

# NEED/OPPORTUNITY STATEMENT (NOS)



Protection-Time Domain Development

NOS- 000000001584 revision 2.0

**Ellipse project no.:** P0009384

**TRIM file:** [TRIM No]

**Project reason:** Reliability - To meet overall network reliability requirements

**Project category:** Prescribed - Replacement

## Approvals

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Endorsed	Mark Jones	Secondary Systems and Communications Asset Manager
Approved	Lance Wee	M/Asset Strategy
Date submitted for approval	17 November 2016	

## Change history

Revision	Date	Amendment
0	20 October 2016	Initial issue
1	17 November 2016	Update to format

## 1. Background

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The National Electricity Rules (NER) specifies maximum fault clearance times by voltage level to maintain network stability. In order to meet these requirements and protect the high voltage (HV) assets, TransGrid implements a variety of traditional phasor based protection schemes.

In the case of transmission line distance protection, the basic scheme has the disadvantage of not providing high-speed instantaneous protection for the complete line. High speed tripping is only provided for Zone 1, typically 80-85% of a protected line, and this is not acceptable for most 330kV and above transmission systems. The basic distance scheme also limits the ability to conduct high-speed auto reclosing. Until recently in order to eliminate these disadvantages, communication-aided tripping schemes are utilised that accelerate fault detection and clearance times. One such method adopted by TransGrid is voice frequency (VF) inter-tripping utilising dedicated intermediate inter-trip devices.

Within the current suite of protection relays TransGrid has deployed on its network, high speed distance relays provide the fastest possible fault clearance option. This option utilises distance relays with high-speed algorithms resulting in operating time of approximately a 15ms. TransGrid also deploys current differential based line protection relays onto the network however such schemes have been measured to operate slower at approximately 25-30ms. One advantage though of a differential relay protection scheme over a communication-aided distance scheme is that they do not require VF inter-tripping devices in order to achieve high-speed fault clearance along the full transmission line span.

## 2. Need/opportunity

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Power system stability has driven the need for faster transmission line protection. The ability to reduce network fault clearance times have several advantages such as:

- > Increased power transfer capabilities
- > Increased personnel safety
- > Decreased risk of high voltage asset damage caused by prolonged system faults
- > Improved power quality

Schweitzer Engineering Laboratories (SEL) have recently released a time-based protection relay (SEL-T400L) utilising a combination of travelling-wave principals and traditional incremental-quantity principals to provide ultra-high-speed line protection.

SEL have reported significant reductions in relay operating times based on travelling wave algorithms across both distance and differential schemes<sup>1</sup>. Of particular interest is the travelling wave differential relay with a quoted operating time of <1ms (plus channel time). Such a relay could potentially replace existing communication aided distance relays and result in cost savings through no longer requiring inter-trip devices.

Based on forecasted VF inter-trip device replacement schedules, it has been estimated that installing travelling-wave differential protection schemes instead of replacing VF units would produce a potential cost saving of \$420k per annum.

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<sup>1</sup> Schweitzer III E, Kasztenny B, Mynam M. Performance of Time-Domain Line Protection Elements on Real-World Faults. 2015. Available from: IEEE

Due to these potential benefits TransGrid proposes to investigate the deployment of ultrahigh speed SEL protection relays within the network.

### 3. Related needs/opportunities

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Nil.

### 4. Recommendation

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It is recommended that options be considered to address the identified need/opportunity.