METHODOLOGY FOR THE ALLOCATION AND DISTRIBUTION OF SETTLEMENTS RESIDUE

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Version Control

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1	31 July 2003		Initial issue
2	22 July 2014	Linda Murdoch	Update to AEMO format. Also updated the treatment of negative inter-regional residues.

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1. Introduction and Concepts

1.1 Introduction

The Australian Energy Market Operator (AEMO) is required to allocate and distribute the total settlements residue in accordance with the principles set out in Clause 3.6.5(a) of the National Electricity Rules (NER).

The purpose of this paper is to describe the methodology to be implemented by AEMO to allocate and distribute the settlements residue in accordance with the principles set out in Clause 3.6.5(a) of the NER.

1.2 Inter-regional settlements residue and intra-regional settlements residue

For the purposes of allocating and distributing the settlements residue, AEMO regards the settlements residue as being comprised of:

(a) inter-regional settlements residue.

(b) intra-regional settlements residue.

Chapter 2 of this paper sets out the methodology to be applied by AEMO for calculating the:

(a) inter-regional settlements residue for each direction of flow for each notional interconnector.

(b) intra-regional settlements residue for each region.

Chapter 3 of this paper sets out the methodology to be applied by AEMO for allocating and distributing the:

(a) inter-regional settlements residue for each direction of flow for each notional interconnector.

(b) intra-regional settlements residue for each region.

1.3 Market network service providers

This methodology does not apply in respect of interconnectors which provide market network services.

1.4 Defined terms

Words used in this paper that are defined in the NER have the meaning given to them in the NER.

A reference to a “notional interconnector” is a reference to the regulated transmission assets, incorporating the assets comprising the regulated interconnector that form a connection between two regional reference nodes (RRNs).

A reference to a “directional interconnector” is a reference to a conceptual grouping of all notional interconnectors between two RRNs, with one directional interconnector for each direction of flow.

2. Calculation of Inter-regional Settlements Residue and Intra-regional Settlements Residue

2.1 Calculating the inter-regional settlements residue for each notional interconnector

The inter-regional settlements residue (IRSR) will be accrued for each direction of flow for each notional interconnector.

For each direction of flow for each notional interconnector the IRSR is the difference in value between the energy entering the interconnector in the exporting region and the value of the energy leaving the interconnector in the importing region, as determined at the regional reference nodes.

The following calculation will be carried out for each direction of flow for each notional interconnector for each trading interval:

EQUATION 1: CALCULATING IRSR

$$\boldsymbol{IRSR_i = RRP_{r2} \times IMP_{ir2} - RRP_{r1} \times EXP_{ir1}}$$

Where:

$IRSR_i$	=	IRSR for Notional Interconnector 'i' connecting Region 1 and Region 2.
RRP_{r2}, RRP_{r1}	=	Prices at the RRN for 'Region 2' and 'Region 1', respectively.
EXP_{ir1}	=	Export Flow into Notional Interconnector 'i' at RRN 1. The value is positive for flow from Region 1 to Region 2, or zero if the flow is in the other direction.
IMP_{ir2}	=	Import Flow out of Notional Interconnector 'i' at RRN 2. The value is positive for flow to Region 2 from Region 1, or zero if the flow is in the other direction.

The values of EXP_{ir1} and IMP_{ir2} will be determined in accordance with the procedure described in Chapter 2.3 below.

2.2 Calculating the intra-regional settlements residue for each region

The intra-regional settlements residue will be accrued for each region.

The approach to determining intra-regional settlements residue is based on a simple balance of settlement transactions within a region, but with the notional interconnector component excluded.

The following calculation will be carried out for each region for each trading interval:

EQUATION 2: CALCULATING INTRA-REGIONAL SETTLEMENTS RESIDUE

$$RR_r = \sum_l (ML_l \times RRP_r \times MLF_l) - \sum_g (ML_g \times RRP_r \times MLF_g) + \sum_i (NEXP_{ir} \times RRP_r)$$

Where:

RR_r	=	intra-regional settlements residue for region 'r'.
ML_l	=	metered load for market load 'l' in region 'r'. Where the market load is metered within a distribution system the value of ML_l is the metered value times the distribution loss factor.
ML_g	=	metered load for market generator 'g' in region 'r'.
MLF_l	=	marginal loss factor for load 'l' to the transmission connection point.
MLF_g	=	marginal loss factor for market generator 'g'. Where the market generator is embedded in a distribution network the loss factor is the product of the marginal transmission factor times the relevant distribution loss factor. Generally: MLF = 1 ± Δ for load and generator respectively.
RRP_r	=	regional reference price for region 'r'.
$NEXP_{ir}$	=	net export or import at region 'r' reference node through each notional interconnector 'i', using the sign convention that exports are positive. This value will be determined in accordance with the procedure described in Chapter 2.3 below.

