INTERCONNECTOR LIMIT FORECAST FOR MTPASA

PREPARED BY: Electricity System Operations Planning and Performance

DOCUMENT NO:

VERSION NO: 23

FINAL

Table of Contents

1. INTRODUCTION

In accordance with clause 3.7.2 of the National Electricity Rules, AEMO produces the Medium Term Projected Assessment of System Adequacy (MTPASA). Transmission network capabilities are modelled in the MTPASA through inter-regional and intra-regional constraints, however as the MTPASA does not forecast generation outputs, a more simplified approach is taken than that used in the dispatch and pre-dispatch processes.

This document shows the most recent interconnector limits forecast that have been produced for MTPASA, and explains the assumptions and methodology applied in determining these limits.

2. BACKGROUND

The Projected Assessment of System Adequacy (PASA) is designed to assess the availability of generation and transmission to supply the forecast 10% Probability of Exceedence (POE) peak demand level and minimum reserve level in each region. The MTPASA covers the next two-year period in daily steps and is updated weekly.

MTPASA provides a medium term supply/demand outlook. It enables market participants to make decisions on scheduling planned generation and transmission outages while considering the overall power system supply/demand outlook. The information also provides AEMO with the basis for assessing the forecast system supply/demand balance and possible need for reserve contracting or direction.

3. INTERCONNECTOR LIMITS AND RESERVE FORECASTS IN MTPASA

MTPASA produces two sets of results for determining low reserve conditions (LRC). These are denoted as RELIABILITY_LRC and OUTAGE_LRC in the public MTPASA file.

RELIABILITY_LRC results consider supply adequacy against a 10% POE demand forecast and only those constraints reflecting network capability with all plant available for service. These results are those that serve as a trigger for AEMO to address forecast reserve shortfalls.

OUTAGE_LRC results consider supply adequacy against a 50% POE demand forecast and include network constraints reflecting expected network outage conditions.

The interconnector limits determined consistent with RELIABILITY_LRC results in MTPASA are presented in Appendix B.

The limits shown in Appendix B are based on constraint equations[1], which incorporate 10% POE demand levels, seasonal line ratings and assume that all generation and transmission plant is available for service. The methodology applied in developing these interconnector limits are described in the following section.

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[1] Transmission network limits and plant ratings are provided to AEMO by the respective TNSPs and implemented in the MTPASA LP as constraint equations.

In addition to forecasts of low reserve conditions, the National Electricity Rules require AEMO to forecast any lack of reserve (LOR) conditions in MTPASA.

Lack of reserve (LOR) in MTPASA is considered against a 50% POE demand forecast and with constraints that reflect expected network outage conditions.

Table 1 below shows the different forecast information published in the public MTPASA results and the input data considered.

RESERVE FORECAST	DEMAND FORECAST	CONSTRAINTS	RESERVE LEVELS USED
SURPLUSRESERVE (RELIABILITY_LRC assessment)	10 % POE	System normal only (ie. no network outage constraints)	Minimum reserve levels
SURPLUSRESERVE (OUTAGE_LRC assessment)	50 % POE	System normal constraints + outage constraints	Minimum reserve levels
MAXSPARECAPACITY (LOR assessment)	50 % POE	System normal constraints + outage constraints	Short term reserve levels

Table 1 – Reserve forecasts in MTPASA and input data

For more information on MTPASA reserve forecasts see http://www.aemo.com.au/electricityops/432-0004.html

4. METHODOLOGY

The methodology for daily and seasonal interconnector limits forecast is described in this section.

4.1 Basis

These transfer limits are based on transmission limit equations developed and provided to AEMO by the Transmission Network Service Providers (TNSPs).

The transfer limits in these transmission limit equations are described in terms of transmission plant ratings, demand and generation. The values used for these terms have been obtained as follows:

- transmission plant ratings that are provided to AEMO with regular updates by TNSPs;
- two year 10% POE demand forecast produced by AEMO for MTPASA; and
- two year generation availability forecast provided to AEMO by scheduled generating units and loads for MTPASA.

4.2 Assumptions for limit development

It is assumed that there are no prior planned network outages. This represents the most likely network condition under high demand levels since AEMO and TNSPs continuously assess the impact of planned network outages and proceed only if security and reliability standards could be satisfied with the outages. Under this arrangement, it is unlikely that a planned transmission network outage would proceed during the peak 10% POE demand levels in summer or winter, which MTPASA uses. However there can be transmission outages during peak demand periods in spring, autumn, weekends and holidays. This is discussed further in Section 4.5.

It is also assumed that the following transmission configuration will apply, which is generally used to optimise the network capability when all transmission plant is available for service:

- The Latrobe Valley to Melbourne 500 kV and 220 kV transmission systems are in the radial mode of operation (no connections between the two voltage levels in the Latrobe Valley).

The forecast interconnector limits shown in Appendix B have been prepared based on generation availability as offered by the generating units and generation from wind farms to be 25% of maximum generation.

4.3 Load diversity

Clause 4.9.1 of the National Electricity Rules states that AEMO must aggregate the regional forecasts to produce a total interconnected transmission network indicative load schedule for use in AEMO processes such as the determination of the required levels of short term capacity reserves, medium term capacity reserves, the PASA assessments and pre-dispatch schedules.

