

NEED/OPPORTUNITY STATEMENT (NOS)



Capacitors to improve QNI limits

NOS- 000000001701 revision 3.0

Ellipse project no(s):

TRIM file: [TRIM No]

Project reason: Economic Efficiency - Network developments to achieve market benefits

Project category: Prescribed - NCIPAP

Approvals

Author	Jay Esson	Network Modelling & Performance Engineer
Reviewed/Endorsed	Jahan Peiris	Network Modelling & Performance Manager
	Hoang Tong	Operations Analysis Manager
	Anwar Kurukchi	Project Portfolio Sponsorship Manager
	Garrie Chubb	Investment Support Manager
Approved	Andrew Kingsmill	Manager/Power System Analysis
Date submitted for approval	28th October 2016	

Change history

Revision	Date	Amendment
0	October 2016	Initial issue

Background

This proposal forms part of the Network Capability Incentive Parameter Action Plan (NCIPAP), for the 2018/19 to 2023/24 regulatory control period. The NCIPAP portion of the STPIS described in section 5 of the STPIS guideline¹ is a plan consisting of a suite of small projects aimed at improving the capability of transmission assets through operational expenditure and minor capital expenditure on the transmission network which results in:

- > Improved capability of those elements of the transmission system most important to determining spot prices;
OR
- > Improved capability of the transmission system at times when Transmission Network Users place greatest value on the reliability of the transmission system.

Need/opportunity

According to recent historical performance of the QNI interconnector, NSW export to Queensland is often limited due to the following constraints:

1. N^{^^}Q_NIL_B1: Avoid voltage collapse for loss of Kogan Creek generator
2. N[^]Q_NIL_A: Avoid voltage collapse for trip of Liddell to Muswellbrook (83) line

Both above voltage stability limits can be improved by adding capacitor banks at Armidale or Tamworth. Expected increase in limit is about (refer OM 520 for respective limit equations):

1. N^{^^}Q_NIL_B1: 32 MW per 100 MVar capacitor
2. N[^]Q_NIL_A: 75 MW per 100 MVar capacitor

Typically, NSW export to QLD constraint set includes the following limits:

Constraint ID	Description	Typical headroom compared to critical limit (MW)
N ^{^^} Q_NIL_B1	Avoid Voltage Collapse on loss of Kogan Creek	0
N ^{::} Q_NIL_KC	Avoid Transient Instability for trip of Kogan Creek.	72
N [^] Q_NIL_A	Avoid Voltage Collapse on loss of Liddell to Muswellbrook (83) line	189
N ^{^^} Q_NIL_B4	Avoid Voltage Collapse on loss of Tarong North	223

¹ AER, Final Electricity Transmission Network Service Providers Service Target Performance Incentive Scheme, Version 5 October 2015.

Constraint ID	Description	Typical headroom compared to critical limit (MW)
N^^Q_NIL_B3	Avoid Voltage Collapse on loss of Millmerran 2	270
N^^Q_NIL_B5	Avoid Voltage Collapse on loss of Callide C3	344
N^^Q_NIL_B6	Avoid Voltage Collapse on loss of Callide C4	344
N^Q_NIL_B	Avoid Voltage Collapse on loss of the largest of Tarong, Stanwell, Callide or Swanbank E generators	346
N::Q_NIL_TNT	Avoid Transient Instability for a trip of Tarong North generators	381
N:Q_NIL_LDTW	Avoid Transient instability for a trip of Liddell-Tamworth 330kV line	421
N:Q_NIL_LDMU	Avoid Transient Instability for a trip of Liddell-Muswellbrook 330kV line.	488
N^^Q_NIL_B2	Avoid Voltage Collapse on loss of Millmerran 1	662

Accordingly, adding 200 MVar of capacitors at Armidale (or near Armidale) will increase the NSW to QLD transfer limit by about 64 MW. However, load-flow studies have shown that for light load situations overvoltage conditions could result from excessive capacitive reactance added in the area.

Related needs/opportunities

None

Recommendation

It is recommended to investigate the options to address the constraint.

This project is to be included in TransGrid NCIPAP for the regulatory period 2019 – 2023.

Attachment 1 Market benefit summary

The market benefit due to a new 120 MVar capacitor(s) is estimated using following assumptions:

Probability of NSW exporting to QLD² = 20%

Market impact due to NSW export limit binding³ = \$25/MWh

Probability of NSW export limit binding⁴ = 75%

Market impact = {(Probability of NSW exporting) * (Probability of NSW export limit binding) * (Market impact due to NSW export limit binding) * (MW increase in NSW export on QNI)} * (duration)

Market impact = $\{[0.20 * 0.75 * 25 * 38.4]\} * 24 * 365 = \$144 * 24 * 365 / \text{year}$

Market impact = \$1.26 million/year

² Based on QNI flows from 1 June 2012 to 31 May 2016 – Refer file “nsw-vic-qld-1557.xlsm” in N:\HV System Planning\PUBLIC\NCIPAP\Risk Costs.

³ Based on the difference between NSW Black Coal and QLD Gas variable costs – refer page 61 of Jacobs report “Retail electricity price history and projections.pdf” filed in PDGS supporting documents. QLD price is expected to be higher than NSW price in this situation. In addition, it is expected that QLD Gas prices will be setting the dispatch price when QLD is importing from NSW. Hence, Gas prices in QLD and Black Coal prices in NSW were used. Accordingly, Market impact = \$45 - \$20 = \$25/MWh. Note that, the average historical price difference between NSW and QLD is about \$69 when NSW export to QLD – Based on prices from 1 June 2012 to 31 May 2016 when NSW is exporting to QLD – Refer file “nsw-vic-qld-1701.xlsm” in N:\HV System Planning\PUBLIC\NCIPAP\Risk Costs.

⁴ Based on Historical average number of binding NSW export constraints with the reduction due to Armidale capacitors unavailability applied for the period from 1 June 2012 to 31 May 2016 – Refer file “nsw-vic-qld-1701.xlsm” in N:\HV System Planning\PUBLIC\NCIPAP\Risk Costs