construction, asset retirement often triggers issues related to the handling of hazardous materials.

Some of these materials include:

- Asbestos
- PCB contaminated oils
- Other mineral oils

- Contaminated SF_6
- Silica Gel
- Batteries

There are various HSP documents, including HSP 05-10 "Hazardous Substances and Dangerous Goods", which include the requirements for the management and disposal of such materials. Refer also to the process and system strategy Health and Safety Management for further information.

5 Safety Assessment

5.1 Risk Management

SP AusNet is committed to understanding and effectively managing risk to provide greater certainty for the community and our shareholders, employees, customers and suppliers. A systematic and consistent approach to risk management and alignment of corporate philosophies and objectives are key principles.

The corporate Risk Management Policy defines the governance of risk and the corporate Risk Management Framework documents in relevant detail, the governance process, management principles and methodology, the assessment and management processes, monitoring and reporting processes and the compliance and review processes within SP AusNet. This framework is based upon AS/NZ 4360:2004, Risk Management and ISO 31000:2009 "Risk Management – Guidelines on Principles and Implementation of Risk Management".

The Audit and Risk Management Committee (ARMC), which is a board committee, provides corporate governance of risk management and the Group Risk Committee aligns the business objectives with the approved risk appetite and risk management strategy. In order to continue to embed a risk management culture within SP AusNet, one or more risk management co-ordinators have been appointed in each Division.

Within the above framework, SP AusNet uses a sophisticated suite of models to assess, monitor and mitigate asset failure risks as well as reliability, availability, health, safety, environment, infrastructure security and code compliance program risks.

Reliability Centred Maintenance (RCM) and asset specific risk models guide decisions on the volume and timing of efficient refurbishment and replacement projects that are necessary to deliver a sustainable or improving risk position.

Program risk models combine asset risk and management improvement programs to guide decisions on the capability of the Victorian electricity transmission network to sustain selected performance levels.

In order to manage identified risks SP AusNet has implemented a risk management information system, known as "Cura". This system records the results from risk assessments, along with the required actions to be carried out to mitigate the risk.

For further information please refer to:

Corporate Risk Management Policy

Corporate Risk Management Framework

Corporate Risk Management Strategy

Corporate Risk Committee

SP AusNet Integrated Response and Contingency System (SPIRACS)

Regulatory Compliance Management System

Process and system strategy Risk Management (AMS 10-22)

Infrastructure Security Risk Assessment Tool (ISRAT)

Within the above framework, SP AusNet uses a suite of sophisticated models to assess, monitor and mitigate asset failure risks on health, safety, capacity, reliability, quality, environment, infrastructure security and code compliance program risks. Reliability Centred Maintenance (RCM) and asset specific risk models guide decisions on the volume and timing of efficient refurbishment and replacement projects that are necessary to deliver a stable or improving risk position.

5.2 Risk Identification, Assessment and Control

A formal safety assessment consistent with the Electricity Safety Act and the Electricity Safety (Management) Regulations has been completed to assess the safety risks associated with SP AusNet's electricity transmission network.

More than one hundred individual safety related risks were identified and assessed in a series of workshops undertaken in 2010. Each workshop involved personnel with a wide range of experience and skills in designing, operating and maintaining electricity transmission networks. Workshops employed the risk assessment methodology detailed in SP AusNet's Risk Management Framework.

The Formal Safety Assessment (ESMS 20-02) contains the details of the process employed, results obtained and the actions identified to manage the risks.

6 Safety Management System

The safety management system contains the following key elements within SP AusNet's Asset Management System:

- Legislative and regulatory compliance obligations management,
- Technical standards for the design, construction, operation, maintenance and retirement of supply network assets
- Safety Policy,
- Asset management strategies for long term supply networks sustainability,
- Asset management plans,
- Asset Information & Systems,
- Network access procedures and requirements,
- Emergency preparedness and response processes and procedures,
- Roles and responsibilities for personnel engaged in managing the supply networks,
- Training & competencies of personnel required to work on the supply networks,
- Consultation & communication processes,
- Maintenance and retention of documentation,

- Operational processes,
- Checking and corrective actions, and
- Management review and feedback.

6.1 Legislation and Regulation

6.1.1 Energy Safe Victoria

Energy Safe Victoria (ESV) is the independent Victorian statutory authority responsible for technical / safety regulation. The responsibilities of ESV relevant to electricity networks are:

- safety of electricity supply including generation, transmission and distribution;
- safety of electrical installations in industrial, commercial and domestic premises;
- safety of electrical workers by the registration of contractors and the licensing of electrical workers on the attainment of an appropriate level of electrical safety competency;
- safety of electrical equipment by ensuring it meets minimum required electricity safety standards before sale;
- the education of the community and the electricity industry on the safe use of electricity through a strong and focussed awareness campaign;
- investigation and analysis of incidents and accidents to identify trends and develop preventative measures; and
- protection against the corrosion of underground or underwater structures from the potential leakage of stray electric current.

The Council of Australian Governments has initiated the development of a regulatory framework for national safety regulation of energy networks. The proposed framework is based on risk management principles, consistent with the approach now administered by ESV in Victoria. It is anticipated that this will progressively supersede the existing state-based safety regulations during the 2011-2015 period.

6.1.2 National Electricity Law and Rules

Economic and technical regulation is subject to a national framework; governed by the National Electricity Law (NEL), and contained in the National Electricity Rules (Rules). The Australian Energy Markets Commission (AEMC) has responsibility for development of the Rules, and the Australian Energy Regulator (AER) is responsible for regulation of industry participants in accordance with the Rules.

The National Electricity Rules and the supplemental Victorian Electricity System Code (published by the Essential Services Commission) set the regulatory framework for the safe, efficient and reliable provision of transmission network services in the state of Victoria.

A complete list of the legislative and regulatory instruments governing SP AusNet's electricity transmission system business is contained in Appendix A.

6.1.3 Regulatory Management System

SP AusNet is committed to complying with all of its regulatory obligations. All employees and agents are responsible for compliance where relevant to their work activities. Regulatory compliance management is embedded in core business activities, functions and processes. SP AusNet ensures employees are aware of relevant obligations. SP AusNet requires its employees to recognise and report breaches, including situations where there is risk of breach occurring, so that improvements can be made.

The Managing Director is accountable to ensure that SP AusNet's regulatory compliance policy is promulgated throughout the business, and ultimately for performance outcomes. The Audit and Risk Management Committee oversees the design and implementation of SP AusNet's regulatory compliance framework. It monitors the appropriateness of the framework to effectively achieve compliance and contribute to SP AusNet's business performance.

SP AusNet's reference point for best practice compliance management is Australian Standard AS3806–2006. The regulatory compliance framework is maintained by the Regulatory Compliance Management Team. This framework supports business units in managing compliance, reports to executive management and the Audit and Risk Management Committee, and provides SP AusNet's interface with regulators on regulatory compliance issues.

Regulatory obligations are assigned to persons (responsible persons) in business units which are best placed to manage an obligation in the conduct of their work activities. Accountability for compliance with the obligation is through line management. Responsible persons are required to confirm compliance and demonstrate that compliance with regulatory obligations can be reliably achieved. SP AusNet is committed to the achievement of regulatory compliance in all areas and activities of the business.

SP AusNet's approach to implementing this regulatory compliance framework is documented by the Regulatory Compliance Team in procedures available to all staff and agents. This approach includes the following features:

- The Regulatory Compliance Management System contains register of all regulatory obligations
- Each regulatory obligation is assigned to an employee (Responsible Person or RP) and their supervisor (Line Manager or LM) for management
- Compliance with the obligation is the responsibility of all staff or agents of SP AusNet whose work activities encounter the regulatory obligation
- Pathways for employees to notify of anomalies and breaches are to be communicated
- Accountability for compliance with an obligation is via line management
- Regulatory obligations are risk assessed in accordance with SP AusNet's Risk Management approach, to ensure appropriate attention and management process is given to high exposure obligations
- Wherever possible management plans for regulatory obligations will be embedded in regular business processes, and provide for measurement of performance against the obligation
- Confirmation of compliance with obligations will be registered in the Regulatory Compliance System, and this will provide the basis for reporting to SP AusNet management and regulators
- The effectiveness of compliance plans will be monitored by the Regulatory Compliance Team

- The Regulatory Compliance Team and business units will develop relationships which facilitate a supportive and continuous improvement approach to developing effective business processes
- Training in the compliance framework and SP AusNet's commitment to compliance is provided to all employees. For further information, refer to Compliance Database & Reporting
- The Audit and Risk Management Committee (ARMC) considers the effectiveness of the framework
- A Regulatory Compliance Reference Group operates to improve the implementation of the framework

6.1.4 Australian Energy Regulator

The AER's regulatory functions and powers are conferred upon it by the NEL and it must act in accordance with its obligations under the Rules (as must industry participants). The AER's key responsibilities at the present time include:

- regulating the revenues of transmission network service providers and distribution supply network service providers;
- monitoring the electricity wholesale market;
- monitoring compliance with the national electricity law, national electricity rules and national electricity regulations;
- investigating breaches or possible breaches of provisions of the national electricity law, rules and regulations and instituting and conducting enforcement proceedings against relevant market participants;
- establishing service standards for electricity transmission network service providers;
- establishing ring-fencing guidelines for business operations with respect to regulated transmission services; and
- exempting network service providers from registration

6.2 Published Technical Standards

SP AusNet recognises the technical standards published by Standards Australia (AS), Electricity Supply Association of Australia (ESAA), Energy Networks Australia (ENA), International Electro-technical Commission (IEC) and Institute of Electrical and Electronic Engineers (IEEE) technical standards as the basis for design, construction and maintenance activities and as the basis for the development of in-house standards. Principally, SP AusNet uses Australian Standards, however the predominant industry codes and standards which are also applied to the electricity transmission network, can be found in Appendix B.

6.3 Technical Standards

In addition a range of internal codes and standards are applied to the planning, design, construction, operations and maintenance of the Victorian electricity transmission network. They are detailed in the following prime documents:

- Station Design Manual
- Project Execution Manual
- Protection and Control Design & Construction Manual

6.4 Safety Policy

6.4.1 General

SP AusNet's safety policy operates under the frameworks of the Occupational Health & Safety (OH&S) Policy and the Asset Management Policy whereby a full life cycle approach is taken toward the design, construction, operation, commissioning, operation and retirement of assets to ensure safety of the public, employees and property.

Victoria's OH&S legislation is currently under review and it is proposed that new requirements will broaden the future policy scope. SP AusNet proposes to develop a single Safety Policy subsequent to the completion the review of the OH&S legislation.

6.4.2 Occupational Health and Safety Policy

SP AusNet is committed to providing a safe and healthy working environment for all while delivering energy across our electricity and gas transmission and distribution supply networks. To achieve this, the commitment and contribution of each and every employee is required to maintain, so far as is practical, a working environment that is safe and without risk to health. We will do this through:

- *Taking responsibility for the health and safety of ourselves and our fellow workmates in all of our activities aiming to eliminate work-related injury and illness.*
- *Not compromising personal health and safety in the mistaken belief that other requirements are more important.*
- *Placing people first, then plant safety and system performance followed by other issues.*
- *The identification, assessment and control of workplace risks and hazards*
- *Complying with all regulatory and legislative requirements, Industry Codes and relevant Australian Standards.*

SP AusNet fosters this safe work environment by:

- *Implementing and maintaining an effective Health and Safety Management System with commitment and involvement from all levels of the organisation*
- *Ensuring that there is a systematic identification of hazards and there is assessment and control of risks associated with those hazards*
- *Providing appropriate education and training*
- *Systemic planning and control of workplace activities and the establishment of measurable objectives and targets.*
- *The provision of appropriate facilities, plant, equipment and supervision*

SP AusNet will also ensure that contractors, suppliers and co-venturers apply similarly high standards. SP AusNet will facilitate continuous improvement in our Health and Safety performance by periodic reviews of objectives and targets and regular and rigorous monitoring and analysis of performance. Health and safety considerations will be taken into account in all our business decisions.

This policy was endorsed by the N Ficca, the Managing Director of SP AusNet in September 2006.

6.4.3 Asset Management

SP AusNet's Asset Management Policy is shown in Figure 6.1 below. It concisely documents SP AusNet's objectives and values with respect to the provision of services and management of the assets forming its energy distribution and transmission networks in Victoria.

SP AusNet
Asset Management Policy

SP AusNet's asset management vision is to be a
"leader in the asset management of energy networks".

Our asset management mission is to
"deliver energy and associated services, safely, reliably and to enhance the lives of our customers and employees in a sustainable manner".

The SP AusNet asset management policy supports our asset management vision and mission by providing the framework for delivering the design, construction, operation, maintenance and retirement of energy networks in an efficient manner which:

- Delivers sustainable outcomes for safety, the environment and network performance
- Informs and supports the business plan
- Sets the direction for the asset management strategy
- Complies with regulatory and legislative requirements, industry Codes and relevant Australian Standards

To achieve this, we will:

- Develop and maintain effective Asset Management Systems with commitment, accountability and involvement from all of the organisation
- Apply key sustainability priorities focused around our environment, people, culture, community and customers
- Use our risk management framework to systematically identify hazards and assess and control the risks associated with those hazards
- Understand and respond to our customers' requirements
- Use our skills and expertise to continually improve the quality of our service
- Recruit, train and develop staff to effectively manage our assets in a sustainable way
- Ensure appropriate facilities, plant, equipment and supervision
- Utilise effective work planning and control
- Apply a life cycle approach to asset management
- Innovate, create and employ leading asset management practices
- Continuously improve our Asset Management effectiveness
- Benchmark our processes and practices
- Review objectives and targets and conduct regular and rigorous monitoring, auditing and analysis of economic and technical performance.

SP AusNet will ensure that contractors, suppliers and partners apply similarly high standards.

Asset management is complementary to achieving safe, reliable, and sustainable, energy network services.

Nino Ficca
MANAGING DIRECTOR

May 2010

SP AusNet™
A member of Singapore Power Group

Figure 6.1 – Asset Management Policy

6.5 Asset Management Process

The asset management process is illustrated in figure 6.2 below and detailed in the AMS 20-10 Asset Management Process. It brings together the external influences, investment drivers, business values and asset management directions and the selected strategies to deliver sustained performance for the benefit of stakeholders.