Therefore, supply demand balance is assessed without explicit load diversity however load diversity was considered when determining the minimum reserve levels.

4.4 Limits development process

The process for interconnector limits calculation is shown in **Figure 1**.

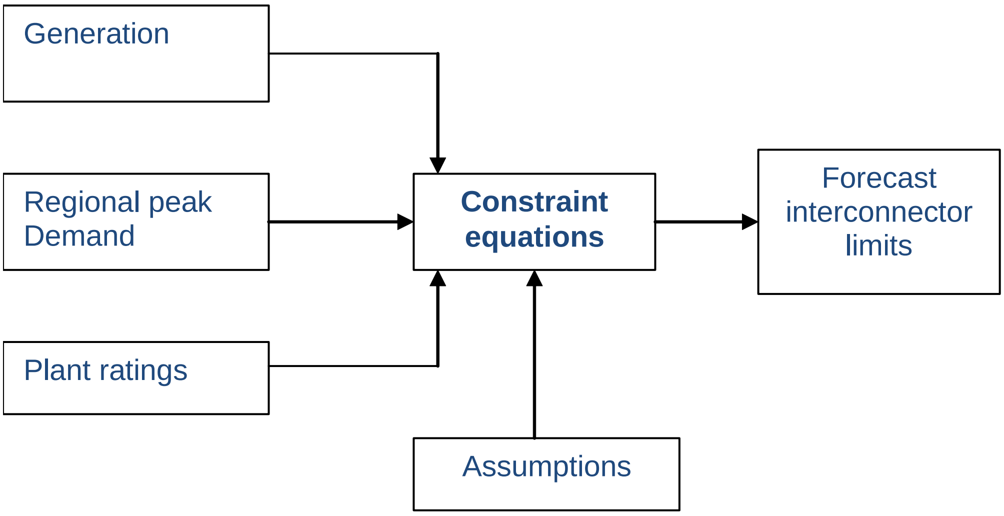

Figure 1 – Interconnector limits calculation process

4.5 Planned transmission outages

A planned transmission outage that violates the system reliability by causing a forecast low reserve condition would not proceed if the actual weather forecast for the planned outage indicated the high demand levels were likely to occur. This level of forecast accuracy can only be obtained two to three days prior to an outage commencing.

This situation presents a dilemma for the MTPASA, to retain the constraint associated with the outage will forecast low reserve conditions which would be unlikely to occur as such an outage would not proceed on the day. To remove the outage constraint from the MTPASA takes away the interconnector limits that would occur when the outage could proceed against average conditions.

The MTPASA results now allow AEMO to consider two sets of results in this circumstance, the OUTAGE_LRC results will contain all network outage constraints and the RELIABILITY_LRC results will only contain system normal constraints (See Table 1). AEMO would discuss the outage with the TNSPs and publish a market notice concerning the planned outage and the conditions under which it would not proceed.

Representation of planned network outages in the MTPASA provides only an indication of the transmission outage to proceed as scheduled. It does not provide all the benefits of MTPASA shown in Section 2. A more detailed assessment of planned network outages is provided to the market participants separately under Clause 3.7A[2] of the National Electricity Rules.

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[2] Clause 3.7A of the National Electricity Rules includes requirements for AEMO and the TNSPs to publish planned network outage information for the following 13 months, updated on a monthly basis. The National Electricity Rules clause also requires AEMO to determine and publish an assessment of the projected impact of network outages on intra and inter-regional power transfer capabilities.

Sometimes an outage is planned to return to service prior to the peak period in a day, or it is intended to run for less than half a day, in either case this type of outage is inappropriate to invoke it against the peak demand of the MTPASA.

Interconnector limit change due to transmission outage will be included either:

- by reducing the interconnector limits from the level with all transmission in service using a nominal value; or
- by a maximum value without reference to the limit with all transmission in service.

It should be noted that the network constraints used in this forecast are designed for the purpose of MTPASA, which is intended for the extreme demand conditions. Conditions applied for this assessment would arise only at very high demand levels (against 10% POE conditions). Network constraints under low demand periods may be significantly different to the constraints produced for high demand levels.

4.6 Planned generating unit outages

Interconnection capability is dependant on generation. Some generating units are more significant compared with others due to their location and characteristics of the transmission network. Therefore, all generation terms are retained in the interconnector limit equations.

The impacts of generating unit outages on interconnector limits (shown in Appendix B) have been assessed on a daily basis using generation availability as offered by the generators.

4.7 Minimum reserve level constraints in MTPASA

When new minimum reserve levels were introduced for all regions in September 2006, new headroom constraints for MTPASA were implemented to ensure that the assumptions used to develop the minimum reserve levels for each region are maintained in MTPASA.

These constraints have been implemented in MTPASA since the 24 October 2006 run and are explained in more detail in section 3 of Appendix A below.

APPENDIX A– MTPASA DATA

The data set used for the interconnector limits in MTPASA is described in this section.

1. Demand forecast

MTPASA is carried out on daily basis using daily 10% POE peak demands. Seasonal interconnector limits have been calculated using the seasonal peak demand obtained from these 10% POE peak demand forecasts.

Peak demand forecasts used for interconnector limit calculation are shown in **Table 1** and Table 2.

