BRIEF ON AUTOMATION OF NEGATIVE RESIDUE MANAGEMENT

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FINAL

Contents

1 Background 5

2 Negative Residue Management Process 5

Version Release History

VERSION	DATE	BY	CHANGES
0.1	01-05-2012	Valerie Lim	Initial draft
1.0	08-06-2012	Duncan Swijnenburg	Change of template

Disclaimer

Glossary

ABBREVIATION	TERM
AEMO	Australian Energy Market Operator Ltd
CVP	Constraint Violation Penalty
DI	Dispatch Interval
LHS	Left Hand Side of constraint
NEM	National Electricity Market
NR$	Negative Residue in dollars
NRM	Negative Residue Management
NRM_DI_AMT	Negative Residue Dispatch Interval Amount
RHS	Right Hand Side of constraint

1 Background

AEMO is to use reasonable endeavours to cease the accumulation of negative inter-regional settlement residues in the NEM when this accumulation reaches or exceeds the negative residue accumulation threshold of -$100,000 (as of 1 July 2010).

AEMO's control room normally acts in the dispatch timeframe, manually constraining flow on the relevant directional interconnector to cease any further accumulation. However, during times of high workload or when managing power system security is the highest priority, this may not always happen expeditiously.

To ensure initial action is taken once the negative residue accumulation is estimated to reach or has exceeded the threshold, AEMO is implementing an automated negative residue management process. This process activates/deactivates relevant Negative Residue Management (NRM) constraint equations by un-swamping/swamping them as soon as the threshold is reached/exceeded or positive residues are now accumulating. The aim of the NRM constraint equations is to prevent further accumulation of negative residues by reducing the counter-price flow on the relevant directional interconnector. This management will also be reflected in the pre-dispatch time frame for up to two trading intervals.

The automatic NRM constraint equations will use the latest accumulation values available from dispatch. The accumulation amount, relevant to the affected directional interconnector, is based on the previous trading intervals and an estimate of the current trading interval. The current trading interval estimate is based on an average of the dispatch interval quantities so far in the current trading interval. In the case where dispatch results aren't available pre-dispatch results are used.

The next section provides an overview of the process.

2 Negative Residue Management Process

The NRM process involves a set of permanently invoked constraint equations to manage each directional regulated interconnector, where the NRM constraint equation name starts with NRM_<directional flow> as shown in *Table 1*. For example, equation NRM_NSW1_QLD1 manages the flow from New South Wales to Queensland. Typically, these constraint equations are not active in the system (swamped out with a large Right Hand Side (RHS) value).

Table 1

Constraint Equation	Interconnector flow direction
NRM_NSW1_QLD1	New South Wales to Queensland
NRM_QLD1_NSW1	Queensland to New South Wales
NRM_NSW1_VIC1	New South Wales to Victoria
NRM_VIC1_NSW1	Victoria to New South Wales
NRM_SA1_VIC1	South Australia to Victoria
NRM_VIC1_SA1	Victoria to South Australia

These constraint equations have the form Left Hand Side (LHS) ≤ RHS where the directional interconnectors are the controllable variables on the LHS. The constraint violation penalty (CVP) factor for each of these equations is set to 2. AEMO's control room will block the relevant constraint equation and manually set the CVP when a different factor is required.

When the threshold is reached or exceeded the relevant NRM constraint equations will be automatically activated to manage the accumulated residue from the next dispatch interval to the end of the following trading interval. The management process is dependent on the amount, and sign, of estimated residue for the current trading interval and is defined as NRM_DI_AMT see *Figure 1* below. The diagram shows a typical example of different thresholds of NRM_DI_AMT (NR$) and the corresponding actions taken by a NRM constraint equation with the different steps sizes (MW).

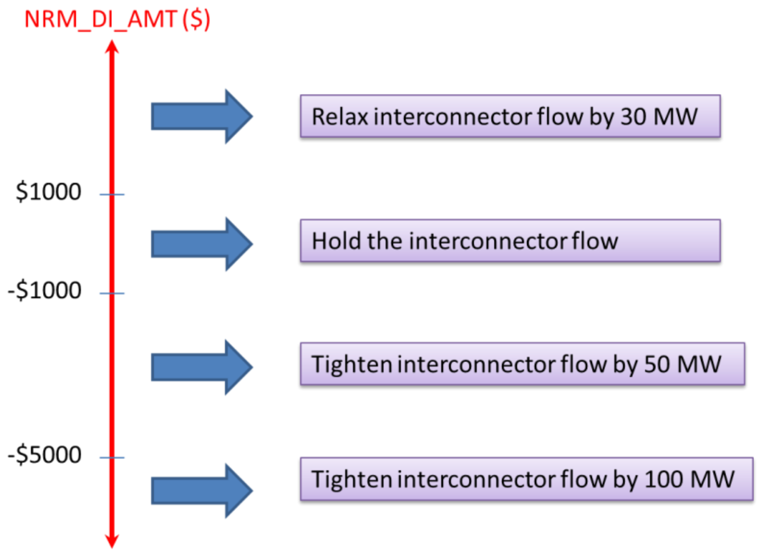

Figure 1

Depending on the negative value of NRM_DI_AMT the constraint equation will constrain the directional interconnector with either a more aggressive or a more conservative step. If the NRM_DI_AMT is positive, beyond a defined positive limit, the NRM constraint equation will relax the directional interconnector flow by another pre-defined step. These step adjustments are automatically carried out while ensuring that the directional flow does not reverse.

The current step sizes and thresholds for NRM_DI_AMT (NR$) for each directional interconnector are listed in Table 2 and will be continually reviewed on a half-yearly basis in order to improve the NRM process.

Table 2

NRM_DI_AMT (NR$) / Interconnector constraint	NR$ < -5000	-5000 <= NR$ < -1000	-1000 <= NR$ < 1000	NR$ >= 1000
NRM_NSW1_QLD1	-100 MW	-50 MW	0 MW	30 MW
NRM_QLD1_NSW1	-100 MW	-50 MW	0 MW	30 MW
NRM_NSW1_VIC1	-100 MW	-50 MW	0 MW	30 MW
NRM_VIC1_NSW1	-100 MW	-50 MW	0 MW	30 MW
NRM_VIC1_SA1	-50 MW	-30 MW	0 MW	30 MW
NRM_SA1_VIC1	-30 MW	-25 MW	0 MW	25 MW

The NRM constraint equation will continue to manage the accumulation of negative residue until one of the following conditions is met:

- For the last three dispatch intervals (DIs), the NRM constraint equation has not bound and non-negative NRM_DI_AMT were occurring.

- For the last three DIs, the NRM constraint equation has violated and non-negative NRM_DI_AMT were occurring.
- AEMO's control room manually intervenes in the process by blocking the NRM constraint equation.
- The management period has expired with none of the above conditions being met and no further negative NRM_DI_AMT exceeding -$1000 have occurred.

The NRM process automatically issues Market Notices whenever an NRM constraint equation is active to inform participants of the management process. This will be followed by another Market Notice when the NRM equation is no longer active to inform participants that the management process has ceased.