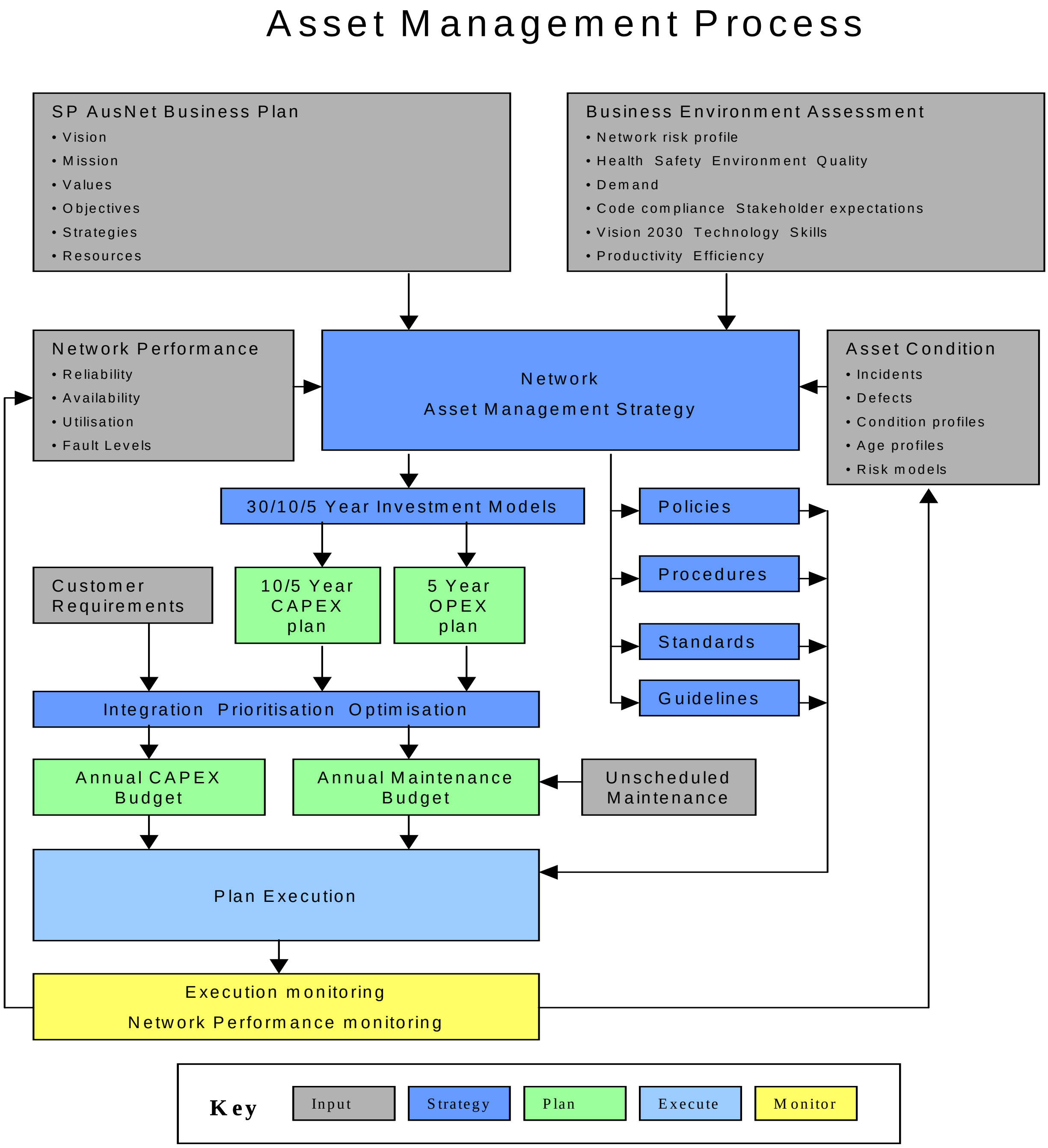


Figure 6.2 – Asset Management Process Flowchart

Two of the key asset management related processes are discussed below.

6.5.1 Capital Expenditure Prioritisation

Capital expenditure is priority directed to projects that most efficiently deliver stakeholder benefits and regulatory commitments. The prioritisation process quantifies the benefits and resource requirements of candidate projects and ranks them according to stakeholder and corporate values, including:

- Health and safety (staff and/or public)
- Network and community impact
- Compliance – statutory, regulatory and code

- Asset condition – performance and reliability
- Environmental impact
- Corporate image
- Financial impact

Modelling the quantum and the timing of benefits from each candidate project against target outcomes provides an optimal list of projects, which following ratification forms the basis of the near term budget and capital works program.

For further information please refer to the process and system strategy Capital Expenditure Prioritisation

6.5.2 Program Delivery

The Program Delivery group provides management and resources to deliver SP AusNet's maintenance (OPEX) and capital works (CAPEX) programs relating to transmission assets.

The resource model includes the use of internal and external resources in the delivery of maintenance and capital works programs. Strategic alliances have been formed with companies that provide design services, installation services and maintenance services. Contract arrangements are performance based with benchmarking of costs and standards to ensure that quality and value is maintained throughout the contract.

The management of changes to assets and installations is specified in the Project Execution Manual and the management of associated procurement is specified in the Procurement Management System.

An important part of the program delivery process is the conduct of COM reviews, as discussed in Section 4.3.2, and post implementation reviews (PIRs). There are three levels of PIRs in use or being implemented, as discussed below.

- Business Case Benefits – As part of the revised Program/Project Lifecycle a PIR is undertaken on all programs and projects to measure the outcomes achieved against the benefits outlined in the approved Business Case. This commenced in early 2010 and is coordinated by the PMO
- Planning Benefits - conducted internally on all projects, with key projects by independent, external consultants to ensure that improvements and innovations documented are achieved and any lessons learned are fed back into future CAPEX and OPEX programs. This is usually completed by Network Strategy and Planning, NSD.
- Project Delivery - these PIR are based on the project performance and aim to identify innovation and learning opportunities, to improve the productivity and efficiency of future projects. They are performed by INS division.

For further information please refer to the process and system strategy Program Delivery.

Further information relating to program delivery is included below.

Expenditure Authority

Project Approval Committee

Accredited Contractors

Project Execution Manual

Health and Safety Manual

6.6 Strategies

6.6.1 Asset Management Strategy

AMS 10-01 Asset Management Strategy, and its supporting strategies, document SP AusNet's holistic approach to management of the network assets, and establishes the linkages with the underpinning processes and plans. This approach seeks optimal network performance at an efficient cost by ensuring that all decisions to augment, replace or maintain network assets are economically justified and appropriately consider all relevant criteria, including:

- Safety
- Performance and condition of network assets
- Objective of maintaining quality, reliability and security of supply
- Technological advances
- The direct challenges of climate change impacts on network assets

The Asset Management Strategy (AMS) for the Electricity Transmission Network is the primary resource in the management of Victoria's electricity transmission assets, defining the delivery of quality services to customers and value to shareholders. It summarises the medium-term strategic actions for achieving regulatory and business performance targets, which are implemented via the programs of work listed in Asset Management Plans.

The AMS is a suite of interlinked documents, arranged in a three-tiered hierarchy, that guide the asset management process. The hierarchy covers strategy, policy, procedures and plans for asset management. The resource documents contained in the foundation and implementation levels support the top level overarching strategy document, as illustrated in Figure 6.3 below.

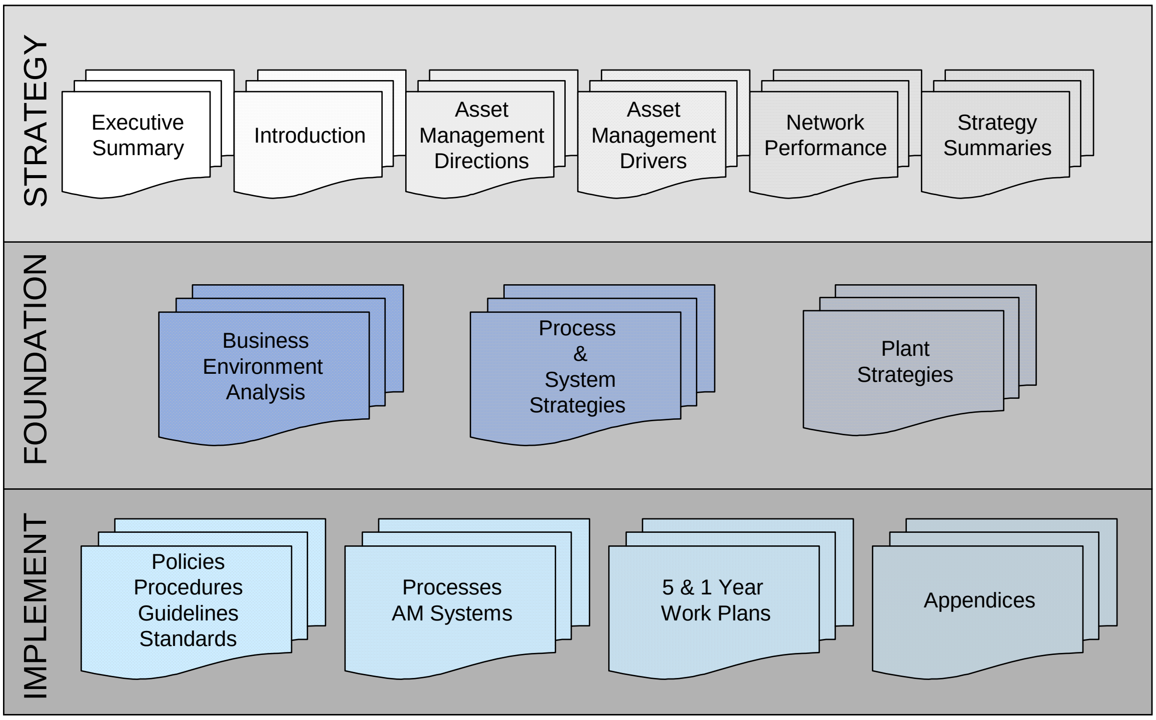


Figure 6.3 – Hierarchy of the Asset Management Strategy

At the top level, the overarching strategy document brings together external influences, investment drivers, business values and asset management directions with a summary of the resources and the strategies that will deliver sustained performance for the benefit of stakeholders.

Hyperlinks integrate this high–level summary with supporting documents in the foundation and implementation levels.

The second level contains the foundation documents that the AMS is built upon. This level includes a detailed analysis of the business environment that the transmission network operates within. This level also details the assets, issues and investment drivers behind each technical, procedural and support system strategy, strategies that are necessary to achieve agreed performance outcomes.

Key documents include:

Business Environmental Assessment

Asset Management Information Systems

Asset Replacement and Refurbishment

Capital Expenditure Prioritisation

Condition Monitoring

Environmental Management

Health and Safety Management

Knowledge and Record Management

Network Performance Monitoring

Operations Management

Plant and Equipment Maintenance

Process and Configuration Management

Program Delivery

Risk Management

Skills and Competencies

Asset Data Gathering Networks

Auxiliary Power Supplies

Capacitor Banks

Circuit Breakers

Civil Infrastructure

Communications Systems

Control and Monitoring - SCADA

Control and Monitoring - General

Diesel Generators

Disconnectors and Earth Switches

Earth Grids

Fire Detection and Suppression

Gas Insulated Switch Gear

Infrastructure Security

Instrument Transformers

Line Easements

Power Cables

Power Transformers and Oil-filled Reactors

Protection Systems

Revenue Metering

Secondary Cabling

Static VAR Compensators

Station Air Systems

Surge Diverters

Synchronous Condensers

Transmission Lines

"Three Networks" Communications Network Strategy

"Three Networks" SCADA Strategy

The third level outlines the implementation of the AMS. At this level, strategies are integrated with SP AusNet's business systems and practices. These documents provide direct links between asset management strategies and company policies, procedures, support system developments, work programs and plans.

6.7 Plans

6.7.1 5-Year Asset Management Plan

The 5 Year Electricity Transmission Asset Management Plan is produced annually. It is an essential link between the Asset Management Strategy and the many projects and programs of activity necessary for the timely achievement of the specified objectives and performance outcomes.

The asset management plan summarises:

- capital expenditure projects initiated by AEMO or connected parties to augment the network as required to meet the energy needs, network reliability and quality of supply requirements of customers
- capital expenditure projects to refurbish or replace assets to maintain network performance and risk to prescribed targets and obligations
- operating expenditures to meet recurrent operating and maintenance requirements
- operating expenditures (asset works) to meet unique or non-recurrent operating and maintenance requirements

Through the Capital Expenditure Process the asset management plan also summarises:

- The scope of projects or programs of activity including success measures
- Time frames for achievement
- Resources allocated, and
- Responsibilities for delivery, monitoring and management

6.7.2 Bush Fire Mitigation Plan

A Bushfire Mitigation Plan is developed on an annual basis through the Bushfire Mitigation Management Committee, to ensure the safety of the network assets during the coming fire season. The Plan provides a system that incorporates all aspects of the management of the bushfire risk arising from the SP AusNet electricity transmission supply network and includes:

- Requirements that ensure compliance with the Act, Regulations and Code;
- Management monitoring, control and overview;
- Key performance indicators, reporting and monitoring systems;
- Process of continuous improvement in risk reduction;
- Contingency planning, including Total Fire Ban days;
- Asset inspection, maintenance and replacement strategies, standards and targets;
- Resource forecasting and deployment
- Incident investigation, reporting and communication protocols and processes;
- System and work activity audit processes.

6.7.3 Vegetation Management Plan

Vegetation management is undertaken throughout each year in accordance with a documented Vegetation Management Plan. The Vegetation Management Plan and Procedures, an integral part of the Bushfire Mitigation system, details the management procedures to ensure compliance with the Electricity Safety Act and Electricity Safety (Electric Line Clearance) Regulations.