REGION	10% POE (MW)	50% POE (MW)
Queensland	10,074	9,582
New South Wales	15,375	14,445
Victoria	10,346	9,790
South Australia	3,500	3,230
Tasmania	1,442	1,417

Table 1 – Summer peak demand forecasts for 2009/10 (medium growth)

REGION	10% POE (MW)	50% POE (MW)
Queensland	8,726	8,606
New South Wales	14,703	14,313
Victoria	8,328	8,190
South Australia	2,730	2,580
Tasmania	1,886	1,863

Table 2 - Winter peak demand forecasts for 2009 (medium growth)

2. Transmission plant ratings

Some interconnector limits have been defined as functions of transmission plant ratings. These seasonally variable plant ratings have been provided by TNSPs and updated regularly.

3. Interconnector limiting factors

Interconnector limits are determined by the thermal, voltage stability, transient stability and dynamic stability limits. The following sections summarise key factors that influence interconnector limits shown in Appendix B.

3.1 New South Wales – Queensland (QNI and Terranora) interconnectors

The limits used in MTPASA for the interconnectors between Queensland and New South Wales are influenced by:

- Oscillatory stability limit for flow on QNI from Queensland to New South Wales (maximum 1078 MW).
- Transient stability considerations limit QNI flow between Queensland and New South Wales (in either direction) for faults in Queensland and New South Wales.
- The combined power transfer from New South Wales to Queensland on QNI and Terranora interconnector may be limited by the contingent loss of any one of the following 275kV Calvale to Tarong, 275kV Tarong to Blackwall, 275kV Woolooga to Palmwoods, Swanbank E, and Wivenhoe generating units; or by the loss of some of the generating units in Queensland.
- The combined power transfer from NSW to QLD on QNI and Terranora might also be limited by the maximum net import into NSW.
- Thermal ratings of 330 kV transmission lines between Armidale and Tamworth, and the 132 kV lines between Lismore 330 kV and Lismore 132 kV substations limit flow on QNI and Terranora interconnectors.
- Thermal ratings of Terranora - Mudgeeraba 110 kV lines and Mullumbimby-Dunoon 132 kV lines limit Terranora interconnector flow to NSW, while thermal ratings of Lismore-Dunoon 132 kV lines limit Terranora interconnector flow to QLD.

3.2 Victoria – South Australia (Heywood and Murraylink) interconnectors

The limits used in MTPASA for the Victoria – South Australia interconnectors are:

- The upper limits for flows from Vic to SA are around 460 MW for Heywood interconnector and 220 MW for Murraylink. This is based on thermal rating considerations.
- Transient stability considerations for faults close to Northern Power station, as well as thermal limit of Tailem Bend – Mobilong 132 kV line on contingent loss of Tailem Bend – Tungkillo and Tailem Bend – Cherry Gardens lines, further limit flows from Vic to SA on Heywood interconnector.
- Flow from Vic to SA on Murraylink is further reduced from the basic design limit by thermal limits at times of high demand periods, by contingent loss of one of Darlington Point transformers, or by the thermal rating of Dederang transformer.
- The combined power transfer from Vic to SA on Murraylink and Heywood interconnector may also be limited by transient stability considerations for a fault and

trip of a Hazelwood to South Morang 500 kV line; or by the maximum net import into VIC.

- The limit for flows from SA to Vic on Heywood interconnector is around 300 MW. This is based on thermal & transient stability limits and the limits due to protection equipment. However, this limit may be further reduced by thermal ratings of Mobilong – Tailem Bend 132 kV on the contingent loss of Tailem Bend – Tungkillo and Tailem Bend – Cherry Gardens lines.
- The basic design limit for Murraylink transfers to Vic is 220 MW. However, thermal limits can significantly restrict flows particularly at times of high demand in summer. The thermal rating of Robertstown to North West Bend line may also further limit Murraylink transfers to Vic.

3.3 Tasmania – Victoria (Basslink) interconnector

The basic design limit for transfers towards Victoria on Basslink is 600 MW while the limit for transfers towards Tasmania from Victoria via Basslink is 480 MW.

- Transient stability considerations can further limit Basslink flow from Vic to Tas for faults on Hazelwood – South Morang 500 kV lines, resulting in tripping these lines.
- Flow from Tas to Vic via Basslink may also be limited by the rating of South Morang 500/330 kV transformer; or by the maximum net import into VIC.

3.4 Victoria – NSW interconnector

The limits used in MTPASA for the Victoria – New South Wales interconnector are:

- Ratings of the Snowy to Canberra and Yass lines limit the import to NSW on this interconnector.
- The limit for flows from Vic – NSW may also be limited by transient stability considerations for fault and trip of a Hazelwood to South Morang 500 kV line; or by fault at Yass on Sydney West to Yass (39) line.
- Flows from VIC – NSW may be further reduced by the rating of the South Morang F2 500/330kV transformer.
- The basic design limit for flow from NSW to Vic is around 1900 MW on this interconnector.
- Thermal ratings of the Dederang to Murray 330 kV lines, the Darlington Point (Tx3 or Tx4) transformers, and No.1 Dederang 330/220kV transformer may further limit the flow from NSW to Vic.
- The power transfer into Vic from NSW can also be limited by transient stability considerations for the contingent loss of the largest generating unit in Vic; or by the maximum net import into NSW and maximum net import into VIC.

