



**Scottish & Southern**  
Electricity Networks

# SHE Transmission

**Transmission Losses Report 2015/16**

**October 2016**



---

# Transmission Losses Report 2015/16

---

## 1. Summary

SHE Transmission has a licence obligation to publish an annual Transmission Losses report for the previous relevant year on or before 31 October in accordance with the requirements of Special Condition 2K.4 of our licence conditions.

The System Operator (SO), National Grid Electricity Transmission (NGET) determined that the transmission losses in SHE Transmission area in 2015/16 were 0.63TWh. This was a 6% reduction compared to 0.67TWh reported in 2014/15. Nevertheless, both the 2014/15 and 2015/16 figures were significantly higher than the annual average losses of 0.31TWh prior to 2014/15 which prompted an investigation to establish the root cause.

An investigation was carried out and it identified a metering error which had occurred in May 2014 at one of our bulk supply point (BSP) substations. It showed that Arbroath BSP recorded an export of energy instead of an import of energy in 2014/15 and 2015/16. SHE Transmission determined that after reversing the polarity of the Arbroath BGP figures, transmission losses reduced from 0.67TWh to 0.35TWh in 2014/15 and from 0.63TWh to 0.28TWh in 2015/16. For the avoidance of doubt, the reductions in 2014/15 and 2015/16 losses figures are initial estimates by SHE Transmission. The actual 2014/15 and 2015/16 losses figures will have to be re-calculated by the SO following the reconciliation of the Trading Dispute (DA797). SHE Transmission had asked the SO to re-calculate the losses figures but the results were not available at the time of publishing this report.

Most of the overhead line reinforcement projects that have been completed or will be completed within the next few years were planned before our losses strategy

was first published in December 2013. However, the impact of losses was considered when undertaking cost-benefit analysis for these reinforcement projects. The impact of losses is still a consideration when carrying out option assessment for the new system expansion and reinforcement projects currently under development. As we are implementing our RII0-T1 business plans, whole lifetime costs consideration through capitalized loss values for efficient and economic designs remain key to our investment decisions and procurement of transformers, materials and equipment.

Transmission losses are sensitive to changes in generation, demand and network topology. While we endeavour to minimise losses in our system through appropriate use of technology and upgrading parts of our system to operate at higher voltages and ratings, it is estimated that transmission losses will increase in our area. We will continue to monitor the level of losses in our transmission system and investigate any unusual losses figures.

## 2. Introduction

SHE Transmission has a licence obligation to publish an annual Transmission Losses report for the previous relevant year on or before 31 October in accordance with the requirements of Special Condition 2K.4 of our licence conditions. Special Condition 2K.4 requirements for the report include:

- 2K.4(a): The level of Transmission Losses measured as the difference between the units of electricity metered on entry to the transmission system and the units of electricity metered on leaving the system.
- 2K.4(b): Progress report on the implementation of Transmission Losses strategy and an estimate of the

# Transmission Losses Report 2015/16

contribution to minimise Transmission Losses that has occurred as a result.

- 2K.4(c): Any changes or revisions of the Transmission Losses Strategy
- 2K.5: Description of any calculations used to estimate Transmission Losses on the transmission system.

In line with our Transmission Losses Strategy, the System Operator (SO) is responsible for determining the actual transmission losses throughout the year in SHE Transmission area. The SO determines the difference between the units of electricity metered on entry to our system and the units of electricity metered on leaving the system in each reporting year. SHE Transmission carries out annual losses studies in compliance with Special Condition 2K.4.

This report presents SHE Transmission's update on transmission losses in the financial year 2015/16. Section 3 of this report presents the results of 2015/16 losses study. Section 4 presents the progress on the implementation of our losses strategy and section 5 highlights the proposed changes to our current losses strategy as published in October 2015. Section 6 shows the calculations we have used to estimate transmission losses for 2015/16 in SHE Transmission area.

## 3. 2015/16 Losses

The SO determined that the difference between the units of electricity metered on entry to SHE Transmission system and the units of electricity metered on leaving the system in 2015/16 was 0.63TWh. This was a 6% reduction in losses compared to 0.67TWh reported in 2014/15. Nevertheless, both the 2014/15 and 2015/16 figures were significantly higher than the annual average losses of 0.31TWh between 2007/08 and 2013/14 as shown in

figure 1 below. The significant increase in annual losses prompted an investigation to establish the root cause.