SP AusNet has a specialist group dedicated to the management of transmission line easements and the vegetation within them. SP AusNet's vegetation management group utilises a small number of contractors to undertake the physical assessment and cutting activities. The vegetation management group is represented on the Bushfire Mitigation Management Committee which ensures the preparation and submission of the annual Vegetation Management Plan to Energy Safe Victoria for approval.

In addition to SP AusNet's vegetation audit and compliance programs, each year Energy Safe Victoria undertakes field and desk top audits to ensure compliance with legislative requirements. ESV's auditing of the industry contributes to the continual improvement process whereby best practice knowledge transfer can occur through observations made by ESV for improvement to vegetation management activities.

Effectiveness of the Vegetation Management Plan is monitored by the Bushfire Mitigation Management Committee through key performance indicators (KPIs) such as the Bushfire Mitigation Index.

SP AusNet's planned response to changes to the Electricity Safety (Electric Line Clearance) Regulations 2010 are documented in Vegetation Management 2010 Regulations Transition Plan

6.8 Asset Information and Systems

6.8.1 Asset Management Information Systems

SP AusNet's main asset management information systems are MAXIMO for asset and work management, TRESIS for relay settings, Ratings Database Repository (RADAR) for plant and equipment ratings, OBJECTIVE for design drawings and Mobile Inspection System (MIS) for recording asset inspections.

The progressive development of asset management information systems is coordinated by the Enterprise Asset Management program within the Business Systems Asset Management Strategy.

The principle drivers of improvement in information systems are:

- Improving data quality for informed operation and strategic decision making
- Increasing costs of supporting disparate, customised, non-interfaced systems
- High risks associated with reliance on the 'local knowledge' of a mature-aged workforce
- Repeatable, transparent and auditable processes to assure compliance to regulatory and safety obligations
- Replacement of obsolete legacy systems

For further information please refer to the process and system strategy Asset Management Information Systems.

6.8.2 Asset Data Gathering Networks

Various online monitoring devices now available are capable of being periodically polled to get a snapshot of equipment's condition over time. The engineering devices can either be retrofitted to existing equipment or integrated with new equipment.

Asset data gathering equipment falls into three distinct categories, communications equipment, IT equipment and engineering devices:

- The main communications equipment assets are the fibre-optic links and associated equipment that provide network connectivity to most sites
- Associated with the fibre-optic links are the switches and routers used to construct the WAN
- The third and most broad category of devices is engineering devices. These range from simple weather monitors to online transformer or circuit breaker monitors that also provide certain control functions (for example, fan control in the case of a transformer). Other prominent devices include Closed Circuit TV cameras (CCTV), building security devices, system disturbance recorders and protection relays

The data from engineering devices allows maintenance and replacement strategies to be optimised, equipment availability to be maximised and equipment failures to be minimised. For further information refer to the process and system strategy Condition Monitoring and the plant strategy Asset Data Gathering Networks.

6.9 Network Access

6.9.1 Authorised Access

Approach by persons, vehicles and mobile plant is managed in accordance with Section 6 'Approach to Electrical Apparatus' of the 'Blue Book[9]'. Approach within these safe approach distances requires the appropriate authorisation and/or competencies as described in Section 4 'Training and Authorisation' of the 'Blue Book'.

To ensure that only persons with the required skills and competence are assigned to carry out work on or near electricity transmission assets SP AusNet issue individual employees and service providers with Network Authorities.

SP AusNet issues the following access authorities:

- HV Operating Authority
- Authority to Make Application
- Electrical Access Permit Authority
- Authority to Enter HV Enclosures
- Sanction for Test Recipient Authority
- Sanction for Test Applicant Authority

Accreditation and authorisation requirements are consistent with those of the 'Blue Book'.

Training associated with maintaining the effectiveness of these authorities is undertaken every three years and employee outcomes are recorded in Drive, the human resources management system and the authorities database which records individual employee and contractors access authorities.

[9] Code of Practice of Electrical Safety for Work On or Near High Voltage Electrical Apparatus

Specific individuals and work groups have access to the SP AusNet Authorities database to assist in verification that individuals proposing to undertake work are approved for access to the electricity transmission network.

Access follows a system of controls that assigns roles and responsibilities to persons based upon their respective level of approved authorisation. These roles are described in definitions 5 to 8 of the Blue Book. Further information can be obtained in the Field Work Procedures relating to Authority for access.

In addition to the procedural controls, physical controls for terminal stations and communications sites include perimeter security fencing, electronic access control, security cameras, building hardening and remote operated switchyard lighting.

6.9.2 Infrastructure Security

Commonwealth and state governments have imposed legal responsibility on both the owners and operators of critical infrastructure (such as gas and electricity installations) to take all necessary preventative security measures to ensure continuity of supply. AMS 10-63 Infrastructure Security focuses on security enhancements for more than 100 terminal stations and communications sites forming part of SP AusNet's electricity transmission network.

The four main security threats to the electricity transmission network are:

- Safety – of untrained persons in the vicinity of energy-containing equipment
- Malicious – motivated by revenge, fame, association or challenge
- Criminal – profit driven; includes theft, fraud, sabotage or extortion
- Terrorism – threat or use of force to influence government or public through fear or intimidation

The Infrastructure Security Risk Assessment Tool (ISRAT) is used to assess physical security risks and control measures in SP AusNet's installations.

SP AusNet's physical security control measures are founded on the following principles:

- Consistent risk identification and quantification;
- Defence in depth – increasing the number and sophistication of control measures commensurate with the degree of intrusion risk;
- Deterrence – measures to deflect would-be intruders towards other targets;
- Delay – measures to increase the time and effort required to successfully intrude;
- Detection – measures to promptly and reliably detect intrusion;
- Response – measures to promptly and appropriately deal with intruders and associated consequences; and
- Contingency planning – measures to promptly recover service and minimise societal impact.

6.10 Emergency Preparedness and Response

SPIRACS is SP AusNet's Integrated Response and Contingency System. It ensures effective and timely response to emergencies which may affect the operation of the network, the health and safety of personnel or the public. The SPIRACS system, illustrated in Appendix G, contains policies, frameworks, standards and procedures that create a single point of reference within SP AusNet for the management of those risks involving the disciplines of business continuity, crisis, emergencies or security. SPIRACS procedure Emergency and Crisis Escalation Guide 30-4006-04, illustrated in Appendix G, is based upon the SP AusNet Risk Management Framework's Risk Assessment Tables (Risk Matrix) used in the formal safety assessment and contains a guide to the range of experienced and potential consequences and subsequent responses.

The outcomes of the Emergency and Crisis Management System as stated in the Emergency Crisis and Management Policy 30-4006-02 procedure, illustrated in Appendix G, cover:

- *Prevention of events that may involve threat to life, health, property or the environment.*
- *Preparing for those events which are not preventable*
- *Responding to those events which impact the business*
- *Recovering from those events*

The purpose of this system is to:

- Ensure the outcomes of the emergency are managed and planned;
- Control events which may interrupt a safe supply;
- Prepare for those events which are not preventable;
- Respond to those events which impact the business; and
- Recover from events.

The Emergency and Crisis Escalation Guide 30-4006-04 provides a system of communication for nominated internal and external stakeholders, which include ESV, AEMO, NEM, Minister and the Executive Leadership Team, for the respective levels of declared emergency response. Subsequent procedures within the SPIRACS manual define emergency roles and responsibilities across SP AusNet and accredited service provider organisations and the communication interface arrangements within its facilities and with outside organisations such as–

- Emergency Services (Police, Fire Authorities etc.);
- Electricity companies (other transmission, distribution or retail businesses);
- Government;
- Media; and
- Community groups and the general public.

It incorporates an emergency organisational structure and operating protocols to be adopted by SP AusNet for the formal declaration of an emergency and emergency management including–

- Immediate response;
- Emergency site management and declared Emergency Operations Centre;
- Ongoing management of the emergency;
- Personnel resourcing and management; and
- Recovery and reinstatement of processes.

Documents within the SPIRACS Manual align with those of the other industry participants to ensure an effective industry response to emergencies.

6.10.1 Call-Out Roster System for Facilities

In accordance with the requirements of the SPIRACS Manual, SP AusNet maintains a 'call out' roster system for the Networks Duty Managers, Network Operations Managers, Field Regional Managers and Field Supervisors.

6.10.2 Contingency Plans

SP AusNet has developed a System Contingency Plan for the Victorian Electricity Transmission Network to guide the timely restoration of service following a significant system event.

SP AusNet has also developed site specific security plans for nominated critical infrastructure sites in the transmission network.

6.10.3 Business Continuity Plans

Each SP AusNet organisational division has developed a business continuity plan to mitigate disruption to critical business processes following a natural or man made event. Communication, testing and maintenance of these plans is carried out on a regular basis.

6.11 Roles and Responsibilities

Personnel associated with the management of the transmission network are appropriately trained and authorised to ensure the safe and effective performance of their respective roles. They are subject to regular performance review and appropriate refresher training in order to maintain competency and performance at the required levels. The personnel responsible for the management, including the operation and maintenance of the transmission network are identified by SP AusNet's organisation charts.

With respect to this ESMS, a summary of the principal roles is included below.

6.11.1 Managing Director

The Managing Director with the support and guidance of the Board of Directors is ultimately responsible for the management of SP AusNet. The Managing Director oversees the strategies, policies and performance of SP AusNet and sets the values and standards. Governance arrangements are established in a charter which describes the functions of the Board and those functions delegated to management.

6.11.2 Group General Manager, Network Strategy and Development

The Group General Manager, Network Strategy and Development (NSD) division is responsible for the stewardship of SP AusNet's regulated gas and electricity networks. This includes the strategic functions of customer strategy, regulatory and network strategy, project and program management, asset engineering, project engineering, communication system development and advanced interval metering.

6.11.3 Director, Regulation and Network Strategy

Reporting to the Group General Manager (NSD), the Director, Regulation and Network Strategy is responsible for the development and continuous improvement of regulatory and network development strategies to ensure compliance of the gas and electricity networks with relevant technical and commercial regulation.

This role includes responsibility for the development and continuous improvement of asset management strategies, asset management plans and compliant safety management schemes for the SP AusNet's gas distribution supply network, electricity distribution supply network and the electricity transmission network.

6.11.4 Manager, Asset Engineering

Reporting to the Group General Manager (NSD), the Manager, Asset Engineering is responsible for the research, development and application of appropriate technical standards and the scoping, specification and initiation of projects and programs of work to continuously improve the performance of SP AusNet's gas distribution supply network, electricity distribution supply network and electricity transmission network.

6.11.5 Group General Manager, Integrated Network Services

The Group General Manager, Integrated Network Services (INS) division is responsible for the delivery of all asset related works, including customer projects, as defined in asset management plans by the NSD division. This responsibility extends to the operational functions of customer service, network operations & control, supply networks maintenance, logistics and procurement and major project delivery. Responsibilities include the accreditation, engagement and management of independent service providers.

6.11.6 General Manager, Operations and Services

Reporting to the Group General Manager, INS, the responsibilities of the General Manager Operations and Services include the continuous provision of network operating and incident management services as well as inspection, maintenance and incident response services.

6.11.7 Manager, Field Services

Reporting to the General Manager, Operations and Services the Manager, Field Services is responsible for the organisation and performance of the geographically based construction, inspection, operations, maintenance and incident response resources.

Resources skilled in primary, lines, secondary, communications and field operations activities are located at Hazelwood, Rowville, Thomastown and Bendigo.

6.11.8 Network Operations and Performance Manager

Reporting to the General Manager, Operations and Services the Network Operations and Performance manager is responsible for the organisation and performance of the network operations centre (CEOT), which authorises and co-ordinates access to the gas and electricity supply and transmission networks, provides continuous network operating services, and manages the response to network incidents. This role includes responsibility for incident investigation and reporting and data gathering associated with key performance indicators (KPIs).

6.11.9 General Manager, People and Safety

The General Manager, People and Safety is responsible for the safety and skill development of SP AusNet personnel, the environmental performance of SP AusNet's energy delivery networks, business communications and the quality of SP AusNet's business processes.

6.11.10 Director, Health Safety Environment and Quality

Reporting to the General Manager, People and Safety the Director, Health Safety Environment and Quality is responsible for the development, communication, implementation and compliance culture within SP AusNet necessary to improve the businesses performance in the area of Health, Safety Environment and Quality.

This role include responsibility for the continuous development of SP AusNet's independently accredited Health and Safety Environment and Quality management systems which underpin all business processes.

6.11.11 General Manager, Select Solutions

The General Manager, Select Solutions is responsible for delivery of asset inspection, vegetation, technical, metering & data services. In providing these services both internally and externally of SP AusNet, the GM Select Solutions is responsible for the continued development of these services together with the introduction of new technologies and innovation that will further extend SP AusNet's management of its supply networks.

6.11.12 Chief Financial Officer

The Chief Financial Officer (CFO) is responsible for delivery of a wide range of Strategic Planning and Financial Services which include treasury, cash management, investor relations, financial modelling, investment analysis, taxation planning & compliance, statutory and regulatory accounting & reporting, accounting operations and management accounting.

6.11.13 General Manager, Information Technology

The General Manager, Information Technology is responsible for strategic IT functions including architecture, portfolio management, IT policy and supporting the Real Time network control systems. The division also manages provision of IT services and systems from Energy Business Solutions to the business, including translating business requirements into functional and technical specifications.

6.11.14 General Counsel and Company Secretary

The General Counsel and Company Secretary division provides advice and support for all business units and project teams to ensure the companies activities are conducted within the limits prescribed by law, rights are fully protected, risks are appropriately managed. The division provides advice on legislative and regulatory issues, drafting and negotiating legal agreements, managing and protecting the company's intellectual property portfolio, assisting with management of claims and litigation, corporate governance, insurance and board administration and approvals.

6.11.15 General Manager, Risk and Assurance

The General Manager Risk and Assurance provides expertise on risk management, regulatory compliance, information security and internal assurance that supports the business to achieve its objectives whilst keeping the business safe and promoting continuous improvement. The division provides independent and objective audits of the businesses' operations and maintains the Risk Management Framework.

