

# Investment Evaluation Summary (IES)



## Project Details:

<b>Project Name:</b>	Power Quality (PQ) Capital Program - MV Regulating Transformer Component
<b>Project ID:</b>	01083
<b>Thread:</b>	Power Quality
<b>CAPEX/OPEX:</b>	CAPEX
<b>Service Classification:</b>	Standard Control
<b>Scope Type:</b>	D
<b>Work Category Code:</b>	PQRIV
<b>Work Category Description:</b>	Install Regulators
<b>Preferred Option Description:</b>	Do nothing
<b>Preferred Option Estimate (Nominal Dollars):</b>	\$0

	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27
<b>Unit (\$)</b>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>Volume</b>	1	1	1	1	1	1	1	1	1	1
<b>Estimate (\$)</b>										
<b>Total (\$)</b>	\$450,000	\$450,000	\$450,000	\$450,000	\$450,000	\$450,000	\$450,000	\$450,000	\$450,000	\$450,000

## Governance:

<b>Project Initiator:</b>	Leon Kwek	<b>Date:</b>	23/06/2015
<b>Thread Approved:</b>	Stephen Jarvis	<b>Date:</b>	19/10/2015
<b>Project Approver:</b>	Stephen Jarvis	<b>Date:</b>	19/10/2015

## Document Details:

<b>Version Number:</b>	1
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## Related Documents:

Description	URL
PQ Capital Program - Investment Evaluation Summary	<a href="http://projectzone.tnad.tasnetworks.com.au/business-projects/nis-program/DD17SAM/Deliverables/Power%20Quality/IES%20-%20PQ%20CAPEX.docx">http://projectzone.tnad.tasnetworks.com.au/business-projects/nis-program/DD17SAM/Deliverables/Power%20Quality/IES%20-%20PQ%20CAPEX.docx</a>

# Section 1 (Gated Investment Step 1)

## 1. Background

Power quality (PQ) describes the output of a power supply with respect to electrical tolerances (as opposed to power availability or reliability). Poor power quality may result in obvious equipment malfunction (such as flickering lights or slow acting appliances), non-fault tripping of protection devices or more subtle equipment degradation resulting in premature appliance failure. From the perspective of a general customer, a PQ issue may not be perceived as any different from overall loss of supply.

Unlike more straight forward network issues (e.g. asset failure), PQ disturbances are frequently intermittent and generally more difficult to quantify and effectively address: local correction options may resolve the immediate complaint but shift the issue to resurface later and elsewhere in the network. Local PQ issues may be symptoms of wider, systematic problems in the network area.

From the perspective of a general customer, a PQ issue may not be perceived as any different from overall loss of supply. Around 10-15% of customer complaints TasNetworks investigates (approximately 400 per year) are attributed to PQ causes. Following the identification of a local power quality issue, a number of corrective network options are available, that range from simple tweaks (e.g. transformer tapping or protection device settings) through to network augmentation in more complex circumstances.

This program finances the full range of network corrections undertaken in response to PQ issues, primarily identified through customer complaints. It is a continuation of activities from Aurora Energy; it represents the base cost of maintaining network performance and regulatory power quality requirements at their historic levels.

It is anticipated that over the next 5-10 years, the network will see a rise in recurring PQ problems associated with the increasing penetration of distributed photovoltaic (PV) generation. While this program will be able to control these problems locally in the short term, it is not intended to manage the potential widespread and accumulating PQ risks.

### 1.1 Investment Need

Ongoing PQ issues are a persistent feature of distribution networks. Complex and unique localised causes, combined with relatively minor consequences, result in diffuse and widespread network performance issues that are expensive to locate and correct proactively.

While not as immediate as loss-of-supply issues, an inability to correct poor PQ exposes an immediate business reputation risk in TasNetworks' perceived willingness and competence in resolving customer issues. Also, TasNetworks is legally required to maintain PQ standards by the National Electricity Rules (NER), with thresholds generally set by Australian Standards.

Further to previous iterations of this program, it is strongly suspected that a systematic network problem can be expected in the next 5-10 years due to the increasing uptake of distributed generation. Though this is already a significant issue in other distribution networks, the full extent and magnitude as it will impact in Tasmania is currently unknown.

This program is critical to managing ongoing PQ risks, while providing the business sufficient opportunity to understand and adapt to the conditions imposed by high PV generation.

### 1.2 Customer Needs or Impact

This program will directly benefit all distribution customers through maintenance of acceptable power quality. The impact will be identical to all standard distribution works and augmentation, which is deemed preferable to other business risks if appropriate customer warning and consultation is given.