The trading interval values of RR_r both positive and negative will then be summed over a billing period to give aggregate billing period values.

2.3 Determination of inter-regional transfer quantities IMP_{ir2}, EXP_{ir1} and Net Export $NEXP_{ir}$

AEMO will determine the import and export flows at the regional reference nodes in accordance with the following steps.

2.3.1 Meter Flow

The first step is to meter the flow F_i for each trading interval across the regulated interconnector at a defined point along the interconnector. This may require the summation at a number of metering points. A positive value means a flow from region 1 to region 2.

2.3.2 Determine inter-regional loss

The second step is to determine the inter-regional loss across the notional interconnector from the regional reference node of exporting region 1 to the regional reference node of importing region 2.

The values of inter-regional losses across the notional interconnectors are derived using average loss equations, obtained by integrating the marginal loss factor equations used for the purposes of dispatch. AEMO determines and separately publishes these marginal loss factor equations. They are represented within the dispatch algorithm as a number of linear segments.

The value of inter-regional loss for each trading interval will be determined as IRL_{12}. A positive value means export from region 1 is greater than import to region 2

2.3.3 Allocate inter-regional loss

The third step is to determine the allocation of inter-regional loss on either side of the regulated interconnector flow metering point. AEMO determines and separately publishes these allocations using the network and system conditions in a load flow analysis. These fixed allocations are:

Region 1 : Region 2

AF_1 : AF_2

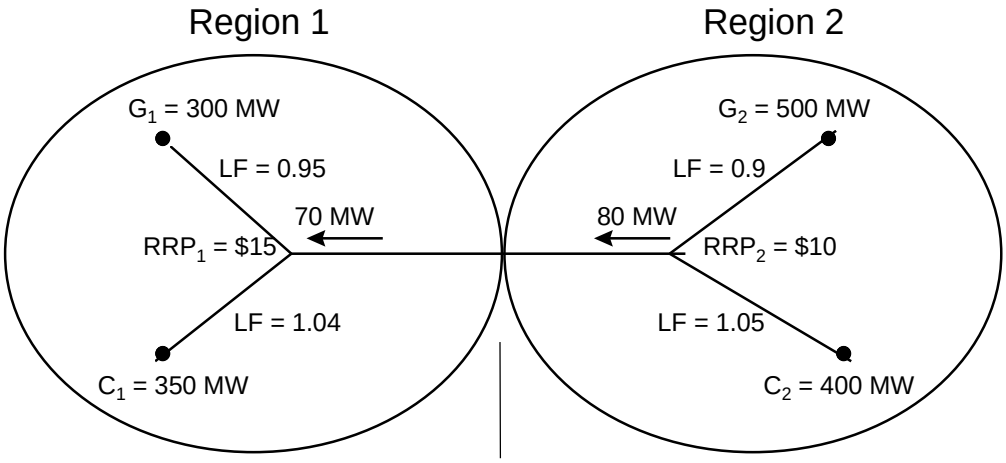
2.3.4 Transfer quantities

The final step is to determine the inter-regional transfer quantities for each trading interval as follows:

EQUATION 3: DETERMINATION OF IMPORT AND EXPORT FLOWS (CALCULATION)

EXP_{ir1}	=	$F_i + (AF_{i1} * IRL_{12})$ when flow is from Region 1 to Region 2 on Notional Interconnector 'i' *or*
	=	zero if the flow is in the other direction.
IMP_{ir2}	=	$F_i - (AF_{i2} * IRL_{12})$ when flow is to Region 2 from Region 1 on Notional Interconnector 'i' *or*
	=	zero if the flow is in the other direction.
Net Export $NEXP_{ir}$	=	$EXP_{ir1} - IMP_{ir2}$
Where:		
F_i	=	Flow across the Notional Interconnector 'i' as measured at the boundary
AF_{i1}, AF_{i2}	=	Apportionment Factors for losses between Regions 1 and 2 on Notional Interconnector 'i'
IRL_{12}	=	*inter-regional* Loss across the Notional Interconnector from RRN_1 to RRN_2

2.3.5 Simplified example of calculation of residue values



This example is for a period of 1 hour

G_1 paid: \$15 * 0.95 * 300 = \$4275

G_2 paid: \$10 * 0.9 * 500 = \$4500

C_1 paid: \$15 * 1.04 * 350 = \$5460

C_2 paid: \$10 * 1.05 * 400 = \$4200

Metered flow = 76MW towards region 1
Loss allocation 60% region 1, 40% region 2
Loss value region $_{21}$ = 10MW

Total Settlements Residue = Payments by customers - payment to generators

= (\$5460 + \$4200) - (\$4275 + \$4500)

= \$885

$EXP_2 = 76 + 0.4 \times 10 = 80MW$ $IMP_1 = 76 – 0.6 \times 10 = 70MW$

Inter-regional $Residue_{21}$ = (RRP_1 * Import) - (RRP_2 * Export)