6.12 Training and Competence

6.12.1 Employee Skills and Competencies

SP AusNet applies a rigorous recruitment process to ensure that staff competencies are well matched with resource needs. The process entails gap identification and analysis, development of position description, management sign-off for recruitment, HR recruitment process, interview process and final personnel selection.

Additionally, networks personnel are subject to regular performance review and appropriate training in accordance with procedure 30-2607, in order to maintain competencies and performance at the required levels. All permanent positions are identified in the SP AusNet organisational charts.

Refer to the process and system strategy Skills and Competencies and also HSP 01-04 OH & S Training and Competency for further information.

6.12.2 Contractor Skills and Competencies

SP AusNet assessment and accreditation of principal contractors is conducted in accordance with Contractor Induction Checklist and core competencies adopted are outlined in document Contractor Training Records Management as amended from time to time.

6.12.3 Monitoring of Personnel Resources

Personnel resources for the network are monitored in accordance with the SP AusNet Human Resources procedures and managed by the primary personnel nominated in Section 7.5.

Opportunities to leverage human skills and competencies within SP AusNet have proved somewhat limited due to the common problems of an ageing technical workforce and increasing technical workloads. Independent analysis reveals that the wider Victorian and Australian utilities workforces are confronted by the same challenges.

For further information please refer to the process and system strategy Skills and Competencies.

6.13 Consultation and Communication

The development of this ESMS has included the following consultation and communication with staff and contractors.

6.13.1 Formal Safety Assessment

More than 50 staff and contractors involved in planning, designing, operating, constructing and maintaining the electricity distribution supply network undertook the assessment of safety risks described in ESMS 20-02 Formal Safety Assessment. The assessment process involved 10 workshops and more than 300 worker-hours of effort.

6.13.2 Publishing of ESMS

All SP AusNet staff and contractors have access to documents defining SP AusNet's electricity safety management scheme together with the management systems and works procedures and processes which underpin the ESMS. All this documentation is published on InSite, SP AusNet's intranet site.

6.13.3 Asset Management Strategy

The overarching AMS 10-01 Asset Management Strategy, and its supporting plant strategies, process and system strategies and implementation documents are available to staff and contractors on InSite.

QMS 22-02 Information Roll Out contains the protocol for communication of the electricity safety management scheme and asset management strategy to all relevant staff and contractors.

6.14 Documentation

Documents that provide key information and instruction relating to effective, safe and environmentally considerate operation of the network are managed in accordance with the QMS 10-01 Quality Management System Manual. Due to the nature of these documents they are maintained as controlled documents. Control of documents is effected by:

- controlling copies of Manual's, Process Procedures and Forms where appropriate
- storing 'Master' and 'Archive' documents
- authorising changes to documents
- re-issuing documents after amendment
- clearly identifying all uncontrolled documents

New and amended documents are issued via the company Internet, Intranet or databases as required. Documents are periodically reviewed (a three year cycle is preferred) and revised as necessary to ensure the documents remain appropriate to the business needs and operations. Records of review are maintained in databases or registers for audit purposes.

Documents and data (hard copy or electronic) from sources external to SP AusNet are deemed to be reference documents and their currency is verified prior to use.

The engineering drawings which represent the "as constructed" electricity distribution supply network are managed using SP AusNet's electronic drawing management system Objective. Objective functions as an electronic storage medium and provides management processes for the editing, reviewing and approval of engineering drawings.

6.15 Operational Processes

6.15.1 Capital Expenditure Prioritisation

Capital expenditure is priority directed to projects that most efficiently deliver stakeholder benefits and regulatory commitments. The prioritisation process quantifies the benefits and resource requirements of candidate projects and ranks them according to stakeholder and corporate values, including:

- Asset condition – performance and reliability
- Health and safety (staff and/or public)
- Environmental impact
- Compliance – statutory, regulatory and code
- System and community impact
- Financial impact
- Corporate image

Modelling the quantum and the timing of benefits from each candidate project against target outcomes provides an optimal list of projects, which following ratification forms the basis of the near term budget and capital works program.

For further information please refer to the process and system strategy Capital Expenditure Prioritisation and the Capital Allocation Process

6.16 Checking and Corrective Action

6.16.1 Key Performance Indicators

The consequence of electrical energy escaping the transmission network can be summarised as the risk of electric shock and/or fire ignition. Accordingly the key performance indicators for the safety of the electricity transmission network are electrical incidents where a member of the public, personnel or a consumer receives an electrical shock and fire ignitions arising from failure of network assets or activities associated with the operation and maintenance of the electricity transmission supply network. Safety related incidents may subsequently impact network reliability which is monitored and reported through a range of network reliability key performance indicators.

Monitoring of network performance is designed to focus on network safety outcomes and therefore compliance with the objectives of the ESMS, Act and regulations. Key performance indicators that monitor network safety outcomes include the following categories:

- Electrical Incident KPIs – monitors general network electrical related incidents
- Fire Incident KPIs – monitoring of network fire related incidents
- Reliability KPIs – monitors network reliability

The ESMS processes and procedures are designed to meet compliance with the Act and regulations which are monitored through the SP AusNet's Audit and Compliance framework discussed in section 6.15.3 'Audit & Compliance'.

KPI's for SP AusNet's Occupational Health & Safety processes and procedures, which are certified to AS 4801 are provided in the Health & Safety Statistical Reporting HSP 01-06 procedure.

6.16.1.1 Electrical and Fire Incidents

Serious and minor electrical incidents are investigated and reported in accordance with Electrical Incident Investigation & Reporting procedure 10-02, and recorded in SP AusNet's Issues Management System (IMS). The Bush Fire Mitigation and ESMS Management Committee is responsible for monitoring network performance trends together with implementation of asset management strategies designed to manage risk as low as reasonably practical (ALARP).

Electrical incident data recorded in IMS is used to provide the following monthly key performance indicators used for internal monitoring and reporting to Energy Safe Victoria:

Serious electrical incidents are investigated and reported to ESV in accordance with the Electricity Safety (Management) Regulations and the Electrical Incident Investigation & Reporting procedure, 10-02.

6.16.1.2 Failures and Defects

Asset failures and defects are detected through the following:

- Protection System Operation
- SCADA system alarms
- Inspection and testing
- Planned maintenance activity
- Loss of control or monitoring facility

Defects recorded through inspection, testing and planned maintenance activities are recorded in the asset management system (Maximo) and work planners are notified to assess priority and program remedial works.

The Customer Energy and Operations Team (CEOT) monitor the operation of the network and request the responsible availability resource from Integrated Network Services division to investigate failures in the agreed timeframe.

Maximo data on unplanned work orders is combined with defect data and preventative maintenance activity from the asset management system in each of the asset specific strategies which underpin AMS 10-01 Asset Management Strategy.

For further information refer to AMS 10-20 Plant and Equipment Maintenance

6.16.2 Records and Record Management

Records are identified, collected, indexed, accessed, filed, stored, maintained and disposed of in accordance with procedure QMS 20-03 Records Management.

Records are electronically or hard copy listed and, as a minimum, include sufficient information for the record to be retrievable in future years. Records are appropriately stored, with consideration to their importance, retention period and regulatory compliance requirements.

Confidential and vital records are identified, handled, stored and disposed of in accordance with procedure QMS 20-03 Records Management.

The ESMS documents are stored on SP AusNet's intranet site called InSite for reference by all personnel engaged management of the supply networks. Subsequent to revisions, obsolete versions of ESMS documentation are retained in the technical library (Lotus Notes based system). Audits and observations from those audits of the ESMS are stored in SP AusNet's Issues Management System (IMS). IMS also retains all reports of investigations into incidents and provides the reporting framework to ESV.

6.16.3 Audit and Compliance

Compliance of the ESMS to the relevant Act and regulations has been validated through an independent, external audit. This major audit has also been supported by an internal framework of systematic auditing and compliance checking processes.

SP AusNet assets and processes are subject to regular audits to verify compliance with specified technical, operational and safety standards and legislative requirements. Audits are undertaken in accordance with QMS 21-11 Technical Compliance Audit Strategy to ensure the requisite compliance is achieved in all aspects of the design, construction, installation, operation and maintenance of the SP AusNet network. Health Safety Environment & Quality audits include:

- Safety Observations
- Work sites, depots and offices,
- Work parties and activities
- Procedure reviews
- Contractor audits

Teams undertaking these audits are trained and competent to ensure a consistent and effective approach to auditing is maintained. The audits are undertaken using the asset life cycle methodology of design, construction and maintenance and are undertaken in the following categories:

- Vegetation management
- Asset inspection (stations and lines)
- Switching activities
- Access procedures and authorities
- Construction Work Party and Health and Safety
- Quality of work

Results of the Health, Safety, Environment and Quality (HSE&Q) audits are reported monthly to senior and line management and include audit summaries for the period identifying audits performed against audits scheduled, their percentage score and associated grading, trend analysis and improvement initiatives, and recommendations on future directions.

Some sample monthly report information is shown in Figure 6.5 below

Measure	YTD Actual	YTD target
Lead Indicator – SEEK		
Safety Observations	3367	3667
Audits – sites, depots and offices	118	141
Audits – work parties	932	717
Procedure reviews	117	157
Contractor reviews – safety systems and contractor matrix	439	392
Lead Indicator – CORRECT		
Opportunities for improvement	57%	>95%
Effectiveness of actions	100%	100%
Lead Indicator – LEADERSHIP		
Management visibility – ELT	240	33
Management visibility – senior management	360	440
Management visibility – line managers	1406	1584
Lag Indicator – RESULTS		
Recordable injury frequency rate	10.00	<18.0
Total number of LTI's and MTI's – rolling 12 months	*53*	*N/A*
Near miss reports	169	367
Human error incident frequency rate	13.30	<20.0
Number of incidents – rolling 12 months	*45*	*N/A*
Network incidents	209	<193

Figure 6.4 – Sample of Monthly Safety Index and Measures

SP AusNet also maintains a compliance data base for registration of all relevant legislative requirements together with assigned responsible persons, as shown below, and compliance review frequencies. Figure 6.6 below shows part of this database.

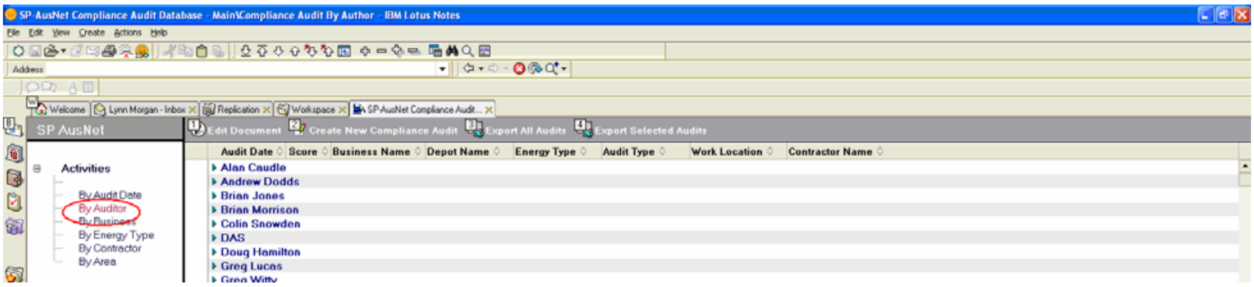


Figure 6.5 – Sample from Compliance Data Base

6.16.3.1 Design

Design audits are undertaken in the form of a "Design Review" in accordance with QMS 21-11 Technical Compliance Audit Strategy for all network generic and complex designs. The day-to-day design reviews for generic design are in accordance with SP AusNet's technical standards. SP AusNet conducts audits of service providers in accordance with QMS 21-11 Technical Compliance Audit Strategy to ensure compliance.

6.16.3.2 Materials Procurement

SP AusNet conducts regular audits to ensure the appropriate quality and functionality of materials used in the network. Quality assurance audits are undertaken in accordance with the requirements of PTP00-122 Procurement Manual.

6.16.3.3 Health and Safety

Health and Safety audits are undertaken on a regular basis in accordance with procedure QMS 21-11 Technical Compliance Audit Strategy for all worksites, plant and equipment.

6.16.3.4 Contractor Performance

SP AusNet conducts regular reviews and audits of contractor and service provider performance in accordance with QMS 21-11 Technical Compliance Audit Strategy and the Project Execution Manual.

HSP 02-08 Contractor Management - Risk Evaluation & Rating Model is used to provide a high level risk assessment of contracted services and/or contractors, upon which an appropriate level of contractor management or oversight is based. This model sets a framework for continual improvement in contractor performance and is applied to all approved contractors.

6.16.3.5 Quality Management System

SP AusNet's design, construction and operations activities are managed in accordance with the accredited ISO AS/NZS 9001 Management System. The certification authority for maintenance of this accreditation undertakes bi-annual audits of the Management Systems. Additionally, internal audits are conducted on all facets of the certification and compliance requirements in accordance with QMS 21-11 Technical Compliance Audit Strategy.

6.17 Management Review and Continuous Improvement

6.17.1 Management Review

6.17.1.1 ESMS and Bush Fire Mitigation

In 2007 SP AusNet established an Asset Management Committee to:

- Provide strategic leadership and guidance to ensure the business meets business strategy, asset management program and compliance obligations,
- Communicate status and issues to relevant stakeholders
- Make recommendations where required, regarding processes and system improvements
- Ensure processes are in place to monitor and review asset management practices and processes

The Asset Management Committee has appropriate membership from both SP AusNet executive and line management to ensure that guidance is based on facts and can be implemented. A formal charter guides the role of this committee.

The governance and management committee arrangements are illustrated in Figure 6.6 below.

The management committees monitor key performance indicators to identify trends, initiate further investigations, actions and strategies for implementation to enhance network safety performance.