### 1.3 Regulatory Considerations

This submission is required to achieve the following capital expenditure objectives as described by the National Electricity Rules section 6.5.7(a). In particular, to:

- comply with all applicable regulatory obligations or requirements associated with the provision of standard control services (in this case the NER and relevant Australian Standards); and
- achieve the quality of standard control services generally where legislation is not applicable.

## 2. Project Objectives

This program finances the full range of network corrections undertaken in response to PQ issues, primarily identified through customer complaints. It represents the base cost of maintaining network performance and regulatory power quality requirements at their historic levels.

The program is designed to align with the following specific business requirements:

- Maintaining network performance, both in controlling local issues and managing power quality overall
- Compliance with the TEC and Australian Standards
- Provision of good customer service (i.e. perceived as well as actual capability to respond to complex issues)

## 3. Strategic Alignment

### 3.1 Business Objectives

Strategic and operational performance objectives relevant to this project are derived from TasNetworks 2014 Corporate Plan, approved by the board in 2014. This project is relevant to the following areas of the corporate plan:

- Customers (“We understand our customers by making them central to all we do”)
- One Business (“We care for our assets, delivering safe and reliable networks services while transforming our business”).

### 3.2 Business Initiatives

This program supports the following greater 2014-15 business initiatives:

Initiative	Performance Indicators	Support Rationale
'Voice of the customer' program	Customer Engagement	PQ works initiated under this program are identified primarily by customer complaints.
	Prices for Customers	The program allows the business to respond quickly and effectively to customer issues.
Safe and reliable network services	Network service performance	PQ works directly improve the reliability and safety of network assets.

## 4. Current Risk Evaluation

Risks are presented in two categories: Table 1 lists the “traditional” localised PQ issues that result from ongoing development and movement in the distribution network. Though geographically diverse, these are considered to be contained locally and have root causes that are generally case-specific. Although the high likelihood of these events drives medium business risks, this is within the TasNetworks risk appetite for the relevant consequence categories.

**Table 1: “Traditional” PQ Risk Analysis**

Risk Category	Risk	Likelihood	Consequence	Risk Rating
Network Performance	Localised quality of supply issues (over/under voltage) due to load growth /	Almost Certain	Minor	Medium

Risk Category	Risk	Likelihood	Consequence	Risk Rating
	shifting or individual PV installation; will not impact major industrials			
Reputation	Individual customers perceive TasNetworks unwillingness to respond effectively to PQ issues, especially in the case of small business or minor industry	Likely	Minor	Medium
Regulatory and Compliance	Minor isolated breaches of the NER and AS61000 PQ compliance thresholds	Almost Certain	Minor	Medium

Table 2 shows the forecast risk of increased PV penetration, which is uncertain but has the potential widespread, recurring and intensifying consequences that cannot be contained on a case-by-case basis. In addition to addressing traditional risks, this program forms an essential network monitoring and data gathering component of the strategy to handle PV uptake.

At present, all risks are Medium as a result of low likelihood; however all may escalate to High by the end of the determination period if PV installation tracks toward moderate industry forecasts.

**Table 2: Risk Analysis of PV Penetration Consequences**

Risk Category	Risk	Likelihood	Consequence	Risk Rating
Network Performance	Interruption of supply to PV generators and substantial voltage issues for surrounding customers, across multiple areas.	Possible	Moderate	Medium
Regulatory Compliance	Minor network-wide, recurring breaches of the NER / Australian Standards	Possible	Moderate	Medium
Reputation	Widespread perception of TasNetworks' inability and unwillingness to accommodate new solar connections	Unlikely	Major	Medium

#### 4.1 5x5 Risk Matrix

TasNetworks business risks are analysed utilising the 5x5 corporate risk matrix, as outlined in TasNetworks Risk Management Framework.