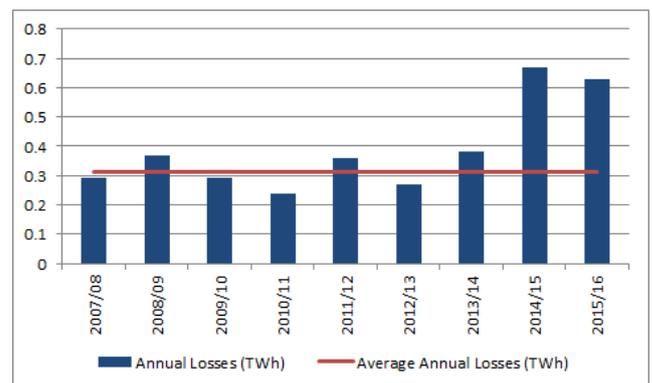


Figure 1: SHE Transmission Losses from 2007/08 to 2015/16 as reported by the SO

An investigation was carried out and it identified a metering error which had occurred in May 2014 at one of our bulk supply point (BSP) substations. It showed that Arbroath BSP recorded an export of energy instead of an import of energy in 2014/15 and 2015/16. The error was the subject of a Trading Dispute DA797. The investigation determined that after reversing the polarity of the Arbroath BGP figures, there was a 20% reduction in losses. Annual losses reduced from 0.67TWh to 0.35TWh in 2014/15 and from 0.63TWh to 0.28TWh in 2015/16 as shown in figure 2. For the avoidance of doubt, the reductions in 2014/15 and 2015/16 losses figures are initial estimates by SHE Transmission. The actual 2014/15 and 2015/16 losses figures will have to be re-calculated by the SO following the reconciliation of the Trading Dispute (DA797). SHE Transmission had asked the SO to re-calculate the losses figures but the results were not available at the time of publishing this report.

# Transmission Losses Report 2015/16

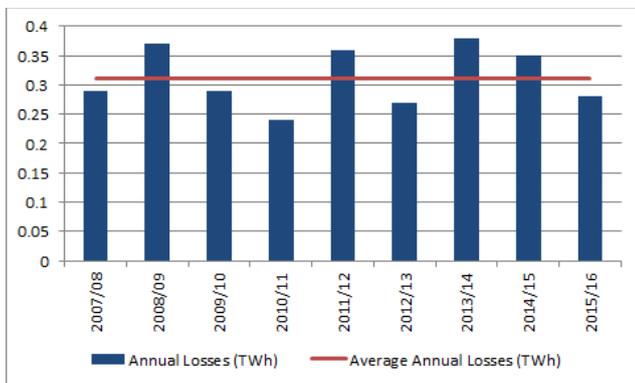


Figure 2: SHE Transmission Losses with estimated 2014/15 and 2015/16 losses

Sense-checks were carried out on the estimated losses figures using Multiple Load Levels methodology. The methodology estimated that losses in 2014/15 and 2015/16 were 0.31TWh and 0.27TWh respectively which correlate with the estimated losses figures obtained after resolving the Arbroath BSP metering error.

## 4. Strategy Implementation

While we endeavour to minimise losses in our system through appropriate use of technology and upgrading parts of our system to operate at higher voltages and ratings, it is estimated that transmission losses will increase in our area due to changes in generation, demand and network topology. We will continue to monitor the level of losses in our transmission system and investigate any unusual losses figures. Figure 3 below gives a forecast of the demand losses in SHE Transmission area at the time of system peak demand over the next five years.

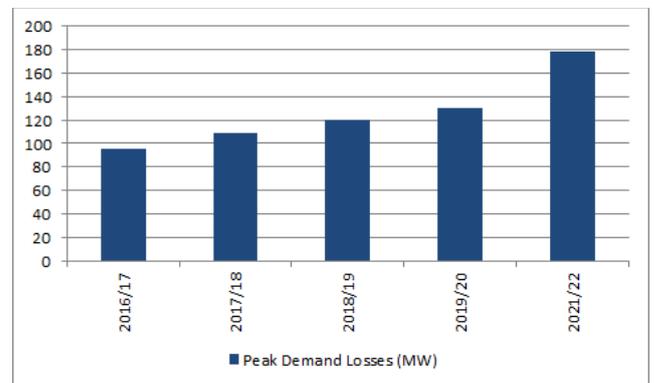


Figure 3: SHE Transmission Peak Demand Losses

## Load-related Reinforcement Projects

Most of the overhead line reinforcement projects that have been completed or will be completed within the next few years were planned before our losses strategy was first published in December 2013. However, the impact of losses was considered when undertaking cost-benefit analysis for these reinforcement projects. The impact of losses is still a consideration when carrying out option assessment for the new system expansion and reinforcement projects currently under development.

