Transmission Losses Calculation – Joint TO methodology

Background

1   Transmission Losses occur due to the physical properties of electricity transmission systems, principally resistance.

2   Two sources of losses occur in transmission systems. These are:

<u>Fixed losses</u>

These occur within the iron cores of transformers, cables and overhead lines whenever the circuit is energised. The magnitude of these losses is not dependent on the magnitude of the current being carried by the conductor but rather the magnetic field created by the applied voltage and the induced currents this creates within the iron core. As the voltage is more or less constant, these losses are also considered non-varying.

And

<u>Variable Losses</u>

These are the "classic" losses which vary with the current carried by the conductor. These losses occur in cables, overhead lines and transformers and are dependent on the degree of resistive heating experienced.

3   Losses in transmission systems are a function of the current carried by the conductors. The loss experienced in a conductor carrying alternating current is given by the equation I^2R, where I is the current and R is the resistance of that conductor. This resistance causes energy to be absorbed by the conductor which results in the conductor heating up in the same way as an electric bar heater or the element in a kettle. This energy is lost to the surroundings.

4   The resistance of an individual conductor is in turn a function of the materials used in its construction, how these are combined, and the length of the conductor.

5   Multiple transmission system components can be considered as a single route with its own characteristics. In this way the route that energy fed in to the north of Scotland takes to reach the demand centres in the south of England can be thought of as a very long conductor. As a longer length increases the overall resistance, and hence transmission losses, we can see that the location of generation infeed relative to demand will affect the level of transmission losses experienced.

Transmission System

Energy lost through resistive heating

**Energy used to drive system equipment**
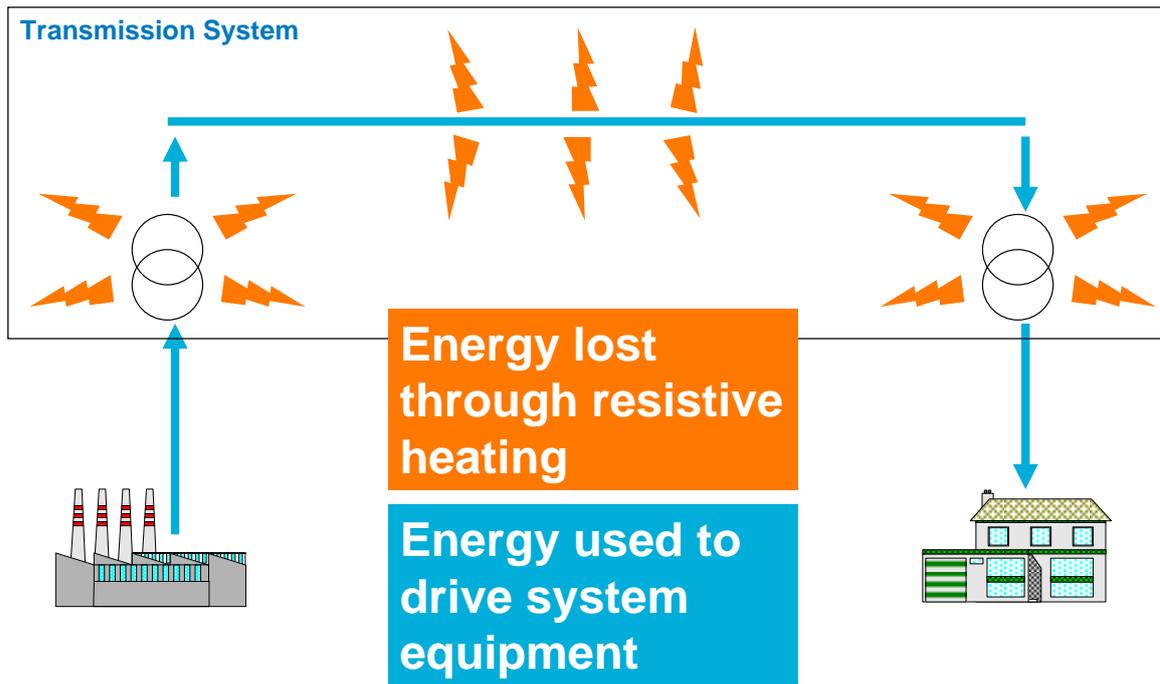
Calculation of GB Losses

6   Overall the losses arising from the GB transmission system can be calculated by taking the difference between the sum of infeed to and the sum of the offtakes from the transmission system.

7   This is carried out using data from the Elexon SAA-IO14 data feed. At a GB level the Total Generation (sum of positive metered active power) and Total Demand (sum of negative metered active power) values can be used.