3.5 Modelling of Queensland Intra-regional Power Transfer Capability

Power transfer capability between Central Queensland and Southern Queensland as well as the Tarong cutset were modelled in the MT PASA run published on 3 July 2007.

Approximately 1900 MW power transfer capability from Central Queensland to Southern Queensland (improving to 2000 MW in summer 2008/09) and a power transfer capability of approx. 4000 MW across Tarong cutset for summer 2008/09 were modelled in this MT PASA run.

4. MTPASA minimum reserve level constraints

4.1 New South Wales – Queensland (QNI and Terranora) interconnectors

The limit for flow on the QNI and Terranora interconnectors is limited by the restriction in MTPASA that no more than 0 MW is supplied to Queensland as the Queensland minimum reserve level is a local requirement. This however allows Queensland to export to New South Wales providing the reserve in Queensland (after any export to New South Wales) is at least the Queensland minimum reserve level.

The transfer to New South Wales from neighbouring regions via interconnectors was different for the 2006-07 year and the 2007-08 year due to differing minimum reserve levels calculated for each year. For the 2006-07 year, the flow into New South Wales from neighbouring regions was limited to 1878 MW, while the flow for the 2007-08 year was restricted to 1946 MW.

With the implementation of new regional boundaries associated with the abolition of Snowy region effective from 1 July 2008, there is a requirement for NSW region to have a net export of 330MW to the neighbouring regions.

4.2 Victoria- South Australia (Heywood and Murraylink) interconnectors

Since the new South Australia minimum reserve level is a local requirement, it is to be assessed with 0 MW transfer into the South Australia region from Victoria via the Heywood and Murraylink interconnectors. This still allows South Australia to export to Victoria, providing the reserve in South Australia after export to Victoria is at least the South Australia minimum reserve level.

4.3 Victoria- New South Wales interconnector

With the implementation of new regional boundaries associated with the abolition of Snowy region effective from 1 July 2008, Victoria – New South Wales interconnector commenced operation as an interconnector from 1 July 2008.

To ensure the assumptions used to develop the minimum reserve levels are preserved in MTPASA, constraint equations are used to ensure the limits on net imports to NSW and Victoria regions are adjusted as required by the following equations[3]:

[3] The document “Translation of Minimum Reserve Levels Following Abolition of the Snowy region is available on AEMO website at: http://www.aemo.com.au/electricityops/240-0024.html

For NSW:

(VIC to NSW) - QNI – (Terranora I/C) <= 1946 – (Tumut + Guthega PASA Availability)

For VIC:

(VIC to NSW) + Murraylink + (VIC to SA) - Basslink >= - 2510 + (Murray PASA Availability)

APPENDIX B - INTERCONNECTOR FLOWS AND LIMITS

Interconnector flows and limits forecast using the generation bids submitted for the MTPASA run on 18 August 2009 are shown below.

