National Grid Electricity Plc
Special Condition 2K.4 – Transmission Losses Report
Reporting Period 1 April 2015 to 31 March 2016

Introduction

National Grid Electricity Transmission (NGET) has a licence obligation that, "On or before 31 October 2014 and for each subsequent year, unless the Authority directs otherwise, the licensee must publish an annual Transmission Losses report for the previous Relevant Year prepared in accordance with the provisions of this condition to be published on, and be readily accessible from its website, and to include in reasonable detail:
(a) the level of Transmission Losses from the licensee's Transmission System, measured as the difference between the units of electricity metered on entry to the licensee's Transmission System and the units of electricity metered on leaving that system;
(b) a progress report on the implementation of the licensee's strategy under paragraph 2K.2, including the licensee's estimate of the contribution to minimise Transmission Losses on the licensee's Transmission System that has occurred as a result; and
(c) any changes or revisions the licensee has made to the strategy in accordance with paragraph 2K.2 of this condition.
There is also the requirement, as part of SC2K.5 to include "a description of any calculations the licensee has used to estimate Transmission Losses on the licensee's Transmissions System."

2K.4 (a) Transmission Losses for this reporting period

Transmission Losses have been calculated for the 2015/16 financial year for the GB system as a whole and for each separate licencee system. The calculation is based on the latest applicable settlement metering currently available for generation, demand and French / Moyle Interconnector BMUs, together with operational metering for the boundaries between the Scottish Hydro Electric and Scottish Power systems and the Scottish Power and England and Wales systems.

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

Table 1 shows last year's losses and the Table 2 shows historical losses for comparison purposes in order to see changes based on the losses strategy and changes to load and non-load related activities.

Table 1 – 2015/16 losses from the UK transmission system

Period – 1 Apr 2015 to 31 Mar 2016		
TRANSMISSION SYSTEM	Loss (TWh)	Loss %
England and Wales (NGET)	4.61	1.17
South Scotland (SPTL)	0.40	1.13
North Scotland (SHETL)	0.28	3.26
TOTAL NETWORK LOSSES	5.28	1.77

Table 2. Historical losses from the UK Transmission System

Losses (TWh)	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**
E/W	5.15	4.92	5.36	4.22	5.23	4.93	4.45	4.60	4.61
South Scotland	0.74	0.67	0.49	0.53	0.55	0.44	0.49	0.42	0.39
North Scotland	0.29	0.37	0.29	0.24	0.36	0.27	0.38	0.35	0.28
GB	**6.18**	**5.96**	**6.14**	**4.99**	**6.14**	**5.64**	**5.32**	**5.68**	**5.63**
Losses (%)	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**
E/W	1.62	1.59	1.77	1.40	1.80	1.67	1.57	1.65	1.7
South Scotland	2.17	1.81	1.46	1.54	1.47	1.30	1.29	1.17	1.13
North Scotland	2.38	2.86	2.59	2.55	3.04	3.05	3.55	8.04	7.34
GB	**1.75**	**1.73**	**1.82**	**1.49**	**1.92**	**1.72**	**1.70**	**1.84**	**1.89**

It is not possible to quantify the exact causes for the small increase in losses from 2014-15 to 2015-16 (1.65% to 1.7%). It can be seen from data from previous years that losses will vary from year to year due to various factors, the effect of which cannot be easily quantified. Transmission losses can be affected by various factors including the volume of electricity transmitted and the amount of resistive equipment electricity travels through from generation to load point. This is affected by the location of generation and the distribution of demand across the system causing varying levels of flow on the network throughout the year. Operational measures are also taken to manage system compliance and security which may affect transmission losses.

Operational measures which affect transmission losses could, amongst others, include the use of Quad Boosters and Series Reactors to divert power away from overloaded lines under particular circumstances or use of Voltage Control Circuits (switching out of certain circuits) to manage high Volts on the system. In 2015 – 16, National Grid experienced a further increased need to undertake operational measures to mitigate voltage increases on the system by using Voltage Control Circuits which can have the impact of increasing transmission losses.

Reactive compensation equipment (MSC, reactors, SVC) all have resistive losses associated. But because they will compensate for VAr travelling on the OHLs from far sources, they also have the effect of reducing losses by providing VAr locally. It is not certain whether the total effect will be positive or negative because this can vary depending on situations.

National Grid's approach for the management of transmission losses remains unchanged from that outlined in the December 2013 published strategy document (as required by Special Condition 2K paragraph 2 of the Transmission Licence) and the subsequent update in October 2014 (SpC 2K, paragraph 4).

In addition to ongoing network investment and to ensure effective and innovative future development of the network, National Grid is investigating new conductor types to install on the network which could provide benefits including increased capacity, reduced noise and reduced resistance. These conductors may be considered for use on the network in due course following R&D activities and Type Registration.