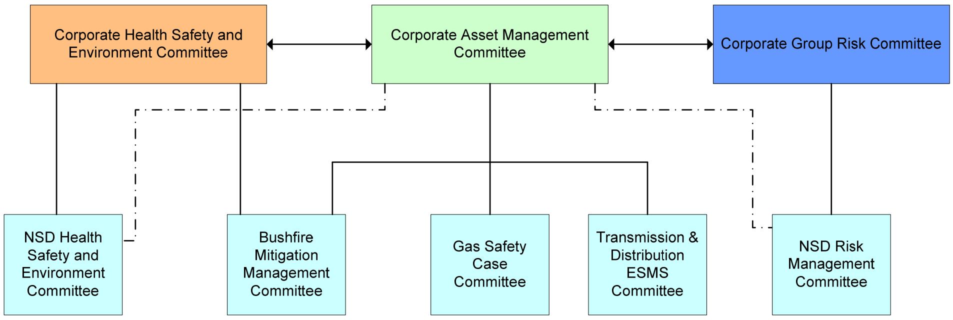


Figure 6.6 – ESMS and BFM Governance and Management

6.17.1.2 Health Safety Environment and Quality

Management review is undertaken to ensure that a systematic means of process management and future capability is reviewed, maintained, improved and that policies and objectives are identified, measured and reported in accordance with QMS 20-01 Management Review. The review includes items as:

- On-going performance against internal KPIs, objectives and targets;
- Review Policies, Business and Management Plan's as appropriate;
- Process and system changes in gaps, risks, deficiencies, suitability and effectiveness;
- Results of audits (internal, external and certification);
- Corrective actions statistics and performance;
- Regulatory and legislative impacts on the system;

6.17.2 Continuous Improvement

6.17.2.1 Culture

Continuous improvement is achieved within SP AusNet by linking our business plan down to an individuals 'Personnel Development Plan' which instils an 'improvement culture'. SP AusNet employees participate in annual performance review and appropriate training in accordance with QMS 10-1031 Learning, Development and Training, in order to maintain competencies and performance at the required levels.

6.17.2.2 Process

QMS 15-01 Value Engineering Policy and Procedure outlines the parameters under which SP AusNet uses Value Engineering techniques to improve the value of an asset, service or process by improving quality, increasing productivity or reducing cost.

The Constructability Operability and Maintainability (COM) review process is outlined in the Project Execution Manual. The purpose of a COM review meeting is to ensure that the engineering design of complex projects does not:

- unnecessarily impose on the ease and safety of installation and construction
- introduce safety or environmental hazards during operation and maintenance
- unnecessarily impose limitations on operation and maintenance

SP AusNet uses Post Implementation Reviews (PIRs) to test the robustness of project management techniques with a view to minimising risk, improving process and adopting innovation. Formal reviews of OPEX & CAPEX projects are conducted to quantify and document variances from scope, schedule, estimates and procedure. Post Implementation Review also identifies innovations employed, and opportunities for process improvement. The application of the Post Implementation Review process is outlined in the Project Execution Manual.

6.17.2.3 Accreditation

SP AusNet uses accreditation of its management systems and processes to internationally recognised standards, to benchmark capabilities, focus development efforts and foster a continuous improvement culture.

In 2008, electricity transmission asset management practices were accredited to the BSI Publicly Available Specification No 55 (PAS 55 2004) for Asset Management. Practices were recertified in 2011 to the updated PAS 55 (2008). This specification covers the requirements for the optimized management of physical infrastructure assets over the long term and includes all aspects of asset management from forecasting of requirements to asset disposal.

SP AusNet's accreditation was the first obtained by a company in Australia and provided a robust and independent validation of Asset Management functions for the electricity transmission supply network.

SP AusNet's PAS 55 accredited asset management system is compatible with the Victorian Electrical Safety (Management) Regulations and the emerging National Electricity Network Safety Code (ENA Doc 001-2008) which are based on the principles of PAS 55.

Appendix A Legislation, Regulations and Codes

Code of Practice of Electrical Safety for Work on or Near High Voltage Electrical Apparatus (The Blue Book)

Electricity Safety (Bushfire Mitigation) Regulations 2003

Electricity Safety (Cathodic Protection) Regulations 2009

Electricity Safety (Electric Line Clearance) Regulations 2010

Electricity Safety (Management) Regulations 2009

Electricity Safety Act 1998

Electricity System Code

Essential Services Commission Act 2001

National Electricity Rules

OHS Act and the OHS Regulations

Road Management (General) Regulations

Road Management (Works and Infrastructure) Regulations

Road Management Act 2004

Road Safety Act 1986

Appendix B Published Standards

Standards listed may include amendments post original publication of the standard.

B.1 Business Operation

Occupational Health and Safety Management Systems	
Specification with guidance for use	AS 4801-2001
General guidelines on principles, systems and supporting techniques	AS/NZS 4804:2001
Environmental Management Systems	
Requirements with guidance for use	AS 14001-2004
General guidelines on principles, systems and support techniques	AS 14004-2004
Risk Management System	
Risk management - Principles and guidelines	AS/NZS ISO 31000-2009
Contracts	
General conditions of contract for the supply of equipment with installation	AS 4910-2002
General conditions of contract for the supply of equipment without installation	AS 4911-2003
Occupational Safety	
Occupational protective footwear	AS/NZS 2210
Guide to selection, care and use	AS/NZS 2210.1-1994
Test Methods	AS/NZS 2210.2-2009

Specification for safety footwear	AS/NZS 2210.3-2009
Specification for protective footwear	AS/NZS 2210.4-2009
Specification for occupational footwear	AS/NZS 2210.5-2009
Acoustics - Hearing protectors	AS/NZS 1270-2002
Occupational protective helmets - Selection, care and use	AS/NZS 1800-1998
Occupational protective helmets	AS/NZS 1801-1997
Recommended practices for occupational eye protection	AS/NZS 1336-1997
Eye protectors for industrial applications	AS/NZS 1337-1992
Personal eye protection - Prescription eye protectors against low and medium impact	AS/NZS 1337.6-2007
Occupational protective gloves	AS/NZS 2161-2008
Clothing for protection against heat and flame – General recommendations for selection, care and use of protective clothing	AS/NZS ISO 2801-2008
Occupational protective clothing	AS/NZS 4501-2008
Sunscreen Products – Evaluation and classification	AS/NZS 2604-1998
High Visibility Safety Garments	AS/NZS 4602-1999
Occupational Noise Management	AS/NZS 1269-2005
Filters for eye protectors	AS/NZS 1338-1992
Sunglasses and fashion spectacles	AS/NZS 1067-2003
Safety in welding and allied processes	AS 1674-2007
Household and Similar Electrical Appliances – Safety – Particular requirements for wet and dry vacuum cleaners, including power brush, for industrial and commercial use	AS/NZS 60335.2.69-2003
Electrical Installations - Construction and Demolition Sites	AS/NZS 3012-2003
In Service Safety Inspection and Testing of Electrical Equipment	AS/NZS 3760-2003
High-Voltage switchgear and control gear - Use and handling of sulphur hexafluoride (SF_6) in high-voltage switchgear and control gear	AS/NZS 2791-1996
Industrial fall-arrest system and devices	AS/NZS 1891
Harnesses and ancillary equipment	AS/NZS 1891.1-2007
Horizontal lifeLine and rail systems	AS/NZS 1891.2-2001
Horizontal lifeLine and rail systems – Prescribed configurations for horizontal lifelines	AS/NZS 1891.2 Supp 1-2001
Fall-arrest devices	AS/NZS 1891.3-1997
Selection, Use and Maintenance	AS/NZS 1891.4-2009
Cranes, Hoists and Winches - Elevating Work Platforms	AS 1418.10-2004
Cranes, hoists and winches - Safe use - General Requirements	AS 2550.1-2002
Cranes, hoists and winches - Safe use – Mobile elevating work platforms	AS 2550.10-2006
Scaffolding - General requirements	AS/NZS 1576.1-2010
Guidelines for scaffolding	AS/NZS 4576-1995
Fixed platforms, walkways, stairways and ladders - Design, construction and installation	AS 1657-1992
Portable ladders - Selection, safe use and care	AS/NZS 1892.5-2000
Interior and workplace lighting - General principles and recommendations	AS 1680.1-2006
Interior and workplace lighting - Specific applications - Office and screen-based tasks	AS/NZS 1680.2.2-2008
Screen-based workstations - Visual display units	AS 3590.1-1990
Screen-based workstations - Workstation furniture	AS 3590.2-1990
Screen-based workstations - Input devices	AS 3590.3-1990
Chainsaws - Safety Requirements	AS 2726-2004
Chainsaws - Guide to Safe Working Practices	AS 2727-1997

Steel Storage Racking	AS 4084-1993
Pressure equipment - In-service inspection	AS/NZS 3788-2006
Assurance of product quality - Pressure equipment manufacture	AS 3920.1-1993
Powder-actuated (PA) hand-held fastening tools	AS/NZS 1873-2003
Compliance Code – Confined spaces	

B.2 Aerial Lines and Services

Conductors	
Bare overhead—Hard-drawn copper	AS 1746-1991
Bare overhead—Aluminium and aluminium alloy	AS 1531-1991
Bare overhead—Aluminium & aluminium alloy—steel reinforced	AS 3607-1989
Steel conductors and stays—Bare overhead: Galvanised	AS 1222.1-1992
Steel conductors and stays—Bare overhead: Aluminium clad	AS 1222.2-1992
Galvanised steel wire strand	AS 2841-2005
Insulated Cables	
Electric cables – Polymeric insulated for working voltages up to and including 0.6/1 kV	AS/NZS 5000.1:2005
Electric cables – Polymeric insulated – For distribution and service applications	AS/NZS 4961-2003
Electric cables – Cross-linked polyethylene insulated - Aerial bundled – For working voltages up to and including 0.6/1(1.2)kV – Aluminium conductors	AS/NZS 3560.1-2000
Mechanical fittings for low voltage aerial bundled cable	AS 3766-1990
Electric cables - Aerial bundled - Polymeric insulated – Voltages 6.35/11(12) kV and 12.7/22(24) kV: Metallic screened	AS/NZS 3599.1-2003
Electric cables - Aerial bundled - Polymeric insulated – Voltages 6.35/11(12) kV and 12.7/22(24) kV: Non-metallic screened	AS/NZS 3599.2-1999
Insulators	
Guidelines for the design & maintenance of overhead distribution and transmission lines Selection	ENA C(b)1-2006 Section 4
Insulators - Ceramic or glass – Station post for indoor and outdoor use - Voltages greater than 1000 V a.c. - Characteristics	AS 4398.1-1996 (R2010)
Insulators - Ceramic or glass – Station post for indoor and outdoor use - Voltages greater than 1000 V a.c. - Tests	AS 4398.2-2005
Insulators - Porcelain & glass for overhead power lines, Voltages greater than 1000V a.c.: Test methods – Insulator Units	AS/NZS 2947.1-1999
Insulators - Porcelain and glass for overhead power lines - Voltages greater than 1000 V a.c. - Test methods - Insulator strings and insulator sets	AS/NZS 2947.4-1999
Characteristics of line post insulators	AS IEC 60720-2007
Insulators for overhead lines with nominal voltage above 1000V – Ceramic or glass insulator units for a.c. systems – Characteristics of insulator units of the cap and pin type.	AS 60305-2007
Insulator for overhead lines with a nominal voltage above 1000V – Ceramic insulators for a.c. systems – Characteristics of insulator units of the long rod type	AS IEC 60433-2007
Pin insulators – Porcelain and glass for overhead power lines – Voltages greater than 1000 V a.c.	AS 4899-2007

Dimensions of ball and socket couplings of string insulator units	AS 60120-2010
Locking devices for ball and socket couplings of string insulator units – Dimensions and tests	AS 60372-2010
Dimensions of clevis and tongue couplings of string insulator units	AS 60471-2010
Insulators – Composite for overhead power lines – Voltages greater than 1000 V a.c. – Definitions, test methods and acceptance criteria for string insulator units	AS 4435.1-1996
Insulators – Composite for overhead power lines – Voltages greater than 1000 V a.c. – Standard strength classes and end fittings for string insulator units	AS/NZS 4435.2-1999
Insulators - Porcelain and glass, pin & shackle type – Voltages not exceeding 1000V a.c.	AS 3608-2005
Insulators - Porcelain stay type – Voltages greater than 1000V a.c.	AS 3609-2005
Insulator and Conductor Fittings	
Insulator and conductor fittings for overhead lines - Performance, materials, general requirements and dimensions	AS 1154.1-2009
Insulator and conductor fittings for overhead lines: Performance and general requirements for helical fittings	AS 1154.3-2009
Thermal Limits	
Guidelines for the design & maintenance of overhead distribution and transmission lines: Thermal limits	ENA C(b)1-2006 Appendix D2
Current rating of bare overhead line conductors	ESAA D(b)5-1988
Overhead line design – Detailed procedures	AS/NZS 7000-2010
Short Circuit Capacity	
Guidelines for the design & maintenance of overhead distribution and transmission lines: Fault ratings	ENA C(b)1-2006 Appendix D2
Overhead line design – Detailed procedures	AS/NZS 7000-2010
Mechanical Loading Conditions	
Guidelines for the design & maintenance of overhead distribution and transmission lines Mechanical Loading Conditions,	ENA C(b)1-2006 Section 3
Overhead line design – Detailed procedures	AS/NZS 7000-2010
Structural Design Actions	AS 1170
General principles	AS 1170.0-2002
Permanent, imposed and other actions	AS 1170.1-2002
Wind actions	AS 1170.2-2002
Snow and ice actions	AS 1170.3-2003
Earthquake actions in Australia	AS 1170.4-2007
Conductor Tensions	
Guidelines for the design & maintenance of overhead distribution and transmission lines	
General	ENA C(b)1-2006 Section 7
Overhead line design – Detailed procedures	AS/NZS 7000-2010
Calculations	ENA C(b)1-2006 Appendix E
Structures and Footings	