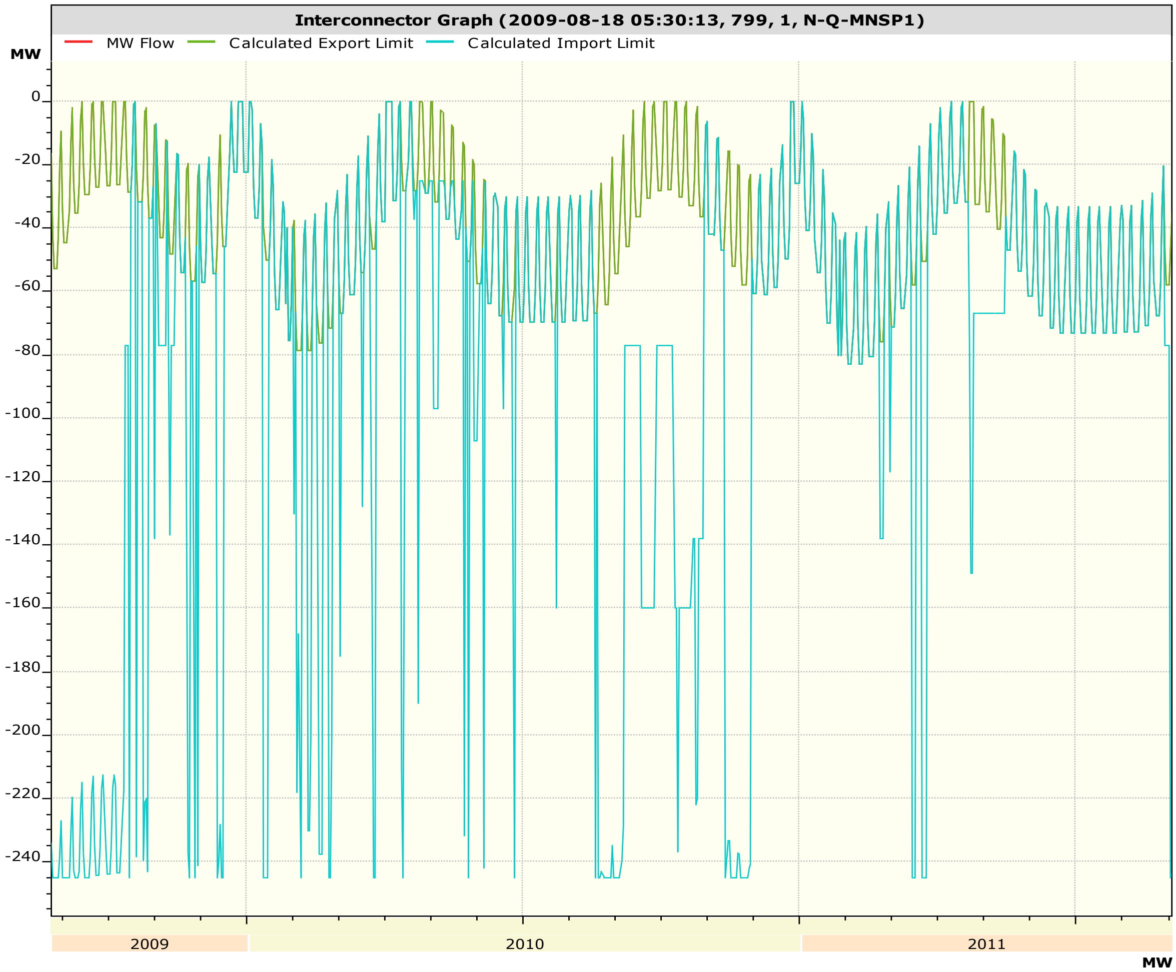

Figure 1 – Terranora Interconnector flows and limits

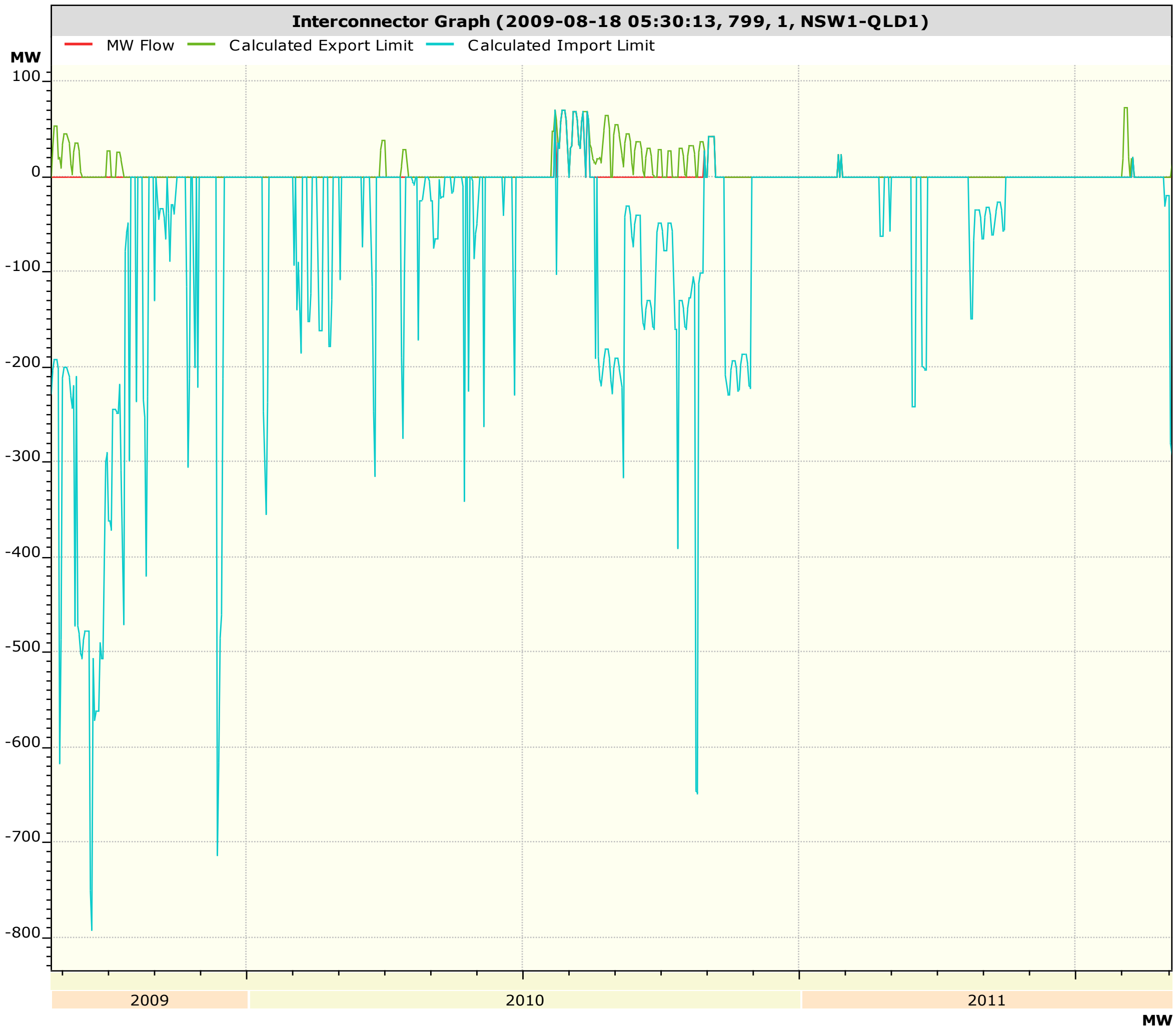