= (\$15 * 70) - (\$10 * 80)

= \$250

Inter-regional $Residue_{12}$ = 0

Intra-regional Residue Region 1 = (Payment by C_1) - (Payment to G_1) - (Import value)

= (\$5460) - (\$4275) - (\$15 * 70)

= \$135

Intra-regional Residue Region 2 = (Payment by C2) - (Payment to G2) + (Export value)

= (\$4200) - (\$4500) + (\$10 * 80) = \$500

Check: Total Settlements Residues = Intra-regional Residue + Inter-regional Residue

= \$135 + \$500 +\$250 = \$885

Note: The loss factors used in this example are consistent with the description of intra-regional loss factors in NER Clause 3.6.2(b) and as such cannot be used to estimate energy losses in this example.

3. Allocation and Distribution of Settlements Residue

3.1 Inter-regional settlements residue

For the purposes of Clause 3.6.5 of the NER the settlements residue "attributable" to a regulated interconnector is, in respect of each direction of flow, the inter-regional settlements residue calculated in respect of the direction of flow for the corresponding notional interconnector in accordance with Chapters 2.1 and 2.3 above.

AEMO will allocate and distribute the settlements residue attributable to notional interconnector as follows.

First, AEMO will assign the inter-regional settlements residue attributable to a notional interconnector to a "directional interconnector" in the following manner:

(a) the inter-regional settlements residue attributable to a notional interconnector will be assigned to a directional interconnector representing the direction of flow on the regulated interconnector.

(b) where there is more than one notional interconnector between the same regions, the inter-regional settlements residue for each of those notional interconnectors will be aggregated to determine the inter-regional settlements residue for the directional interconnector based on the direction of net energy flow between those regions.

AEMO will then notionally allocate all of the inter-regional settlements residue calculated for a directional interconnector to the Transmission Network Service Provider (TNSP) responsible for the directional interconnector in the importing region.

The inter-regional settlements residue that is notionally allocated in accordance with the previous paragraph will then be distributed as follows:

(a) full effect is given to the jurisdictional derogations contained in Chapter 9 of the NER relating to settlements residues.

(b) the remaining inter-regional settlements residue will be distributed in accordance with the Auction process conducted under Clause 3.18 of the NER.

Where:

(a) inter-regional settlements residue is distributed pursuant to the Auction process conducted under Clause 3.18 of the Code; or

(b) inter-regional settlements residue is made available but is not distributed pursuant to the Auction process

the proceeds of the Auction process or the remaining inter-regional settlements residue will be distributed to the Transmission Network Service Providers to whom the inter-regional settlements residue was first notionally allocated as outlined above.

Negative Inter-regional Settlements Residue

If the inter-regional settlements residue for a directional interconnector for a trading interval is a negative amount, AEMO will recover that amount from the Transmission Network Service Providers to whom the inter-regional settlements residue was first notionally allocated as outlined above.

3.2 Intra-regional Settlements Residue

AEMO will notionally allocate the intra-regional settlements residue calculated for a region to the Transmission Network Service Providers in that region.

The intra-regional settlements residue notionally allocated in accordance with the previous paragraph will then be distributed as follows:

(a) full effect is given to the jurisdictional derogations contained in Chapter 9 of the NER relating to settlements residues; and

(b) the remaining intra-regional settlements residue will be distributed to the Transmission Network Service Providers responsible for a network or part of a network in the region.

If there is more than one Transmission Network Service Provider for a region, the intra-regional settlements residue will be, unless otherwise agreed between the relevant Transmission Network Service Providers:

(a) allocated between the Transmission Network Service Providers in proportion to the total network charges relating to their connection points in that region for the previous financial year; and

(b) distributed to those Transmission Network Service Providers accordingly.

Negative Intra-regional Settlements Residue

If the intra-regional settlements residue for a region for a trading interval is a negative amount, AEMO will recover that amount as follows:

(a) to the extent the intra-regional settlements residue would have been distributed giving full effect to jurisdictional derogations, by recovering that amount from the jurisdictional body to which the intra-regional settlements residue would have been distributed if it was a positive amount.

(b) to the extent the intra-regional settlements residue would have been distributed to the Transmission Network Service Providers responsible for a network or part of a network in the region, by recovering that amount from the Transmission Network Service Providers to which the intra-regional settlements residue would have been distributed if it was a positive amount.

3.3 Transmission Network Service Providers

In accordance with Clause 3.6.5(a)(6) of the NER, AEMO will:

(a) distribute settlements residue to Transmission Network Service Providers; and

(b) pay amounts to Transmission Network Service Providers under Clause 3.18 of the NER,

on the basis that the Transmission Network Service Providers must use the settlements residue or other amounts to offset network service charges.