In 2015/16, there was the completion of transmission reinforcement works Beaulieu – Denny 400/275kV overhead line project and Crossaig – Hunterston 220kV subsea cable project. These projects increased the transfer capability across the system boundaries and the Beaulieu – Denny project upgraded the 132kV Beaulieu – Denny corridor to 400/275kV which may reduce current flows through the corridor. However, loss reduction may be achieved if pre-reinforcement levels of loading occur for most parts of the year which usually is not the case in our area with the significant increase in generation being

# Transmission Losses Report 2015/16

connected to the transmission system. Any significant increase in loading may offset the loss mitigation benefits from the voltage upgrades.

## Non-load Related Asset Replacement Projects

There was no replacement of transformers and overhead line conductors under non-load related asset replacement programme in 2015/16 and therefore their impact has not been considered in the current reporting year.

## Equipment Specification and Procurement

As we are implementing our RIIO-T1 business plans, whole lifetime costs consideration through capitalized loss values for efficient and economic designs remain key to our investment decisions, specifications and procurement of transformers, materials and equipment.

## 5. Changes to our Losses Strategy

We are proposing a revision to our Transmission Losses Strategy, as published in October 2015, to include a Multiple Load Levels methodology for estimating annual transmission energy losses. This methodology will provide sense-checks on the losses figures reported by the SO. In the event of discrepancies between the losses figures, we will engage with NGET to address them. For the avoidance of doubt, the sense-checks will be estimates by SHE Transmission. The actual losses figures remain the responsibility of the SO.

## 6. Losses Calculations

We carried out losses studies for 2015/16 using Multiple Load Levels methodology and regression analysis. The Multiple Load Levels methodology used quadratic loss equation and load frequency distribution with load levels

covering all the seasonal variations in the year. The quadratic loss equation was established from a load-loss relationship which was obtained from power flow analyses of 96 sample cases using Siemens PTI's Power System Simulation for Engineering (PSS/E) version 33 software and regression analysis of the PSS/E results using Microsoft Excel. The loss factor equation obtained is shown below: -

$$\text{Loss factor} = -0.0112 + 0.632L - 0.0098L^2$$

Where  $L$  is the load level in per unit of annual peak demand

Using the load frequency distribution for 2015/16 annual load data, the annual transmission losses in SHE Transmission area were estimated using the loss factor equation as shown in table 1 below. A sensitivity analysis has been carried out on the accuracy of the methodology in estimating transmission energy losses.

Table 1: Estimated Annual Losses for 2015/16

% of System Peak Demand	Load Level in per unit	Hours of Occurrence	Losses (TWh)
90-100	0.95	2	0.001
80-90	0.85	64	0.0038
70-80	0.75	661	0.0339
60-70	0.65	1292	0.0556
50-60	0.55	2677	0.0921
40-50	0.45	2521	0.0642
30-40	0.35	1397	0.0226
20-30	0.25	170	0.0011
10-20	0.15	0	0.0000
0-10	0.05	0	0.0000
<b>Total</b>		<b>8784</b>	<b>0.2736</b>



## Issue Revision (no 1.0 – October 2016)

Scottish and Southern Electricity Networks is a trading name of: Scottish and Southern Energy Power Distribution Limited Registered in Scotland No. SC213459; Scottish Hydro Electric Transmission plc Registered in Scotland No. SC213461; Scottish Hydro Electric Power Distribution plc Registered in Scotland No. SC213460; S+S Limited Registered in Scotland No. SC214382 (all having their Registered Offices at Inveralmond House 200 Dunkeld Road Perth PH1 3AQ); and Southern Electric Power Distribution plc Registered in England & Wales No. 04094290 having its Registered Office at 55 Vastern Road Reading Berkshire RG1 8BU which are members of the SSE Group

[www.ssen.co.uk](http://www.ssen.co.uk)