Guidelines for the design & maintenance of overhead distribution and transmission lines General	ENA C(b)1-2006, Sections 8 & 9 and Appendix G
Overhead line design – Detailed procedures	AS/NZS 7000-2010
Methods of testing soils for engineering purposes	AS 1289 (set)
Piling - Design and installation	AS 2159-2009
Timber Structures (Timber structures code)	AS 1720
Design methods	AS 1720.1-1997
Timber properties	AS 1720.2-2006
Timber - Heavy structural products – Visually graded – Utility poles	AS 3818.11-2009
Timbers - Classification into strength groups	AS 2878-2000
Timber – Heavy structural products – Visually graded – Cross-arms for overhead lines	AS 3818.4-2003
Design of steel lattice towers & masts	AS 3995-1994
Steel structures	AS 4100-1998
Concrete structures	AS 3600-2009
Clearances From Ground	
Guidelines for the design & maintenance of overhead distribution and transmission lines - Environmental & loading conditions	ENA C(b)1-2006 Section 8
Overhead line design – Detailed procedures	AS/NZS 7000-2010
Clearances From Structures	
Guidelines for the design & maintenance of overhead distribution and transmission lines - Environmental & loading conditions	ENA C(b)1-2006 Section 9
Overhead line design – Detailed procedures	AS/NZS 7000-2010
Spacing of Conductors	
Guidelines for the design & maintenance of overhead distribution and transmission lines	ENA C(b)1-2006 Section 10
Overhead line design – Detailed procedures	AS/NZS 7000-2010
Maintenance	
Guidelines for the design & maintenance of overhead distribution and transmission lines - Maintenance and inspection procedures	ENA C(b)1-2006 Appendix I

B.3 Underground Lines and Services

High Voltage Cables	
Electric cables – Polymeric insulated – For working voltages 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV	AS/NZS 1429.1-2006
Electric cables – Polymeric insulated – For working voltages above 19/33 (36) kV up to and including 87/150 (170) kV	AS/NZS 1429.2-2009
Electric cables – Impregnated paper insulated – For working voltages up to and including 19/33 (36) kV	AS/NZS 1026-2004
Extruded insulation – 1 kV to 30 kV	IEC 60502-1 2009
Power cables with extruded insulation and their accessories for rated voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) - Test methods and requirements	AS/NZS 60840-2006

Low Voltage Cables	
Electric cables – Impregnated paper insulated – For working voltages up to and including 19/33 (36) kV	AS/NZS 1026-2004
Conductors in insulated electric cables and flexible cords	AS/NZS 1125-2001
Electric Cables – Polymeric insulated – For distribution and service applications	AS/NZS 4961-2003
Electric cables – Polymeric insulated – For working voltages up to and including 0.6/1 (1.2) kV	AS/NZS 5000.1-2005
High Voltage Cable Accessories	
High Voltage Cable Joints	ANSI/IEEE 404-1994
High Voltage Cable Terminations	ANSI/IEEE 48-1990
Separable insulated connectors for power distribution systems above 1kV	AS 2629-2008
Continuous Cable Ratings	
Electric cables - Calculation of the current rating – Part 1-1: Current rating equations (100% load factor) and calculation of losses – General	IEC 60287-1-1-2006
Electric cables - Calculation of the current rating – Part 2-1: Thermal resistance – Calculation of the thermal resistance	IEC 60287-2-1-2006
Electrical installations - Selection of cables – Cables for U< 0.6/ 1kV	AS/NZS 3008.1-2009
Short Circuit Currents	
The calculation of Short Circuit Currents in three phase a.c. systems	AS 3851-1991
Installation	
ESAA Guide to the Installation of Underground Cables	ESAA C(b) 2 -1989
ESAA Guide to the Use of Separable Connectors	ESAA D(b) 30-1983
Code of Practice for Safety Precautions in Trenching Operations	
Co ordination of Street Works, Code of Practice—1983	
Shared trench Agreement. Telecom SECV—1973	
Maintenance	
ESAA Guide for the Maintenance of High Voltage Paper Oil Insulated Cables and Accessories	ESAA D(b) 31-1989

B.4 Stations

Electrical Design	
Substations and high voltage installations exceeding 1 kV a.c.	AS 2067-2008
The calculation of Short Circuit Currents in three phase a.c. systems	AS 3851-1991
Short-circuit currents - Calculation of effects - Part 1: Definitions and calculation methods	IEC 60865-1 1993
Circuit Breakers and Ancillary Equipment	
Classification of degrees of protection provided by enclosures for electrical equipment (IP code)	AS 1939-1990
High-voltage switchgear & control gear – High-voltage alternating	AS 62271.100-2008

current circuit-breakers	
Switchgear Assemblies and Ancillary Equipment	
High voltage switches -	
Switches for rated voltages above 1 kV and less than 52 kV	AS/NZS 60265.1-2001
Switches for rated voltages of 52 kV and above	AS/NZS 60265.2-2005
High-voltage switchgear and controlgear - High-voltage alternating-current circuit-breakers	AS 62271.100-2008
High-voltage switchgear and controlgear – Alternating current disconnectors and earthing switches	AS 62271.102-2005
High-voltage switchgear and controlgear - Inductive load switching	AS 62271.110-2006
High voltage a.c. switchgear and control gear – Switch-fuse combinations	AS 2024-1991
Common specifications for high-voltage switchgear and controlgear standards	AS 2650-2005
High-voltage switchgear and controlgear - A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV	AS 62271.200-2005
High-voltage switchgear and controlgear - AC insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV	AS 62271.201-2008
High-voltage switchgear and controlgear - Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV	AS 62271.203-2005
High voltage switchgear and controlgear - Dimensional standardization of terminals	AS 62271.301-2005
High voltage switchgear and controlgear - Guide for asymmetrical short-circuit breaking test duty T100a	AS 62271.308-2005
Classification of degrees of protection provided by enclosures for electrical equipment (IP code)	AS 1939-1990
Insulating liquids -	AS 1767
Specification for unused mineral insulating oils for transformers and switchgear	AS 1767.1-1999
Test Methods – Determination of the breakdown voltage at power frequency	AS 1767.2.1-1999
Test Methods – Measurement of relative permittivity, dielectric dissipation factor (tan δ) and d.c. resitivity	AS 1767.2.2-1999
Power reactors and earthing transformers	AS 1028-1992
Shunt capacitors for a.c. power systems having a rated voltage above 1000 V – General	IEC 60871-1-2005
Control Equipment	
Low voltage switchgear & control gear:	
General rules	AS 60947.1-2004
Switches, disconnectors, switch-disconnectors and fuse-combination units	AS 3947.3-2001
Contactors and motor starters - Electromechanical contactors and motor starters	AS 60947.4.1-2004
Circuit control devices and switching elements - Electromechanical control circuit devices	AS 60947.5.1-2004
Control circuit devices and switching elements - Proximity switches	AS 60947.5.2-2004
Power Transformers	

Power Transformers	AS 60076, AS 2374
General requirements	AS 60076.1-2005
Temperature rise	AS 2374.2-1997
Insulation Levels, dielectric tests and external clearances in air	AS 60076.3-2008
Guide to the lightning impulse and switching impulse testing – Power transformers and reactors	AS 60076.4-2006
Ability to withstand short circuit	AS 2374.5-1982
Loading guide for oil-immersed power transformers	AS 2374.7-1997
Application guide	AS 2374.8-2000
Determination of sound levels	AS 60076.10-2009
Determination of sound levels – Application Guide	AS 60076.10.1-2009
Insulating liquids	AS 1767
Specification for unused mineral insulating oils for transformers and switchgear	AS 1767.1-1999
Test Methods – Determination of the breakdown voltage at power frequency	AS 1767.2.1-1999
Test Methods – Measurement of relative permittivity, dielectric dissipation factor (tan d) and d.c. resistivity	AS 1767.2.2-2008
Test Methods – Method of sampling liquid dielectrics	AS 1767.2.3-1999
Test methods – Detection and determination of specified anti-oxidant additives in insulating oils	AS1767.2.4-1999
Insulating liquids - Test methods - Unused hydrocarbon based insulating liquids - Test methods for evaluating the oxidation stability	AS1767.2.5-1999
Insulating liquids - Test methods - Determination of PCB contamination in insulating liquids by capillary column gas chromatography - Identification of congeners	AS1767.2.7-1999
Insulating liquids - Test methods - Determination of water in oil-impregnated paper and pressboard by automatic coulometric Karl Fischer titration	AS1767.2.8-1999
Bushings	
Insulated bushings for alternating voltages above 1000 V	AS/NZS 60137-2008
Surge Arresters	
Surge arresters - Metal-oxide surge arresters without gaps for a.c. systems	AS 1307.2-1996
Batteries	
Stationary batteries	
Lead acid – vented type	AS 4029.1-1994
Lead acid – valve regulated sealed	AS 4029.2-2000
Lead acid - pure lead positive pasted type	AS 4029.3-1993
Insulation Co ordination	
Insulation Co ordination	
Definitions, principles and rules	AS 1824.1-1995
Phase to earth and phase to phase above 1 kV - Application Guide	AS 1824.2-1985
Insulation coordination within LV systems: Principles, requirements and tests	IEC 60664-1-2007

Safety Clearances	
Classification of degrees of protection provided by enclosures for electrical equipment (IP code)	AS 1939-1990
Substations and high voltage installations exceeding 1 kV a.c.	AS 2067-2008
"The Blue Book" Code of practice of Electrical Safety for Work On or Near High Voltage Electrical Apparatus 2005	
Buildings and Enclosures	
Australian Building Code	
Fixed platforms, walkways, stairways & ladders: Design construction & installation	AS 1657-1992
The use of ventilation & air conditioning in buildings	
Fire and smoke control in multi-compartment buildings	AS/NZS 1668.1-1998
Ventilation design for indoor air contaminant control	AS 1668.2-2002
Classification of degrees of protection provided by enclosures for electrical equipment (IP code)	AS 1939-1990
The storage and handling of flammable and combustible materials	AS 1940-2004
Oil containment	AS 1940-2004, Environmental Protection Authority. Victoria Building Guidelines
Fire protection of electricity substations	ENA Doc 18-2008
Electrical Installations - Secondary batteries installed in buildings	
Vented cells	AS 3011.1-1992
Sealed cells	AS 3011.2-1992
Switchyard Structures, Footings and Foundations	
Structural Design Actions	AS/NZS 1170
General principles	AS/NZS 1170.0-2002
Permanent, imposed and other actions	AS/NZS 1170.1-2002
Wind actions	AS/NZS 1170.2-2002
Snow and ice actions	AS/NZS 1170.3-2003
Earthquake actions in Australia	AS/NZS 1170.4-2007
Design of steel lattice towers & masts	AS 3995-1994
Steel structures	AS 4100-1998
Concrete structures	AS 3600-2009
Structural steel welding	AS/NZS 1554-2010
Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings	AS/NZS 2312-2002
Hot-dip galvanized (zinc) coatings on fabricated ferrous articles	AS/NZS 4680-2006
Maintenance	
Guide to maintenance & supervision of insulating oils in service	AS 1883-1992
Maintenance of electrical switchgear	AS 2467-2008
Guide to the installation, maintenance, testing and replacement of secondary cells in buildings:	
Vented cells	AS 2676.1-1992
Sealed Cells	AS 2676.2-1992

B.5 Protection and Earthing Systems

Protection	
Instrument transformers - Current transformers	AS 60044.1-2007
Instrument transformers – Inductive voltage transformers	AS 60044.2-2007
Instrument transformers – Combined transformers	AS 60044.3-2007
Instrument transformers – Capacitor voltage transformers	AS 60044.4-2007
Low voltage switchgear & control gear:	
General rules	AS 60947.1-2004
Switches, disconnectors, switch-disconnectors and fuse-combination units	AS 3947.3-2001
Contactors and motor starters - Electromechanical contactors and motor starters	AS 60947.4.1-2004
Contactors and motor starters – A.C. semiconductor motor controllers and starters	AS 60947.4.2-2004
Circuit control devices and switching elements - Electromechanical control circuit devices	AS 60947.5.1-2004
Control circuit devices and switching elements - Proximity switches	AS 60947.5.2-2004
Control circuit devices and switching elements - Requirements for proximity devices with define behaviour under fault conditions	AS/NZS 3947.5.3-2000
Control circuit devices and switching elements - Electrical emergency stop device with mechanical latching function	AS/NZS 3947.5.5-2000
Control circuit devices and switching elements - D.C.interface for proximity sensors and switching amplifiers (NAMUR)	AS/NZS 3947.5.6-2000
Multiple Function equipment - Automatic transfer switching equipment	AS/NZS 3947.6.1-2000
Earthing	
Substations and high voltage installations exceeding 1 kV a.c.	AS 2067-2008 Appendix B
Substation earthing guide	ENA EG1-2006
Guide to safety in substation grounding	IEEE 80-2000
Guide for measuring earth resistively, ground impedance and earth surface potentials of a ground system	IEEE 81- 1991
Electrical installations	AS/NZS 3000-2007
Electrical installations – Transportable structures and vehicles including their site supplies	AS 3001-2008
Guidelines for the design & maintenance of overhead distribution and transmission lines - Stay wires	ENA C(b)1-2006 Section 12
Step & touch potentials	ENA C(b)1-2006 Section 12
Overhead line design – Detailed procedures	AS/NZS 7000-2010
ESAA - Australian Telecommunications Commission "Earth Potential Rise" Code of Practice	
ESAA - Australian Telecommunications Commission "Earth Return High Voltage Power Lines" Code Of Practice.	
Earth potential rise – Protection of telecommunications network users, personnel and plant – Code of practice	AS/NZS 3835.1-2006
Earth potential rise – Protection of telecommunications network users,	AS/NZS 3835.2-2006

personnel and plant – Application Guide	
Copper and copper alloys – Wrought rods, bars and sections	AS/NZS 1567-1997
Maintenance	
Substations and high voltage installations exceeding 1 kV a.c.	AS 2067-2008
Electrical installations	AS 3000-2007
Guide to safety in substation grounding	IEEE 80-2000
Guidelines for the design & maintenance of overhead distribution and transmission lines	ENA C(b)1-2006
ESAA - Australian Telecommunications Commission "Earth Potential Rise" Code of Practice	
ESAA - Australian Telecommunications Commission "Earth Return High Voltage Power Lines" Code of Practice	
Testing	
Earthing	AS 3000-2007 IEEE 80-2000 ENA C(b)1-2006

