

SSEN Transmission

Transmission Losses Report 2020/21

October 2021



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1. Introduction

Scottish Hydro Electric Transmission plc (SSEN Transmission) has a licence obligation to publish an annual transmission loss report every financial year in accordance with Special Condition 2K of our licence. This is the report for the 2020/21 financial year.

Special Condition 2K requires this report to 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 annual losses on our network are provided by National Grid Electricity System Operator (ESO). The ESO's

calculation uses 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.

We continuously monitor and estimate the losses on the transmission network, and endeavour to minimise the losses by implementing our [Transmission Losses Strategy Rev 3.0](#)¹ published in October 2016.

We estimate that losses on our network will increase in the long term due to the rapid growth of renewable generation in the North of Scotland and the long distance over which the renewable power requires to be transmitted. In the [RIIO-2 Draft Determinations - Electricity Transmission Annex](#)² 2.112, Ofgem pointed out, "... we do not think it is appropriate to emphasise loss minimisation in a Licence condition for the TOs ... We think that a Licence condition to minimise losses could give undue weight to reducing losses in network investment decisions over factors such as cost and system need, which are important considerations to ensure that any proposed investment is economic and efficient." SSEN Transmission share the same view and will continue to prioritise economic and efficient investment decisions based on the most relevant key factors as well as doing our best to mitigate the losses increase in the long term.

¹ <https://www.ssen.co.uk/WorkArea/DownloadAsset.aspx?id=12077>

² https://www.ofgem.gov.uk/sites/default/files/docs/2020/07/draft_determinations

Transmission Losses Report 2020/21

2. 2020/21 Transmission Losses

2.1 Losses Reported by the ESO

The ESO has determined that our losses in 2020/21 were 0.470TWh, which was equivalent to 2.68% of the total electricity transmitted. Figure 1 shows the variation in losses over the past 10 years, where there have been average annual losses of 0.32TWh.

Power losses are an inevitable consequence of generating, transmitting and distributing electricity to consumers. Transmission losses are mainly determined by the power dispatch set by the operation of the electricity market and the balancing actions taken by the ESO, and can be affected by several factors such as the volume of electricity transmitted, the number of circuits and their resistance, the electrical distance between generations and demand, as well as the use of operational measures such as circuit outages, quadrature boosters and static var compensators, which are mostly under the operational responsibility of the ESO and outside of our control, particularly in operational timescales.

Losses vary from year to year, however, there was a steady decline in transmission losses between 2013/14 and 2017/18. This period is when some major transmission upgrade projects, such as Beaulay-Denny 400kV overhead line and Crossaig-Hunterston 220kV subsea cables, have been commissioned and have had a strong impact in reducing losses, by providing additional high voltage paths across the network and to the rest of Great Britain. Increasing volumes of large generators on the distribution network during that period has also contributed to the decrease in transmission losses. These generators can supply local demand, which reduces load on the relatively high-loss 132kV circuits that connect the distribution

network to the transmission system at grid supply points (GSPs). However, as more generators connect to the distribution network, generation may exceed local demand, and the excess power is exported from the GSP onto the transmission network which would increase transmission loading and losses.

In 2020/21, 277MW of renewable generation was connected to our network, bringing the total amount of renewable generation connected to our network up to 6.7GW. The higher utilisation of transmission assets and continued increase in renewable generation development facilitated by the “Connect and Manage” regime have led to a reversal in the recent trend of declining losses. Annual losses have increased by 0.03TWh since 2019/20, while the total annual electricity generated on our network passed 20TWh in 2019/20 and showed a slight fall in 2020/21 to 18.09TWh.



Figure 1. SHE Transmission's annual losses between 2011/12 and 2020/21 as reported by the ESO

Transmission Losses Report 2020/21

2.2 Losses Estimated by SSEN Transmission

We have cross-checked the transmission losses reported by the ESO using regression analysis according to the methodology described in our [Losses Strategy](#)³ published in October 2016. A quadratic loss factor equation has been derived to establish the relationship between loss and load level, as shown below:

$$\text{Loss factor} = 0.064644 - 0.053948L + 0.022758L^2$$

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

Using the system peak demand and the load duration curve from 2020/21, and applying the above loss factor equation, the annual transmission losses on SHE Transmission's network were estimated to be 0.528TWh, shown in Table 1. The estimated figure is relatively close to the 0.470TWh losses figure reported by the ESO and we are satisfied of the credibility of the losses calculated by the ESO.