Relevant strategic business risk factors that apply are follows:

Risk Category	Risk	Likelihood	Consequence	Risk Rating
Network Performance	Interruption of supply to PV generators and substantial voltage issues for surrounding customers, across multiple areas.	Possible	Moderate	Medium
Network Performance	Localised quality of supply issues (over/under voltage) due to load	Almost Certain	Negligible	Medium

	growth / shifting or individual PV installation; will not impact major industrials			
Regulatory Compliance	Minor network-wide, recurring breaches of TEC / Australian Standards	Possible	Moderate	Medium
Regulatory Compliance	Minor isolated breaches of TEC and AS61000 PQ compliance thresholds	Almost Certain	Negligible	Medium
Reputation	Widespread perception of TasNetworks' inability and unwillingness to accommodate new solar connections	Unlikely	Major	Medium
Reputation	Individual customers perceive TasNetworks unwillingness to respond effectively to PQ issues, especially in the case of small business or minor industry	Likely	Negligible	Low

## Section 1 Approvals (Gated Investment Step 1)

<b>Project Initiator:</b>	Leon Kwek	<b>Date:</b>	23/06/2015
<b>Line Manager:</b>		<b>Date:</b>	
<b>Manager (Network Projects) or Group/Business Manager (Non-network projects):</b>		<b>Date:</b>	
[Send this signed and endorsed summary to the Capital Works Program Coordinator.]			

<b>Actions</b>			
<b>CWP Project Manager commenced initiation:</b>		<b>Assigned CW Project Manager:</b>	
<b>PI notified project initiation commenced:</b>		<b>Actioned by:</b>	

## Section 2 (Gated Investment Step 2)

### 5. Preferred Option:

The preferred option is an open CAPEX allowance based on historical trends, to correct network PQ issues as they are identified.

PQ fluctuations are a persistent issue within distribution networks. Unlike other more straight forward issues (e.g. asset failure) it is non-trivial to determine when corrective action is cost-effective. Works are thus primarily expected to follow from customer complaints and PQ logging investigations.

#### 5.1 Scope

This program covers a number of expected individual network projects of varying scale, based on historic spending requirements. The full design, consultant review, construction and close out works required to address the specific PQ issue are included in the budget.

The majority of jobs (>80%) are not expected to require design or engineering input, with total works less than \$20,000. In general, projects deemed appropriate for this program are not asset defined, but address a single specific, immediate PQ concern and typically do not extend beyond an LV circuit. Examples include (in rough order of increasing complexity):

- LV transformer re-tapping
- LV circuit phase rebalancing or load shifting
- LV transformer upgrade
- LV circuit split through the introduction of a new transformer
- LV conductor upgrades

Work may extend beyond the LV however, when multiple complaints are found to be resolvable through a single upstream correction. Historically the most commonly selected solution in these cases has been the installation (or repositioning) of an MV voltage regulating transformer, followed by MV conductor upgrades.

Figure 1 shows the historic breakdown of expenditure on corrective PQ works: a 15:85% split between MV and LV work costs is typical, with LV transformer work always comprising the bulk of spending. These divisions are not expected to vary significantly through the next determination.