B.6 System Operation

Power Quality	
Electromagnetic compatibility (EMC)	
Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems	AS 61000.2.2-2003
Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public medium voltage power supply systems	AS 61000.2.12-2003
Limits – Limits for harmonic current emissions (equipment input current (16 A per phase))	AS 61000.3.2-2007
Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current (<=16 A per phase and not subject to conditional connection)	AS61000.3.3-2006
Limits – Limitation of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than 16A	AS61000.3.5-1998
Limits – Assessments of emission limits for distorting loads in MV and HV power systems	AS61000.3.6-2001
Limits – Assessment of emission limits for fluctuating laods in MV and HV power systems	AS61000.3.7-2001
Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current less than or equal to 75 A and subject to conditional connection	AS61000.3.11-2005
Electromagnetic compatibility (EMC) - Testing and measurement techniques - Power quality measurement methods	AS/NZS 61000.4.30-2007
IEEE recommended practices and requirements for Harmonic Control in Electrical Power Systems	IEEE 519 -1992

IEEE recommended practice and monitoring for electric power quality	IEEE 1159 - 2009
Voltage Characteristics of electricity supplied by public distribution systems	CENELEC EN 50160 - 2007
IEEE recommended practice for grounding in Industrial and Commercial power systems	IEEE 142 - 2007
IEEE recommended practice powering and grounding sensitive electronic equipment	IEEE 1100 - 2005
IEEE recommended practice emergency and standby systems for Industrial and Commercial Applications	IEEE 446 - 1995

Appendix C Communication Sites

	Name
	452 FLINDERS ST
ASET	ARTHURS SEAT RADIO STATION
BEEF	BEECHFOREST RADIO STATION
	BIG HILL BENDIGO RADIO STATION
BIGH	BIG HILL RADIO STATION
BLAK	BLACKWARRY RADIO STATION
	BUNNINYONG RADIO STATION
CAMH	CAMPBELLS HILL RADIO STATION (aka ALLAMBEE)
	CERES RADIO STATION
COCK	COCKATOO RADIO STATION
	DUNNS HILL RADIO STATION
	FRESHWATER PLACE
GNAR	GNARWARRE RADIO STATION (aka Bayview)
JERH	JEERLANG HILL RADIO STATION
KCC	KEILOR CONTROL CENTRE
KING	KINGLAKE RADIO STATION
	MARY STREET (OLD SYSTEM CONTROL CENTRE)
MTBD	MT BARANDUDA RADIO STATION
MTBN	MT BENAMBRA RADIO STATION
MTBL	MT BLACKWOOD RADIO STATION
MTBB	MT BURRAMBOOT RADIO STATION
	MT CLAY RADIO STATION
MTFT	MT FATIGUE RADIO STATION
	MT HOLDEN RADIO STATION
MTMD	MT MACEDON RADIO STATION
MTMJ	MT MAJOR RADIO STATION
MTPP	MT PIERREPOINT RADIO STATION
	MT SHADWELL RADIO STATION
MTST	MT STANLEY RADIO STATION
	MT TAURUS RADIO STATION
MTTL	MT TAYLOR RADIO STATION
MTBW	MT TOOLE-BE-WONG RADIO STATION
MTWH	MT WARRENHEIP RADIO STATION
MTWL	MT WILLIAM RADIO STATION
OTHB	ONE TREE HILL, BENDIGO RADIO STATION
RENH	RENNIES HILL RADIO STATION
ROCC	ROWVILLE CONTROL CENTRE
SPRL	SPEERS LANE RADIO STATION (VIA DDTS)
RTTS	SYNCRONOUS CONDENSER BUILDING RADIO STATION
TAMK	TAMINICK RADIO STATION
TATA	TATURA RADIO STATION
	VINEBANKS RADIO STATION
	WAUBRA RADIO STATION
	YARRAVILLE ADMIN AREA
JLA	Blue Scope Steel*
DPS	Dartmouth Power Station*
EPS	Eildon Power Station*

FVTS	Fosterville Terminal Station*
HPK	Hampton Park Zone Substation*
HWPS	Hazelwood Power Station*
JLTS	Jeeralang Terminal Station*
BAPS	Lake Banimboola Power Station*
LYPSA	Loy Yang A Power Station*
LYPSB	Loy Yang B Power Station*
MCKPS	McKay Creek Power Station*
MOE	Moe Zone Substation*
MOPS	Mortlake Power Station*
MPS	Morwell Power Station*
MSS	Murray Switching Station*
NPS	Newport Power Station*
PTH	Point Henry*
APD	Portland*
WGL	Warragul Zone Substation*
WBTS	Waubra Terminal Station*
WKPS	West Kiewa Power Station*
YWPS	Yallourn W Power Station*

*Site not owned by SP AusNet however SP AusNet owns and operates some communications assets at these sites.

Appendix D Terminal Stations and Lines

Acronym	Terminal Stations	Comments	Voltage (KV)	Address
ATS	Altona Terminal Station	LNGS 220kV Connection	220/66 kV	Cherry Lane, Altona, VIC, 3018
BATS	Ballarat Terminal Station		220/66 kV	Coulsons Road, Ballarat, Victoria, 3352
BETS	Bendigo Terminal Station		220/66/22 kV	Allingham Street, Bendigo, VIC, 3555
BLTS	Brooklyn Terminal Station	Synchronous Condenser	220/66/22 kV	Kyle Road, Altona North, VIC, 3025
BTS	Brunswick Terminal Station		220/22 kV	King Street, Brunswick East, VIC, 3057
CBTS	Cranbourne Terminal Station		500/220/66 kV	1120 Thompsons Road, Cranbourne West, VIC, 3977
DDTS	Dederang Terminal Station		330/220 kV	Dederang Road, Dederang, VIC, 3691
EPSY	Eildon Power Station Switchyard	220 kV Switch Yard	220 kV	Eildon Road, Eildon, VIC, 3713
ERTS	East Rowville Terminal Station		220/66 kV	Lot 1 Police Road, East Rowville, VIC, 3178
FBTS	Fishermens Bend Terminal Station	Synchronous Condenser	220/66 kV	132-140 Turner Street, Port Melbourne, VIC, 3207
FTS	Frankston Terminal Station	66 kV Switchyard	66 kV	585 McClelland Drive, Frankston, VIC, 3199
FVTS*	Fosterville Terminal Station	Station Owned by Fosterville Gold Mine	220/11 kV	Axedale-Goornong Road, Fosterville, VIC, 3557
GNTS	Glenrowan Terminal Station		220/66 kV	Winton-Glenrowan Rowan, Glenrowan, VIC, 3675
GTS	Geelong Terminal Station		220/66 kV	Corner of Cox Road and Anakie Road, Geelong, VIC, 3214
HOTS	Horsham Terminal Station	Static Var Compensator	220/66 kV	Corner of Williams (Horsham-Lubeck Road) Road and Riverside East Road, Horsham, VIC, 3400
HTS	Heatherton Terminal Station		220/66 kV	495-503 Warrigal Road, Heatherton, VIC, 3202
HWPS#	Hazelwood Power Station	220 kV Power Station Switchyard	220 kV	Brodribb Road, Hazelwood, VIC, 3840

HWTS	Hazelwood Terminal Station		500/220 kV	Tramway Road, Hazelwood North, VIC, 3840
HYTS	Heywood Terminal Station		500/275/22 kV	Rifle Range Road, Heywood, VIC, 3304
JLGSA	Jeeralang Gas Station A	220 kV Power Station Switchyard	220 kV	Bonds Lane, Hazelwood North, Victoria, 3840
JLGSB	Jeeralang Gas Station B	220 kV Power Station Switchyard	220 kV	Bonds Lane, Hazelwood North, Victoria, 3840
JLTS	Jeeralang Terminal Station		220 kV	Bonds Lane, Hazelwood North, Victoria, 3840
KGTS	Kerang Terminal Station	Static Var Compensator	220/66/22 kV	Loddon Valley Highway, Kerang, Victoria, 3579
KTS	Keilor Terminal Station		500/220/66 kV	Dodds Road, Keilor East, VIC, 3033
LY	Loy Yang	66 kV Switchyard	66 kV	Bartons Lane, Loy Yang, VIC, 3844
LYPS	Loy Yang Power Station	500 kV Power Station Switchyard	500 kV	Bartons Lane, Loy Yang, VIC, 3844
MBTS	Mount Beauty Terminal Station		220/66 kV	Kiewa Valley Highway, Mount Beauty, VIC, 3699
MLTS	Moorabool Terminal Station		500/220 kV	955 Anakie Road, Moorabool, VIC, 3221
MOPS*	Mortlake Power Station	500 kV Power Station Switchyard	500 kV	Connewarren Lane, Mortlake, VIC, 3272
MPS	Morwell Power Station		220/11 kV	Commercial Road, Morwell, VIC, 3840
MTS	Malvern Terminal Station		220/66/22 kV	632 Waverley Road, Malvern East, VIC, 3145
MWTS	Morwell Terminal Station		220/66 kV	Monash Way, Morwell, VIC, 3840
NPSD#	Newport Power Station ‘D’	220 kV Power Station Switchyard	220 kV	350 Douglas Parade, Newport, VIC, 3015
RCTS	Red Cliffs Terminal Station		220/66/22 kV	Woomera Avenue, Red Cliffs, VIC, 3496
ROTS	Rowville Terminal Station	Static Var Compensators	500/220 kV	890 Wellington Road, Rowville, VIC, 3178
RTS	Richmond Terminal Station		220/66/22 kV	347 Mary Street, Richmond, VIC, 3121
RWTS	Ringwood Terminal Station		220/66/22 kV	61 Heatherdale Road, Ringwood, VIC, 3134
SHTS	Shepparton Terminal Station		220/66 kV	Verney Road, Shepparton, VIC, 3630
SMTS	South Morang Terminal Station		500/330/220/66 kV	McDonalds Road, South Morang, VIC, 3752
SVTS	Springvale Terminal Station		220/66 kV	917 Princes Highway, Springvale, VIC, 3171

SYTS	Sydenham Terminal Station		500 kV	Victoria Road, Sydenham, VIC, 3037
TBTS	Tyabb Terminal Station		220/66 kV	28 Thornells Road, Tyabb, VIC, 3913
TGTS	Terang Terminal Station		220/66 kV	26 Littles Lane, Terang, VIC, 3264
TSTS	Templestowe Terminal Station	Synchronous Condenser	220/66 kV	630-658 Blackburn Road, Templestowe, VIC, 3106
TTS	Thomastown Terminal Station		220/66 kV	High Street, Thomastown, VIC, 3074
WBTS	Waubra Terminal Station		220/66 kV	Troys Road, Waubra, VIC, 3352
WETS	Wemen Terminal Station		220/66 kV	Hattah-Robinvale Road, Wemen, VIC, 3549
WMTS	West Melbourne Terminal Station		220/66/22 kV	Corner of Lloyd and Arden Streets, Kensington, VIC, 3031
WOTS	Wodonga Terminal Station		330/66/22 kV	Baranduda Drive, Baranduda, VIC, 3691
YPS	Yallourn Power Station	220 kV Power Station Switchyard	220 kV	Moe-Glengarry Road, Yallourn, VIC, 3825

*Switchyard not owned by SP AusNet however SP AusNet owns some secondary assets at these sites.

#Site owned by others, SP AusNet owns switchyard and supporting systems

Lines	Circuit No.	Voltage (KV)	Station 1	Station 2	Station 3
APD – HYTS No. 1 Line	1	500	APD	HYTS	
APD – HYTS No. 2 Line	2	500	APD	HYTS	
ATS – BLTS 220 kV Line		220	ATS	BLTS	
ATS – BLTS 66 kV Line		66	ATS	BLTS	
ATS – KTS Line		220	ATS	KTS	
BATS – BETS Line		220	BATS	BETS	
BATS – MLTS No. 1 Line	1	220	BATS	MLTS	
BATS – MLTS No. 2 Line	2	220	BATS	MLTS	
BATS – TGTS Line		220	BATS	TGTS	
BATS – WBTS Line		220	BATS	WBTS	
BETS – KGTS Line		220	BETS	KGTS	
BETS – FVTS – SHTS Line		220	BETS	SHTS	
BLTS – FBTS Line		220	BLTS	FBTS	
BLTS – KTS Line		220	BLTS	KTS	
BLTS – NPSD Line		220	BLTS	NPSD	
BTS – RTS Line		220	BTS	RTS	
BTS – TTS No. 1 Line	1	220	BTS	TTS	
BTS – TTS No. 3 Line	3	220	BTS	TTS	
CBTS – ERTS No. 1 Line	1	220	CBTS	ERTS	
CBTS – ERTS No. 2 Line	2	220	CBTS	ERTS	
CBTS – HWTS Line		500	CBTS	HWTS	
CBTS – ROTS Line		500	CBTS	ROTS	
CBTS – TBTS No. 1 Line	1	220	CBTS	TBTS	
CBTS – TBTS No. 2 Line	2	220	CBTS	TBTS	
CBTS – ERTS – LYD Line		66	CBTS	ERTS	LYD
CBTS – ERTS – BWN Line		66	CBTS	ERTS	BWN
CBTS – FTS No. 1 Line	1	66	CBTS	FTS	
CBTS – FTS No. 2 Line	2	66	CBTS	FTS	
DDTS – GNTS No. 1 Line	1	220	DDTS	GNTS	
DDTS – GNTS No. 3 Line	3	220	DDTS	GNTS	
DDTS – MBTS No. 1 Line	1	220	DDTS	MBTS	
DDTS – MBTS No. 2 Line	2	220	DDTS	MBTS	
DDTS – MSS No. 1 Line T001-T222	1	330	DDTS	MSS	
DDTS – MSS No. 2 Line T001-T222	2	330	DDTS	MSS	
DDTS – SHTS Line		220	DDTS	SHTS	