Figure 2 – QNI Interconnector flows and limits

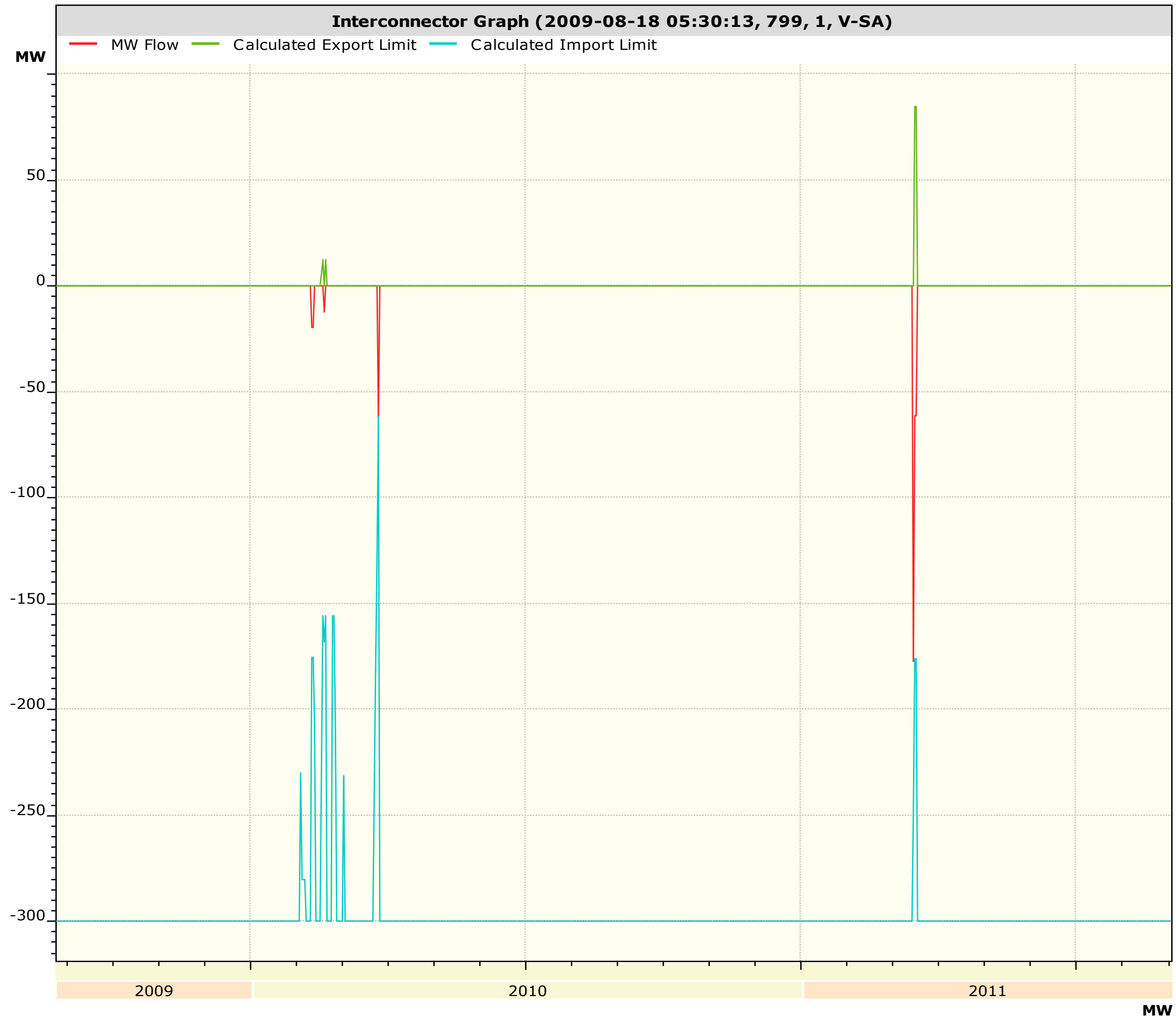

Figure 3 – Heywood Interconnector flows and limits