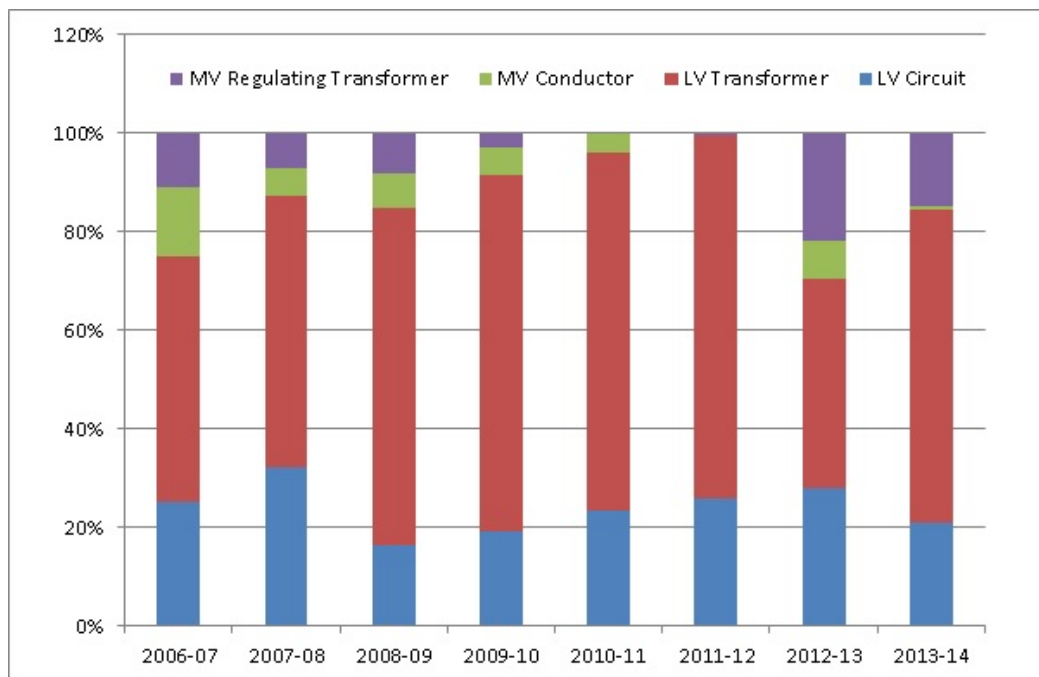


Figure 1: Percentage breakdown of historical PQ corrective works

## 5.2 Expected outcomes and benefits

Although the TEC and Australian Standards provide formal definitions for compliance thresholds, these limits are currently under review since they do not enforce prudent operation of the network. The prescribed standards have never been achieved network-wide, as strict adherence would require prohibitive expenditure, with disproportionate return in supply quality as perceived by customers.

The primary objectives of network performance, regulatory requirements and provision of customer service are thus best weighed in terms of risk mitigation.

Option description	NPV	Reason got selection/rejection
Option 0 – Do Nothing	Unaddressed medium business risks	Leaves business exposed to significant array of Medium risks; potential to evolve into unacceptable High risks with large PV uptake
Option 1 – Complaint-driven corrective works	\$-22.0M	Addresses current risks, supports TasNetworks' customer perception and service objectives, and positions the business to deal with future PV-related risks
Option 2 – Pre-targeted works	\$-22.0M	Likely unnecessary expenditure on PQ improvement, as network performance as defined by regulatory standards better maintained, but not aligned to customer service or expectations.

## 5.3 Regulatory Test

This does not apply to this initiative.

## 6. Options Analysis

The following table lists the options considered:

Option description	
Option 0 – Do Nothing	<p>No works are initiated in response to PQ, until issues result in loss of supply.</p> <p>Minimises capital expenditure.</p> <p>Business is subject to a set of almost certain medium risks, all with the potential to develop into unacceptable high risks through the next determination period.</p>
Option 1 – Complaint-driven corrective works	<p>Corrective PQ capital works are initiated primarily in response to investigated customer complaints.</p> <p>PQ issues are corrected with priority aligned to customer experience, such that unnecessary works and reputational risks are minimised. Technical resources are not used in identifying and locating diffuse problems.</p> <p>Works must be completed under time pressure to ensure prompt resolution of customer issues. Customers experiencing legitimate PQ issues may be “punished” for tolerating disturbances rather than lodging complaints.</p>



<p><b>Option 2 – Pre-targeted works</b></p>	<p>Corrective PQ capital works are initiated primarily through engineering analysis and compliance to regulation.</p> <p>PQ issues are corrected with priority aligned to regulatory requirements, such that higher overall objective network PQ is maintained, and regulatory risks are minimised. Works can be scheduled strategically for efficient use of field resources and minimal disruption through planned outages.</p> <p>Significant technical and investigative field resources required to identify non-issues. Some customer issues likely to be neglected. More equitable and objective treatment of PQ issues.</p>
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## 6.1 Option Summary

Option description	
Option 0 (preferred)	Do nothing
Option 0 (preferred)	Do nothing
Option 0 (preferred)	Do nothing No works are initiated in response to PQ, until issues result in loss of supply. Minimises capital expenditure. Business is subject to a set of almost certain medium risks, all with the potential to develop into unacceptable high risks through the next determination period.
Option 1 (preferred)	Complaint-driven corrective works Corrective PQ capital works are initiated primarily in response to investigated customer complaints. PQ issues are corrected with priority aligned to customer experience, such that unnecessary works and reputational risks are minimised. Technical resources are not used in identifying and locating diffuse problems. Works must be completed under time pressure to ensure prompt resolution of customer issues. Customers experiencing legitimate PQ issues may be “punished” for tolerating disturbances rather than lodging complaints.
Option 2	Pre-targeted works Corrective PQ capital works are initiated primarily through engineering analysis and compliance to regulation. PQ issues are corrected with priority aligned to regulatory requirements, such that higher overall objective network PQ is maintained, and regulatory risks are minimised. Works can be scheduled strategically for efficient use of field resources and minimal disruption through planned outages. Significant technical and investigative field resources required to identify non-issues. Some customer issues likely to be neglected. More equitable and objective treatment of PQ issues

