Scottish & Southern Electricity Networks

Scottish Hydro Electric Transmission

Transmission Losses Report 2017/18

October 2018

Transmission Losses Report 2017/18

1. Introduction

Scottish Hydro Electric Transmission plc (SHE Transmission) has a licence obligation to publish an annual transmission losses report for the previous financial year on or before 31 October in accordance with the Special Condition 2K of our licence conditions.

Special Condition 2K requirements for the report include:

- 2K.4(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
- 2K.4(b): A progress report on the implementation of the licensee's strategy, including the licensee's estimate of the contribution to minimise transmission losses on the licensee's transmission system that has occurred as a result
- 2K.4(c): Any changes or revisions the licensee has made to the strategy
- 2K.5: The strategy and the report must contain or be accompanied by a description of any calculations the licensee has used to estimate transmission losses on the licensee's transmission system.

The total transmission losses on SHE Transmission's network throughout the year are provided by National Grid Electricity System Operator (ESO). The ESO's calculation is carried out using data from the Elexon SAA-IO14 data feed, as laid out in the ESO's "Transmission Losses Calculation – Joint TO Methodology". For the avoidance of doubt, the ESO is responsible for the accuracy of the annual transmission losses figures.

For the reporting year 2017/18, the ESO has determined that SHE Transmission's transmission losses were 0.25TWh. This is a 7.4% drop compared to 0.27TWh in 2016/17.

Whist we endeavour to minimise the transmission losses on SHE Transmission's network through appropriate new technologies and reinforcements to operate at higher voltages and ratings, it is estimated that SHE Transmission's losses in the long term will increase due to the rapid growth of renewable generation connected in the North of Scotland. We will continue to monitor the level of losses on SHE Transmission's network and understand how our investments, including innovations, may reduce losses.

2. 2017/18 Transmission Losses

2.1 Losses Reported by the ESO

The ESO has determined that the difference between the units of electricity metered on entry to SHE Transmission's system and the units of electricity metered on leaving SHE Transmission's system in 2017/18 was 0.25TWh. This amounts to approximately 7.4% reduction in losses compared to 0.27TWh reported in 2016/17.

Transmission losses can be affected by several factors such as the volume of electricity transmitted, the number of circuits with various resistances, and the operational measures including circuit outages and settings of Quadrature Boosters and Static Var Compensators, etc., which is not under SHE Transmission's control in operational timescales. Figure 1 shows historical SHE

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Transmission's losses in the last 10 years reported by the ESO. The average annual losses are 0.30TWh. It can be seen that the losses vary from year to year. What is interesting in Figure 1 is the steady decline of transmission losses in the last four years, where our major projects such as Beauly-Denny 400kV overhead line and Crossaig-Hunterston 220kV subsea cables exerted a powerful effect. The increased volume of large embedded generators at grid supply points those years is another significant contributory factor to a decrease in transmission losses.

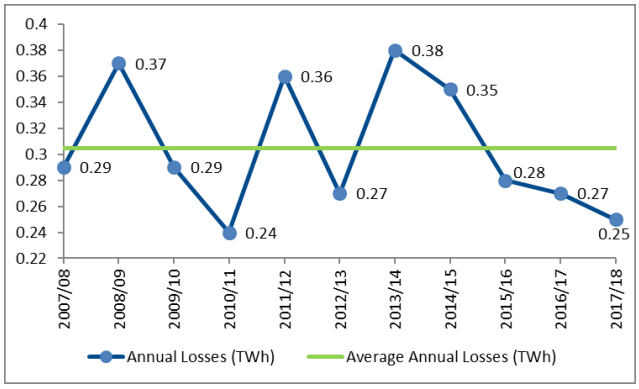


Figure 1. SHE Transmission's annual losses between 2007/08 and 2017/18 as reported by the ESO

2.2 Losses Estimated by SHE Transmission

In line with the losses estimation described in our Losses Strategy published in October 2016, sense-checks were carried out on the transmission losses figures reported by the ESO using regression analysis. A quadratic loss factor equation is derived to establish the relationship between loss and load level, as shown below:

$$\text{Loss factor} = -0.006484 + 0.03869L + 0.01235L^2$$

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

Using the system peak demand and the load duration curve in 2017/18, the annual transmission losses in SHE Transmission area were estimated as 0.2554TWh applying the above loss factor equation, as illustrated in Table 1. The estimated figure is comparable to the 0.25TWh losses figure reported by the ESO.

Table 1: Estimated Annual Losses for 2017/18

% of System Peak Demand	Load Level in per unit	Hours of Occurrence	Losses (TWh)
90-100	0.95	30	0.0019
80-90	0.85	462	0.0249
70-80	0.75	994	0.0447
60-70	0.65	1290	0.0471
50-60	0.55	2936	0.0832
40-50	0.45	1879	0.0386
30-40	0.35	1116	0.0147
20-30	0.25	51	0.0003
10-20	0.15	2	0.0000
0-10	0.05	0	0.0000
Total		**8760**	**0.2554**

3. Strategy Implementation

The transmission losses are taken into account when we carry out option assessment for the load/non-load related reinforcement as well as the equipment specification and procurement. We endeavour to minimise SHE Transmission's losses through the appropriate use of low losses technologies, e.g. Extra High Conductivity (EHC) AAAC, ACCC conductors, and HVDC, and upgrading parts of our network to operate at higher voltages and ratings. Meanwhile, we will continue to monitor the level of losses, investigate unusual loses figures, and understand how our investments help reduce losses.

Applying the Electricity Ten Year Statement study models, the 2017/18 transmission losses (MW) under the average cold spell winter peak demand scenario are 13% lower compared to 2016/17, noting that the losses are known to be sensitive to changes in generation, demand, and network topology, etc.

