Equipment Strategy for Voltage Transformers – Strategy

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1. Introduction

1.1 Purpose

Equipment Strategies document Powerlink's vision for equipment technologies, to provide both Powerlink and Suppliers with consistent planning and project management platforms for the life of the Strategy. The document expresses Powerlink's vision in terms of the equipment performance requirements. It is not a detailed contract specification.

It is envisaged that the Equipment Strategy for Voltage Transformers will have a life of ten (10) years. It is expected that secondary systems process bus development will enable increased use of low power instrument transformers within this period. If this development reaches implementation stage, then a review of this equipment strategy will be triggered. If not, a review of this equipment strategy is required in the fifth (5^{th}) and the eighth (8^{th}) years to enable inclusion of technologies which have matured and show merit to be considered for inclusion in the equipment strategy.

The Equipment Strategy for Voltage Transformers has been developed with input from the relevant teams in Powerlink.

1.2 Scope

This document covers Voltage Transformers (used for voltage measurement or used for provision of auxiliary substation supply) ranging from 110 kV to 275kV for use in new substations and substations requiring partial or full equipment replacement and augmentation.

Voltage transformers suitable for use at different voltages other than the range mentioned above can be purchased on ad hoc basis as required but following the same strategic principles described in this document.

1.3 References

Document code	Document title
IEC 61850	IEC (2013) *Communication networks and systems for power utility automation*
ISO/IEC 17025	ISO (2005) *General requirements for the competence of testing and calibration laboratories*

1.4 Defined terms

Terms	Definition
APLAC	Asia Pacific Laboratory Accreditation Cooperation
CVT	Capacitive Voltage Transformers
ILAC	International Laboratory Accreditation Cooperation
NATA	National Association of Testing Authorities
EMVT	Electro Magnetic Voltage Transformers
SAP	Software package used for computerised maintenance management system and asset register

1.5 Monitoring and compliance

This equipment strategy will guide development of the technical specification. The success is monitored through regulatory information notice, annual reporting and SAP records review of installed equipment.

The success of this strategy is measured by monitoring life cycle costs as well as availability and service history associated with this equipment.

The minimum records required are:

- Technical specification
- Tender evaluation report
- Period contract
- Purchase orders
- SAP equipment records
- Operation and Manufacturer Manual
- Nameplate details

1.6 Risk management

The risks considered in the development of this strategy are:

- **Network Operations Risk** – risk related to the increased probability of network outages and their impact on customers and stakeholders.
- **Safety Risk** – risk associated with malfunction of voltage transformer resulting in the catastrophic failure leading to injuries caused by porcelain pieces or caused by contact with oil or insulation gas SF6 bi products. In addition there is a risk of inadequate protection operation exposing personnel and public to fault conditions – can result in serious injuries and fatalities due to electrocution.
- **Environmental Risk** – related to oil leak and gas leaks.
- **Financial and Contractual Risk** – risk associated with inability to make warranty claims, request access to adequate technical support and spares, increased maintenance costs, additional capital investment costs.
- **Compliance Risk** – associated with non-compliance with accuracy requirements as set up by National Electricity Rules.

2. Strategy

The vision that drives equipment strategy documents is based on historical experience, research and investigations into new products available on the market, reliability centred maintenance analysis and lifecycle cost experience over the expected service life of the equipment (40 years). The main features of the vision for high voltage transformers are as follows:

General:

- Annual operation and maintenance cost less than 0.5% of the asset value.
- High availability and reliability.
- Can be used as a source of local substation supply and/ or as an instrument transformer for voltage measurement.
- Access to allow oil or gas samples.
- Routine on-site visual inspection only once a year.
- Appropriate monitoring and remote interrogation facilities to allow maintenance staff to optimize site visits.

- Voltage transformers have to be tested by NATA certified laboratory or by facilities accredited to ISO/IEC 17025 and have mutual recognition through ILAC or APLAC.
- The manufacturer's ability to be able to provide support for the whole of life of the voltage transformer including the ability to install, commission and service, perform failure root cause analysis, provide detailed work instructions, supervise or perform repairs as well as holding spares required to support the voltage transformer across the 40 year life will be well regarded.

Safety and Environmental:

- The risk of explosive failure kept as low as possible.
- The design of the unit allows for safe and environmentally appropriate disposal.
- Minimum leakage rates to meet or exceed environment standards and reduce operational costs.
- Meeting standard requirements for noise and radio interference voltage (RIV).

Maintenance:

- Minimal maintenance requirements.
- No moving parts.
- Simple and reliable design.
- Enables addition of online condition monitoring.

2.1 Projected use of equipment

Voltage Transformers to be purchased will be used either for control, protection and instrumentation or to provide local power supply for a substation.

2.2 Technologies available now:

Capacitive Voltage Transformers (CVT) and Electro Magnetic Voltage Transformers (EMVT) are presently used in the transmission network in Queensland. CVTs are used predominately for voltage measurement and EMVTs for provision of power supply for substations and in other applications where high burden capability is required. Some EMVTs are used for busbar voltage measurements, of these, most are oil filled but there is a small number that are SF6 filled.

Non-Conventional Instrument Transformers (NCITs) and electronic voltage transformers (EVTs) are not yet considered to be a commercially viable solution for Powerlink. However development is ongoing and is expected to become viable during the life of this equipment strategy, especially as implementation of digital substations are progressed.

A careful selection of equipment is essential to ensure high reliability and availability, ease of commissioning, simple operation and low maintenance cost.

2.3 Equipment strategy elements:

Voltage Transformers (Instrument and Power) shall include the following main features:

- Design/ Operating life of 40 Years.
- Composite insulators to maximise safety in the event of failure.
- High reliability and availability.
- Safe operation.
- Analogue density monitoring of SF6 insulated equipment (where used).
- Inclusion of overpressure protective devices (e.g. rupture disc).

- Spare parts support during the complete life of the equipment.
- Minimal leakage of insulating medium in accordance with standards and specifications.
- Minimal maintenance requirements (both preventive and corrective).

2.4 Concurrent investigations:

The market position for Non-Conventional Instrument Transformers and Electronic Voltage Transformer (EVT) with merging units integrating with fully digital secondary systems will continue to be monitored.

2.5 Summary

The Equipment Strategy detailed in this document will be adopted for future requirements of Voltage Transformers (Instrument and Power) for the life of the Equipment Strategy.

- Instrument Voltage Transformers shall be CVTs with polymer bushing.
- Power Voltage Transformers shall be oil insulated EMVTs with polymer bushing.