Table 1: Estimated Annual Losses for 2020/21

% of System Peak Demand	Load Level in per unit	Hours of Occurrence	Losses (TWh)
90-100	0.95	173	0.008
80-90	0.85	346	0.017
70-80	0.75	669	0.035
60-70	0.65	1216	0.067
50-60	0.55	2476	0.146
40-50	0.45	2408	0.153
30-40	0.35	1393	0.095
20-30	0.25	78	0.006
10-20	0.15	2	0.000
0-10	0.05	3	0.000
Total		8760	0.528

3. Strategy Implementation

We consider transmission losses when carrying out option assessments for load and/or non-load reinforcements as well as when specifying and procuring equipment. We endeavour to minimise losses on our network through the appropriate use of low-loss technologies, such as extra high conductivity AAAC and ACCC conductors, HVDC systems, or by upgrading parts of our network to operate at higher voltages and ratings. Meanwhile, we will continue to monitor the level of losses, investigate unusual losses figures, and consider losses when making investment decisions.

³<https://www.ssen.co.uk/WorkArea/DownloadAsset.aspx?id=12077> ©

Transmission Losses Report 2020/21

3.1 Load Related Reinforcement Projects

There were several major overhead line reinforcement projects completed in 2020/21.

Reconductoring of 86.5km of 275kV overhead line between Loch Buidhe and Dounreay has been carried out this year. The new line uses 625mm² AAAC cable to ensure reduced losses for the same loading level. The winter post-fault rating of these lines has been increased from 535MVA to 702MVA.

Approximately 47km of 275kV conductors and fittings between Blackhillock and Rothienorman were also replaced at the end of the 2020/21 period using 425mm² AAAC cable. As a result of this upgrade, the winter post-fault rating of these overhead lines has been increased from 1090MVA to 1360MVA.

On the 132kV Beauly to Keith line, a replacement of underground cable sections was carried out to facilitate a new capacity requirement for the circuit. In total 7.5km of cable was removed and replaced by 12.5km of new uprated cable. The uprated capacity is now 265MVA from Beauly to Balblair and 306MVA from Slackbuie to Keith. Related reconductoring works of approximately 61km from Beauly to Keith have also been completed, resulting in a winter post-fault rating increase from 126MVA to 241MVA.

It is important to note that the projects listed here use low-loss technology with the potential to reduce losses where network loading remains constant. Generally, however, a constant network loading is not the case when considering load related reinforcements, as these are intended to enable more power generation to connect and network loading will therefore increase. For example, a larger

diameter conductor or transformer with a lower resistance connecting to a GSP substation may have lower losses when supplying the GSP demand, however, the additional generation on the GSP could increase the average current flowing on the circuit and thus increase the absolute losses. Nevertheless, although this increase in current flow can result in a net increase in losses, the effect of the lower resistance equipment is to reduce the magnitude of the increase.

3.2 Non-load Related Asset Replacement Projects

In 2020/21 the VISTA Boat of Garten project was completed, with sections of 132kV double circuit overhead line around Boat of Garten and Nethy Bridge replaced with 12.7km of underground cable. The majority of the line replaced with underground cable resulted in a capacity increase from 132MVA to 227MVA (winter post-fault rating).

3.3 Equipment Specification and Procurement

The whole life cost including capitalised losses has been considered in our investment decisions to ensure efficient and economic designs for the specification and procurement of transformers, conductors, materials and other equipment.

Transmission Losses Report 2020/21

4. Changes to Transmission Losses Strategy

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

For RIIO-T2, we have published our [losses strategy](https://www.ssen-transmission.co.uk/media/3750/losses-strategy.pdf)⁴ to support our “Network for Net Zero” vision, which has been accepted without any amendment in Ofgem’s [draft determinations](https://www.ofgem.gov.uk/sites/default/files/docs/2020/07/draft_determinations)⁵ in Section 2.111 saying, “We are satisfied that if they implement their proposed losses strategies, the TOs will make a positive contribution to an efficient level of transmission losses, which we consider is in the interests of current and future consumers.”

⁴ <https://www.ssen-transmission.co.uk/media/3750/losses-strategy.pdf>

⁵ https://www.ofgem.gov.uk/sites/default/files/docs/2020/07/draft_determinations



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