3.1 Load Related Reinforcement Projects

There were four major overhead line reinforcement projects completed in 2017. The Fort Augustus-Skye Tee reconfiguration was completed in May 2017. The new 9km 132kV circuit connected onto Fort Augustus's double busbar allowed the current to flow through a lower impedance route associated with lower losses. The Beauly-Loch Buidhe 275kV circuit reconductoring was completed in September 2017. The 65km 520mm^2 Beauly-Loch Buidhe overhead line was upgraded to larger 625mm^2 EHC TAAAC conductor. The Fort Augustus-Ceannacroc/Glenmoriston 132kV reconductoring were completed in January/March 2017, which enabled the current to flow through two dedicated larger size low resistivity ACCC Monte Carlo for Ceannacroc and Glenmoriston respectively.

The downside of reconductoring projects driven by generation connections need to be noted from the losses perspective. Although a larger diameter conductor leads to a smaller resistance and lower associated losses for the same level of current flow, the future increased utilisation of the line may still increase the losses (I^2R) overriding the effect of decreased resistance.

3.2 Non-load Related Asset Replacement Projects

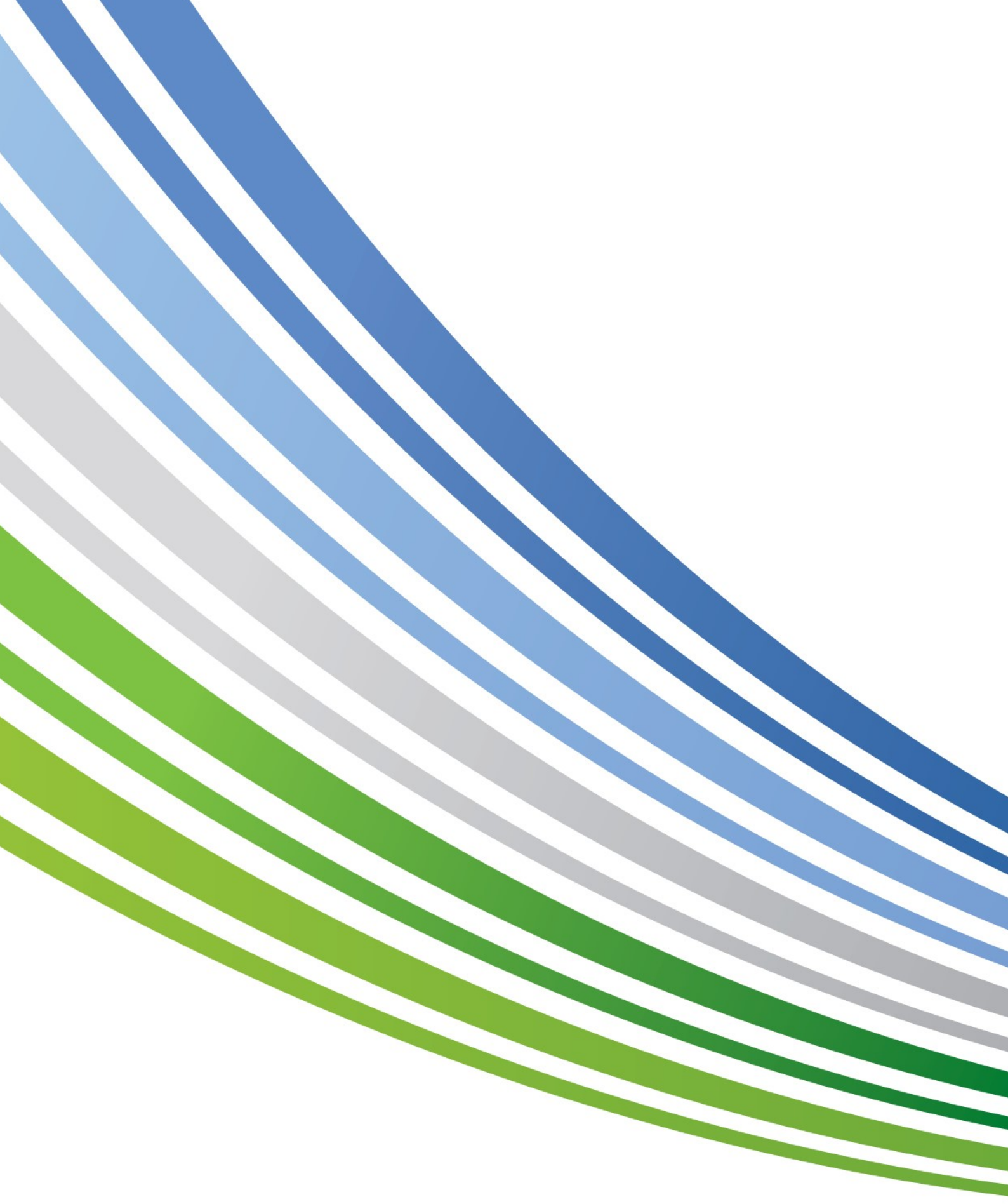
Under the condition-based asset replacement programme in 2017/18, 76km overhead line (Coupar Angus-Clunie) and 31km overhead line (Coupar Angus-Birkhill) have been reconductored with 300mm^2 EHC AAAC, which will yield lower losses compared to the old 175mm2 ACSR conductors. The completion of like-for-like super grid transformer replacement at Tealing, but with 9% lower impedance, will also contribute to the reduction of the losses.

3.3 Equipment Specification and Procurement

The whole life cost values together with losses capitalisation figures were considered for efficient and economic designs as part of our investment decisions, specifications, and procurement of transformers, conductors, materials and other equipment.

4. Changes to Transmission Losses Strategy

We are not proposing changes to the Transmission Losses Strategy Rev 3.0 published in October 2016.



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