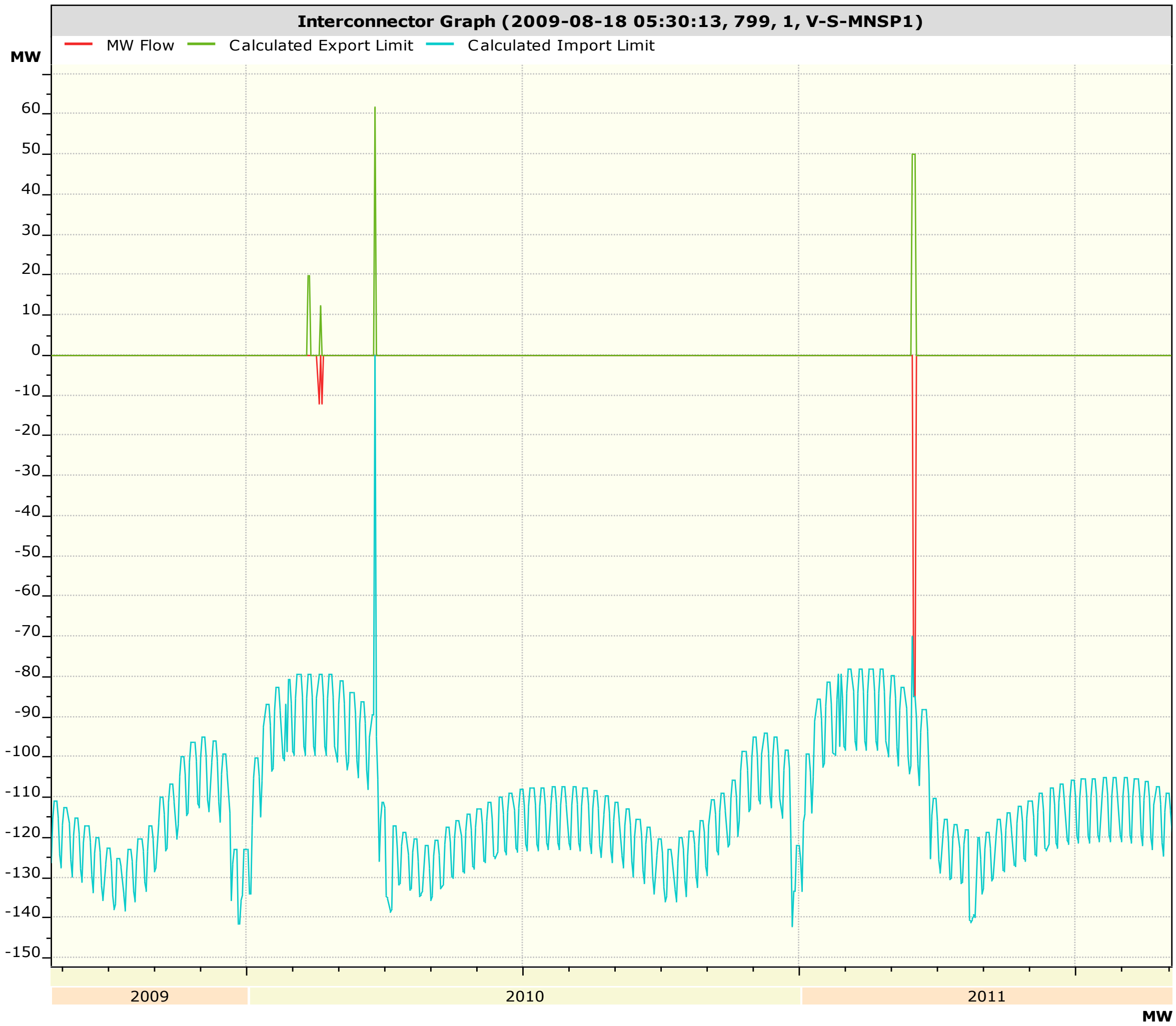

Figure 4 – Murraylink Interconnector flows and limits

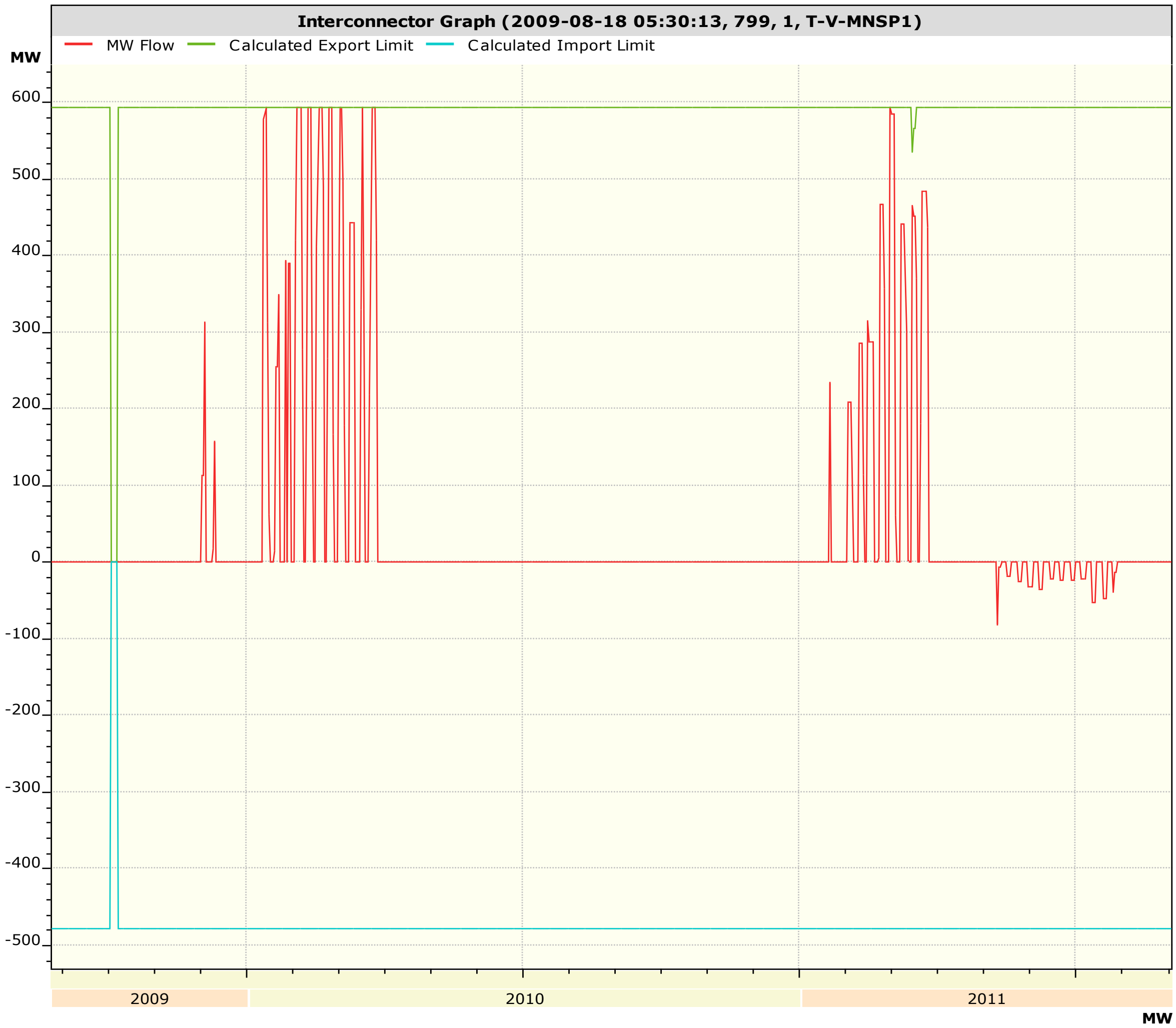