DDTS – SMTS No. 1 Line	1	330	DDTS	SMTS	
DDTS – SMTS No. 2 Line	2	330	DDTS	SMTS	
DDTS – WOTS Line		330	DDTS	WOTS	
DPS – MBTS Line		220	DPS	MBTS	
EPSY – MBTS No. 1 Line	1	220	EPSY	MBTS	
EPSY – MBTS No. 2 Line	2	220	EPSY	MBTS	
EPSY – TTS Line		220	EPSY	TTS	
ERTS – ROTS No. 1 Line	1	220	ERTS	ROTS	
ERTS – ROTS No. 2 Line	2	220	ERTS	ROTS	
FBTS – NPSD		220	FBTS	NPSD	
FBTS – WMTS No. 1 Line	1	220	FBTS	WMTS	
FBTS – WMTS No. 2 Line	2	220	FBTS	WMTS	
GNTS – SHTS No. 1 Line	1	220	GNTS	SHTS	
GNTS – SHTS No. 3 Line	3	220	GNTS	SHTS	
GTS – KTS No. 1 Line	1	220	GTS	KTS	
GTS – KTS No. 2 Line	2	220	GTS	KTS	
GTS – KTS No. 3 Line	3	220	GTS	KTS	
GTS – MLTS No. 1 Line	1	220	GTS	MLTS	
GTS – MLTS No. 2 Line	2	220	GTS	MLTS	
GTS – PTH No. 1 Line	1	220	GTS	PTH	
GTS – PTH No. 2 Line	2	220	GTS	PTH	
HOTS – RCTS Line		220	HOTS	RCTS	
HOTS – WBTS Line		220	HOTS	WBTS	
HTS – SVTS No. 1 Line	1	220	HTS	SVTS	
HTS – SVTS No. 2 Line	2	220	HTS	SVTS	
HWPS – HWTS No. 1 Line	1	220	HWPS	HWTS	
HWPS – HWTS No. 2 Line	2	220	HWPS	HWTS	
HWPS – HWTS No. 3 Line	3	220	HWPS	HWTS	
HWPS – HWTS No. 4 Line	4	220	HWPS	HWTS	
HWPS – JLTS No. 1 Line	1	220	HWPS	JLTS	
HWPS – JLTS No. 2 Line	2	220	HWPS	JLTS	
HWPS – JLTS No. 3 Line	3	220	HWPS	JLTS	
HWPS – JLTS No. 4 Line	4	220	HWPS	JLTS	
HWPS – MPS – MWTS Line		220	HWPS	MPS	MWTS
HWPS – ROTS No. 1 Line	1	220	HWPS	ROTS	

HWPS – ROTS No. 2 Line	2	220	HWPS	ROTS	
HWPS – YPS No. 1 Line	1	220	HWPS	YPS	
HWPS – YPS No. 2 Line	2	220	HWPS	YPS	
HWTS – LYPS No. 1 Line	1	500	HWPS	LYPS	
HWTS – LYPS No. 2 Line	2	500	HWPS	LYPS	
HWTS – LYPS No. 3 Line	3	500	HWPS	LYPS	
HWTS – ROTS Line	1	500	HWPS	ROTS	
HWTS – SMTS No. 1 Line	1	500	HWPS	SMTS	
HWTS – SMTS No. 2 Line	2	500	HWPS	SMTS	
HYTS – MLTS Line		500	HYTS	MLTS	
HYTS – MOPS Line		500	HYTS	MOPS	
HYTS – SESS No. 1 Line	1	275	HYTS	SESS	
HYTS – SESS No. 2 Line	2	275	HYTS	SESS	
JIND – WOTS Line T401 - T452		330	JIND	WOTS	
JLA – TBTS No .1 Line	1	220	JLA	TBTS	
JLA – TBTS No .2 Line	2	220	JLA	TBTS	
JLTS – JLGSA Line		220	JLTS	JLGSA	
JLTS – JLGSB Line		220	JLTS	JLGSB	
JLTS – MWTS No. 1 Line	1	220	JLTS	MWTS	
JLTS – MWTS No. 2 Line	2	220	JLTS	MWTS	
KGTS – RCTS Line		220	KGTS	RCTS	
KTS – TTS No. 1 Line	1	220	KTS	TTS	
KTS – TTS No. 2 Line	2	220	KTS	TTS	
KTS – WMTS No. 1 Line	1	220	KTS	WMTS	
KTS – WMTS No. 2 Line	2	220	KTS	WMTS	
KTS – SMTS Line		500	KTS	SMTS	
KTS – SYTS Line		500	KTS	SYTS	
LY – MWTS No. 1 Line	1	66	LY	MWTS	
LY – MWTS No. 2 Line	2	66	LY	MWTS	
LY – MWTS No. 3 Line	3	66	LY	MWTS	
LY – MWTS No. 4 Line	4	66	LY	MWTS	
MBTS – McKPS Line		220	MBTS	McKPS	
MBTS – WKPS Line		220	MBTS	WKPS	
MLTS – MOPS Line		500	MLTS	MOPS	

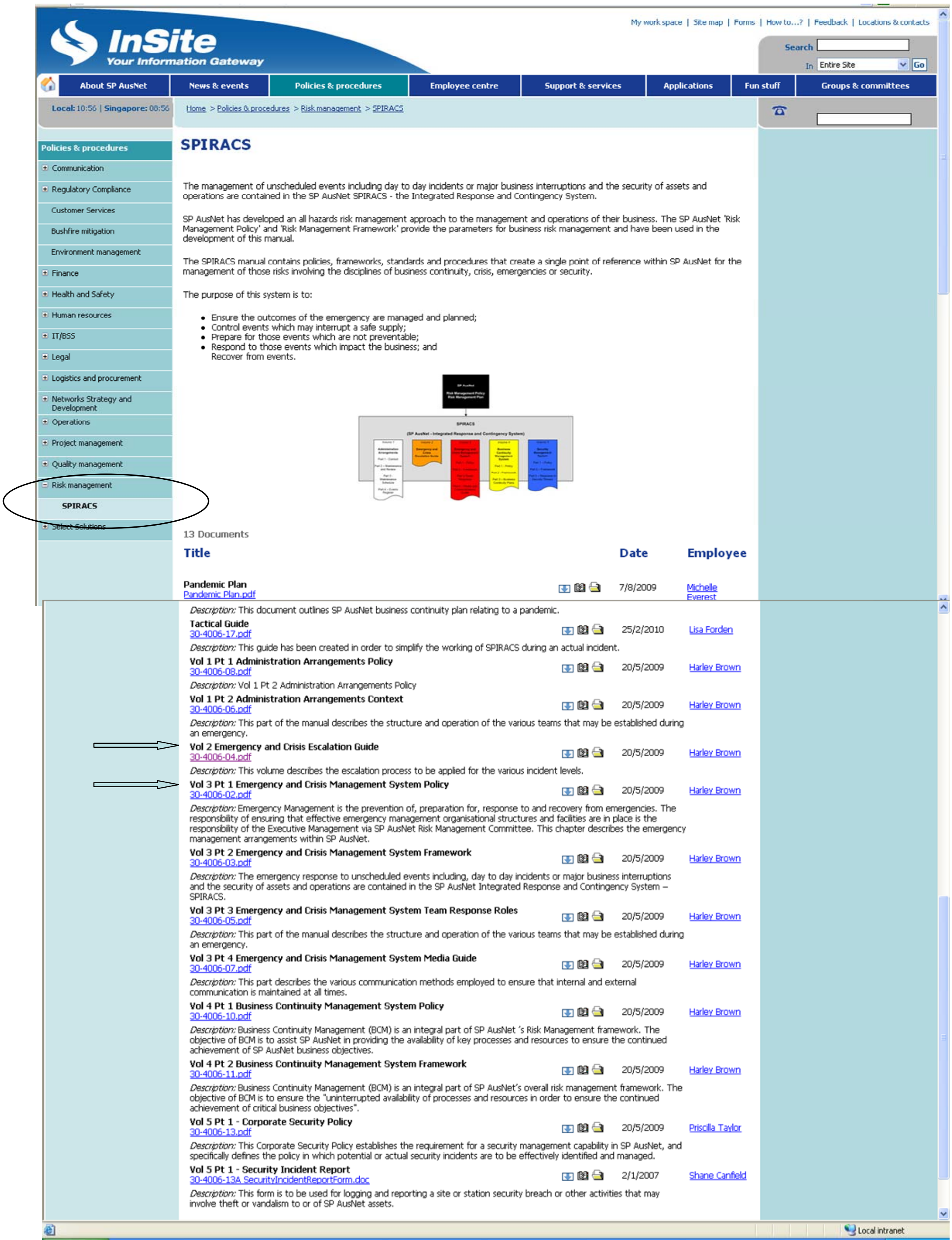
MLTS – SYTS No. 1 Line	1	500	MLTS	SYTS	
MLTS – SYTS No. 2 Line	2	500	MLTS	SYTS	
MLTS – TGTS Line		220	MLTS	TGTS	
MTS – ROTS No. 1 Line	1	220	MTS	ROTS	
MTS – ROTS No. 3 Line	3	220	MTS	ROTS	
ROTS – SMTS Line		500	ROTS	SMTS	
ROTS – RTS No. 1 Line	1	220	ROTS	RTS	
ROTS – RTS No. 4 Line	4	220	ROTS	RTS	
ROTS – RWTS Line		220	ROTS	RWTS	
ROTS – SVTS No. 1 Line	1	220	ROTS	SVTS	
ROTS – SVTS No. 2 Line	2	220	ROTS	SVTS	
ROTS – TSTS Line		220	ROTS	TSTS	
ROTS – TTS Line		220	ROTS	TTS	
ROTS – YPS No. 5 Line	5	220	ROTS	YPS	
ROTS – YPS No. 6 Line	6	220	ROTS	YPS	
ROTS – YPS No. 7 Line	7	220	ROTS	YPS	
ROTS – YPS No. 8 Line	8	220	ROTS	YPS	
RWTS – TTS Line		220	RWTS	TTS	
SMTS – SYTS No. 1 Line	1	500	SMTS	SYTS	
SMTS – SYTS No. 2 Line	2	500	SMTS	SYTS	
SMTS – TTS No. 1 Line	1	220	SMTS	TTS	
SMTS – TTS No. 2 Line	2	220	SMTS	TTS	
TSTS – TTS Line		220	TSTS	TTS	

Appendix E Organisation Charts

Up to date organisation charts are available from the SP AusNet internal internet “InSite” at the following reference:

http://insite.sp-ausnet.com.au/Intralogic/content/February%202013.pdf

Appendix F SPIRACS



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SPIRACS

The management of unscheduled events including day to day incidents or major business interruptions and the security of assets and operations are contained in the SP AusNet SPIRACS - the Integrated Response and Contingency System.

SP AusNet has developed an all hazards risk management approach to the management and operations of their business. The SP AusNet 'Risk Management Policy' and 'Risk Management Framework' provide the parameters for business risk management and have been used in the development of this manual.

The SPIRACS manual contains policies, frameworks, standards and procedures that create a single point of reference within SP AusNet for the management of those risks involving the disciplines of business continuity, crisis, emergencies or security.

The purpose of this system is to:

- Ensure the outcomes of the emergency are managed and planned;
- Control events which may interrupt a safe supply;
- Prepare for those events which are not preventable;
- Respond to those events which impact the business; and Recover from events.

13 Documents

Title	Date	Employee
Pandemic Plan Pandemic Plan.pdf *Description:* This document outlines SP AusNet business continuity plan relating to a pandemic.	7/8/2009	Michelle Everest
Tactical Guide 30-4006-17.pdf *Description:* This guide has been created in order to simplify the working of SPIRACS during an actual incident.	25/2/2010	Lisa Forden
Vol 1 Pt 1 Administration Arrangements Policy 30-4006-08.pdf *Description:* Vol 1 Pt 2 Administration Arrangements Policy	20/5/2009	Harley Brown
Vol 1 Pt 2 Administration Arrangements Context 30-4006-06.pdf *Description:* This part of the manual describes the structure and operation of the various teams that may be established during an emergency.	20/5/2009	Harley Brown
Vol 2 Emergency and Crisis Escalation Guide 30-4006-04.pdf *Description:* This volume describes the escalation process to be applied for the various incident levels.	20/5/2009	Harley Brown
Vol 3 Pt 1 Emergency and Crisis Management System Policy 30-4006-02.pdf *Description:* Emergency Management is the prevention of, preparation for, response to and recovery from emergencies. The responsibility of ensuring that effective emergency management organisational structures and facilities are in place is the responsibility of the Executive Management via SP AusNet Risk Management Committee. This chapter describes the emergency management arrangements within SP AusNet.	20/5/2009	Harley Brown
Vol 3 Pt 2 Emergency and Crisis Management System Framework 30-4006-03.pdf *Description:* The emergency response to unscheduled events including, day to day incidents or major business interruptions and the security of assets and operations are contained in the SP AusNet Integrated Response and Contingency System – SPIRACS.	20/5/2009	Harley Brown
Vol 3 Pt 3 Emergency and Crisis Management System Team Response Roles 30-4006-05.pdf *Description:* This part of the manual describes the structure and operation of the various teams that may be established during an emergency.	20/5/2009	Harley Brown
Vol 3 Pt 4 Emergency and Crisis Management System Media Guide 30-4006-07.pdf *Description:* This part describes the various communication methods employed to ensure that internal and external communication is maintained at all times.	20/5/2009	Harley Brown
Vol 4 Pt 1 Business Continuity Management System Policy 30-4006-10.pdf *Description:* Business Continuity Management (BCM) is an integral part of SP AusNet 's Risk Management framework. The objective of BCM is to assist SP AusNet in providing the availability of key processes and resources to ensure the continued achievement of SP AusNet business objectives.	20/5/2009	Harley Brown
Vol 4 Pt 2 Business Continuity Management System Framework 30-4006-11.pdf *Description:* Business Continuity Management (BCM) is an integral part of SP AusNet's overall risk management framework. The objective of BCM is to ensure the "uninterrupted availability of processes and resources in order to ensure the continued achievement of critical business objectives".	20/5/2009	Harley Brown
Vol 5 Pt 1 - Corporate Security Policy 30-4006-13.pdf *Description:* This Corporate Security Policy establishes the requirement for a security management capability in SP AusNet, and specifically defines the policy in which potential or actual security incidents are to be effectively identified and managed.	20/5/2009	Priscilla Taylor
Vol 5 Pt 1 - Security Incident Report 30-4006-13A SecurityIncidentReportForm.doc *Description:* This form is to be used for logging and reporting a site or station security breach or other activities that may involve theft or vandalism to or of SP AusNet assets.	2/1/2007	Shane Canfield