## 6.2 Summary of Drivers

Option	
Option 0 (preferred)	
Option 0 (preferred)	
Option 0 (preferred)	<p><b>Maintaining network performance</b></p> <p>Un-corrected ongoing issues will result in accumulating widespread minor issues. Future connection of PV generators may be restricted</p> <p>High uptake of PV may possibly result in widespread, intensifying issues that existing local practices cannot manage.</p> <p><b>Compliance with appropriate legislation</b></p> <p>Almost certain widespread minor non-compliance issues.</p> <p>High uptake of PV may result in systemic, state-wide breaches of legislation. May require intervention by the regulator or other legislative bodies.</p> <p><b>Provision of good customer service / reputational risk</b></p>

	<p>Individual customer perception of TasNetworks' unwillingness to respond effectively to PQ issues, especially in the case of small business or minor industry.</p> <p>High uptake of PV may result in a general customer perception of TasNetworks' poor service and inability to accommodate new solar connections</p>
Option 1 (preferred)	<p><b>Maintaining network performance</b></p> <p>Priority of PQ augmentation is aligned to customer demand: higher density areas with more sensitive quality requirements (e.g. manufacturing).</p> <p>Performance is not actively maintained in the absence of strong complaints, most notably rural areas. Overall objective network-wide performance measures likely lower than Option 2, owing to sub-optimal works under time pressure.</p> <p><b>Compliance with appropriate legislation</b></p> <p>Minor breaches of regulatory standards in rural and other lower density areas are almost certain but tolerated.</p> <p><b>Provision of good customer service / reputational risk</b></p> <p>Works as matched to customer complaint intensity, traded against overall network-wide PQ levels.</p>
Option 2	<p><b>Maintaining network performance</b></p> <p>Highest overall network performance (as measured through objective standards) as a result of longer-term and better optimised works program.</p> <p>Business is slower to respond to unpredicted issues (as compared to Option 1); several customer issues likely neglected.</p> <p><b>Compliance with appropriate legislation</b></p> <p>Highest overall average, network-wide objective network standards, minimising regulatory risk.</p> <p>Unlikely to achieve full network compliance through the determination period for the given budget.</p> <p><b>Provision of good customer service / reputational risk</b></p> <p>Select customers unlikely to find assurance in long-term / network-wide PQ programs, potential outcomes similar to Option 0.</p>

### 6.3 Summary of Costs

Option	Total Cost (\$)
Option 0 (preferred)	\$0
Option 0 (preferred)	\$0
Option 0 (preferred)	\$0
Option 1 (preferred)	\$19,640,000
Option 2	\$8,100,000

### 6.4 Summary of Risk

The adoption of the preferred option of complaint-driven corrective works is expected to address the current risks, support TasNetworks' customer perception and service objectives, and position the business to deal with future PV-related risks.

## 6.5 Economic analysis

Option	Description	NPV
Option 0 (preferred)	Do nothing	\$0
Option 0 (preferred)	Do nothing	\$0
Option 0 (preferred)	Do nothing No works are initiated in response to PQ, until issues result in loss of supply. Minimises capital expenditure. Business is subject to a set of almost certain medium risks, all with the potential to develop into unacceptable high risks through the next determination period.	\$0
Option 1 (preferred)	Complaint-driven corrective works Corrective PQ capital works are initiated primarily in response to investigated customer complaints. PQ issues are corrected with priority aligned to customer experience, such that unnecessary works and reputational risks are minimised. Technical resources are not used in identifying and locating diffuse problems. Works must be completed under time pressure to ensure prompt resolution of customer issues. Customers experiencing legitimate PQ issues may be "punished" for tolerating disturbances rather than lodging complaints.	-\$19,640,000
Option 2	Pre-targeted works Corrective PQ capital works are initiated primarily through engineering analysis and compliance to regulation. PQ issues are corrected with priority aligned to regulatory requirements, such that higher overall objective network PQ is maintained, and regulatory risks are minimised. Works can be scheduled strategically for efficient use of field resources and minimal disruption through planned outages. Significant technical and investigative field resources required to identify non-issues. Some customer issues likely to be neglected. More equitable and objective treatment of PQ issues	-\$19,640,000

### 6.5.1 Quantitative Risk Analysis

No quantitative risk analysis available.

### 6.5.2 Benchmarking

No benchmarking available.

### 6.5.3 Expert findings

Not expert findings available.

### 6.5.4 Assumptions

Not applicable.

## Section 2 Approvals (Gated Investment Step 2)

<b>Project Initiator:</b>	Leon Kwek	<b>Date:</b>	23/06/2015
<b>Project Manager:</b>		<b>Date:</b>	

### Actions

<b>Submitted for CIRT review:</b>		<b>Actioned by:</b>	
<b>CIRT outcome:</b>			