Energy Added

Energy Removed

Transmission Losses
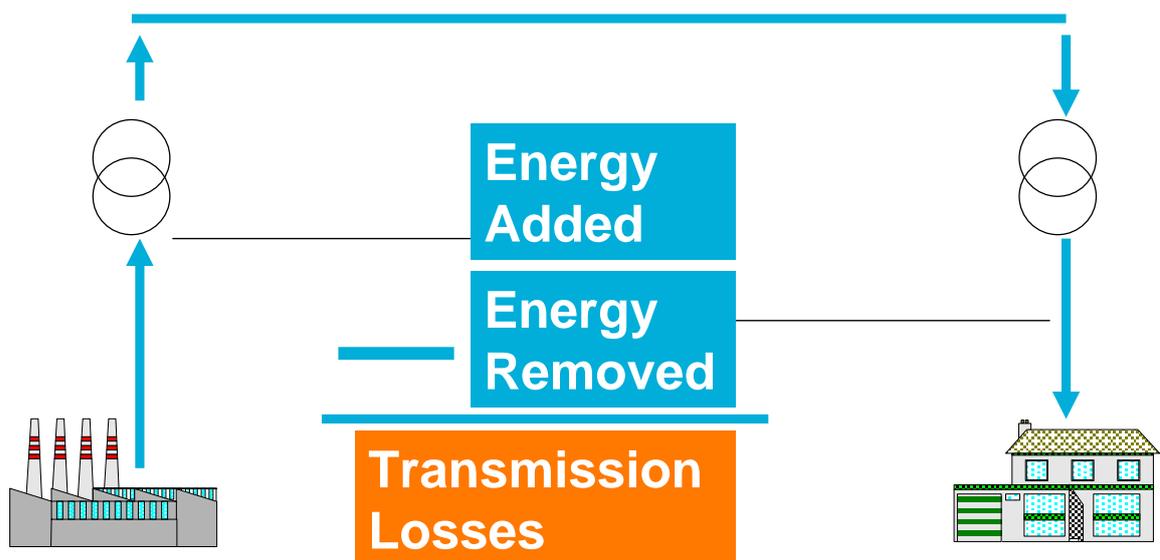
Calculation of Zonal Losses

8   In a similar way to GB wide losses the losses in each zone can be calculated from the sum of infeed and offtake in each zone from the Elexon active power metering data.

9   In order to calculate the zonal losses the flow of power from one zone to another also needs to be considered. For this calculation National Grid's own metering is used to record the transfer of power between the zones.

10 Further, all generation and demand must be assigned to one of the zones so that these can be added up for that zone.

11 The sum of all these elements then gives the losses in each zone and will be shared with the other Transmission Owners to use for actual transmission loss calculations.

12 For clarity the losses in

- the north of Scotland zone are the sum of Generation and Demand in this zone less the transfer to the south of Scotland zone

- The south of Scotland zone is the sum of generation and demand in this zone plus the transfer from the north of Scotland less the transfer to England

- The England & Wales zone is the sum of generation and demand in this zone plus the transfer from the south of Scotland.

EW Loss =G+D+Transfer

Boundaries shown are approximate
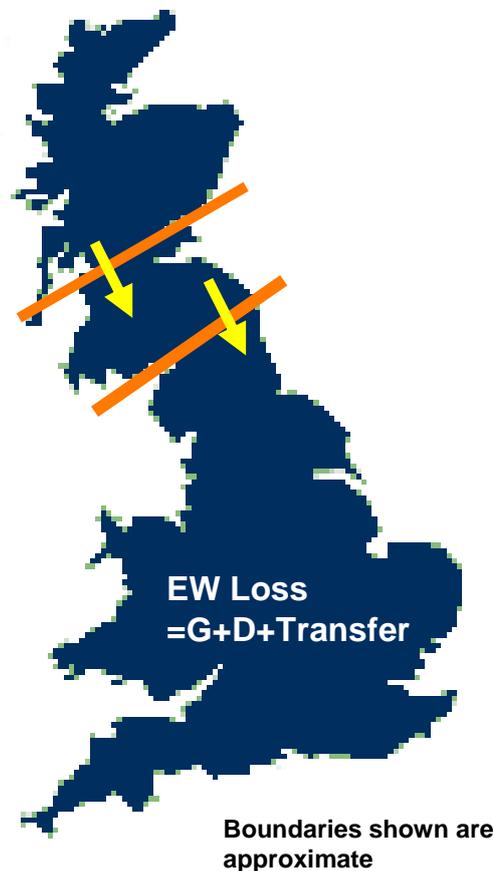
Data Validation and Audit

13 The majority of data used in the calculation is captured directly from the files from Elexon's SAA-IO14 data stream. This is the verified data sent out by Elexon to industry participants detailing the results of the settlement calculations. As this is generated by Elexon, and contains information about settlements, it is subject to revision between the initial files and the end of the settlement process to correct any issues. These revisions are all captured and the calculations performed for Transmission Losses updated.

14 The process by which data is loaded into the database which stores this information is closely monitored with both automated and manual checks performed daily to ensure that the data is loaded correctly.

15 A regular process is carried out within National Grid to ensure that all settlement BMUs are allocated to one of the three zones and any which are unmapped are updated to reflect their connection.

16 The transfer information between zones is captured from the operational control systems and as such the metering for these is subject to the same rigour as other operational systems within National Grid in that the metering is audited regularly and errors reported to be fixed.

17 Finally the results of the zonal calculation are compared to the results of the GB wide calculation to ensure these remain in line. This ensures that any discrepancies are flagged, investigated and resolved.

18 In all cases the zonal transmission losses calculation is updated to reflect any corrections needed and the latest Elexon data. A history table of results is also maintained when this occurs providing an audit path for changes.