As more generation is connected at the periphery of the network, the losses are expected to increase. Load losses do not linearly change with circuit loading being proportional to the square of the current carried. A particularly heavily loaded circuit in one year contributing significantly to the total losses may be less loaded the next year and have a much smaller proportion of the total losses. Local reactive support for voltage management avoids the transmission of reactive power over distances that would otherwise increase system losses.

2K.4 (b) Progress on implementation of Transmission Losses Strategy for this reporting period

Information shown in this section is in the context of National Grid operating the full GB system but only owning and being responsible for the assets of the England and Wales transmission system.

National Grid's approach for the management of transmission losses remains unchanged from that outlined in the December 2013 published strategy document. Utilisation of National Grid's Whole Life Value framework assists the selection of economically justified investments based on a broad range of investment criteria, including consideration of transmission losses. Where the Whole Life Value framework identifies that the cost of transmission losses are material to the investment decision and that sufficient certainty of future year-round transmission flows make the analysis worthwhile, then further detailed transmission loss assessments will be undertaken that quantify year-round transmission losses.

National Grid has been considering transmission losses in equipment specifications and procurement processes in line with this strategy prior to its launch, so non-load related investments delivered can be attributed to this strategy.

Further like-for-like replacement schemes delivered in 2014/15 are reported via updates to section 5 of the strategy.

Transmission network developments that have passed or shall pass through the optioneering phase after National Grid's transmission losses strategy release in December 2013 present the greatest opportunity for the consideration of transmission losses to influence the chosen investment solution. All schemes where optioneering has taken place since December 2013 (load and non-load) have been assessed under National Grid's Whole Life Value framework. Of these investment decisions, optioneering has identified that losses could be material to the investment decision in some instances.

In alignment with the Whole Life Value assessment, transmission losses have been considered for different transmission solutions. Studies concluded that under peak system conditions, investment solutions that employed a new circuit would experience up to a 25% reduction in losses on local transmission circuits, justifying a clear losses benefit from investment for system peak conditions.

As a result of the 2015 Network Development Policy (the economic decision making process for undertaking load related investment on the Transmission Network) as published in the Network Option Assessement, the following schemes are being progressed by National Grid Transmission Owner which were identified as reducing losses on the system in the Transmission Strategy.

The reconductoring works completed between Harker, Hutton and Quernmore Tee have increased transfer capability across B7 boundary and also reduced transmission losses due to the less resistive conductor type used. The same is also true for the reconductoring works completed on the Trawsfynydd-Treuddyn circuit.

2K.4 (c) Proposed changes to Transmission Losses Strategy for future reporting periods

In this section the aim is to give an overview of the proposed changes or recommendations and the Strategy document itself will have the full details that list refers to. These are not changes to the overall strategy as that is unchanged, merely amendments to reflect the actual output from each year. These updates show the latest information available.

- An update of load related and non-load related investments will be provided in sections 4 and 5 of the Strategy assessing the impact on transmission losses of additional transmission developments (delivered and planned) since the Strategy's first publication in 2013 and last year's updates.
- Section 5 of the strategy outlines the treatment of non-load related investments that are deemed to have a material impact on transmission losses, namely; transformer, cable and overhead line replacement schemes. To assess the benefits in terms of indicative losses that replacement schemes can offer, this section will be modified to include all replacement schemes delivered in the year 2014/15
- For transformer replacements, section 5.1 will be updated to estimate losses for all like-for-like replacements in the previous Relevant Year, discounting replacements where transformer capacity has been increased or transformers are replaced for load-related investments. All transformers assessed under this methodology demonstrate a reduction in transformer losses as a result of each recent replacement scheme.
- Similarly, cable and overhead line sections of the strategy (5.2 and 5.3) will also be revised to account for further replacements for the 2014/15 year. No further cable replacement schemes were delivered for the previous Relevant Year, leaving the conclusion of cable assessments unchanged, i.e. they must be considered on a per replacement basis.
- We are continually refining our transmission losses assessment methodology for load related developments, and as a result the use of a modelling tool for assessment of losses will be replaced with a different system over the next two years.

2K.5 Calculations used to estimate Transmission Losses

The calculations outlined below show how we estimate the overall Transmission Losses, taking into consideration the collection of metered information detailing the power flow onto and off of the Electricity System

$$BoundaryLosses(TWh) = \frac{(\frac{ConstrainedFlow}{100})^2 \times kmWT \times R\%/km}{\frac{CCTWT}{CapWT}}$$

$$Annual\ MWh\ Losses = \frac{\left(\frac{(LoadLoss_{Old} - Load\ Loss_{New})}{\Delta} + (No\ LoadLoss_{Old} - No\ Load\ Loss_{New})\right) \times \frac{50}{52} \times 8760h}{1000}$$

$$\Delta = \frac{1}{(RMS\ average\ \ transformer\ loading)^2}$$

$$TotalLosses(TWh) = \left(\sum BoundaryLosses\ per boundary\right) + Load\ Related Losses + Fixed Losses$$