Figure 5 – Basslink Interconnector flows and limits

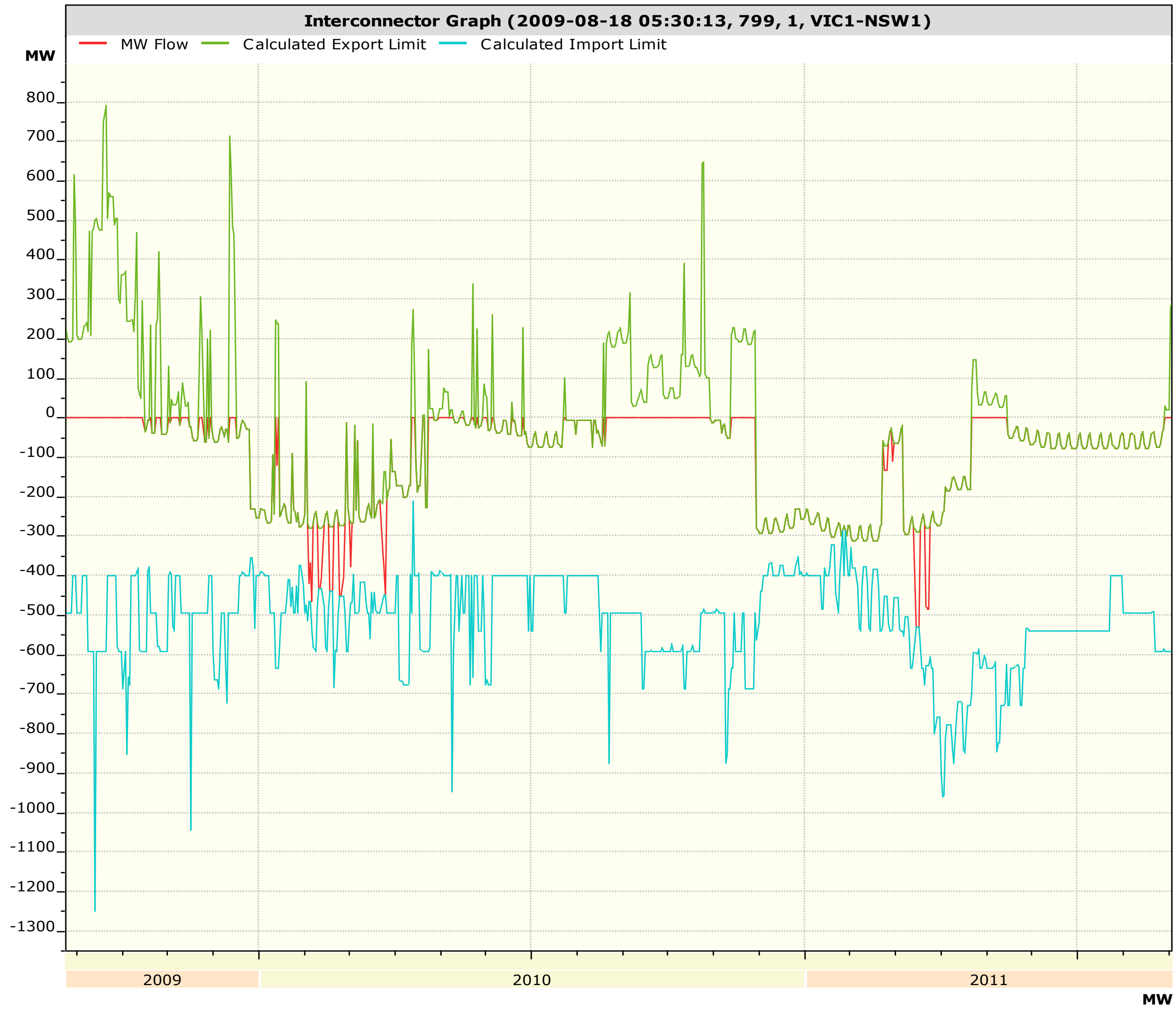

Figure 6 – VIC to NSW Interconnector flows and limits