INVESTIGATION INTO TRANSMISSION LOSSES ON UK ELECTRICITY TRANSMISSION SYSTEM

June 2008

PURPOSE AND SCOPE

This document is written in response to an open letter sent to National Grid by Ofgem on 1st April 2008 directing National Grid under paragraph 1 of standard condition B4 of NGET's transmission licence to produce a report on the rise in the level of transmission losses over 2006 – 2007.

This document describes the investigation performed, and details a new analytical model developed to represent transmission losses more accurately. It further describes the application of the model to historical data in order to investigate possible causes of the increase in losses between June 2006 and December 2007. It concludes that the losses can be explained by changes in the geographical distribution of generation that occurred over this period, in particular the unanticipated loss of significant generation in the South West of England.

In addition, this document provides an updated forecast for Transmission Losses for the financial year 2008/09.

1 INTRODUCTION

A small percentage of the energy transferred over the GB electricity transmission system is lost every year, due to physical processes such as resistive heating of transmission lines and magnetic and resistive losses in transformers. This loss is typically of the order of 2% of the energy transferred across the network. National Grid is incentivised to minimise losses as part of the Balancing Services Incentive Scheme.

Transmission losses rose continuously from the introduction of BETTA in April 05 until the start of 2008. The total loss for 2005/2006 was some 5.6 TWh (1.6%), rising to 6.1 TWh (1.8%) in 2006/2007. In the Autumn of 2007, extrapolation of the latest trend suggested that transmission losses in 2007/2008 would out-turn at 6.8 TWh, rising to 6.9 TWh for 2008/2009.

As a consequence of this unexplained rising trend, National Grid instigated a two pronged investigation into the losses, one project aimed at validation of the data and calculational methodology used to produce the transmission losses, and the other aimed at producing an analytical model that could better explain the trend of rising losses. These investigations are now complete.

Since instigating these investigations, the trend of transmission losses has reversed, and is currently declining. The out-turn losses for 2007/2008 were approximately 6.2 TWh against an initial forecast of 5.95 TWh.

The trend of losses from April 2005 to March 2008 may be seen by considering a graph of the total loss in a rolling 365 day period. This graph shows the total loss for the 365 days ending on the date on the y-axis. Thus, the first point on the graph is the total loss for the period from 01 April 2005 to 31 March 2006, and the second point shows the loss from 02 April 2005 to 01 April 2006 etc. This data is presented in Figure 1.

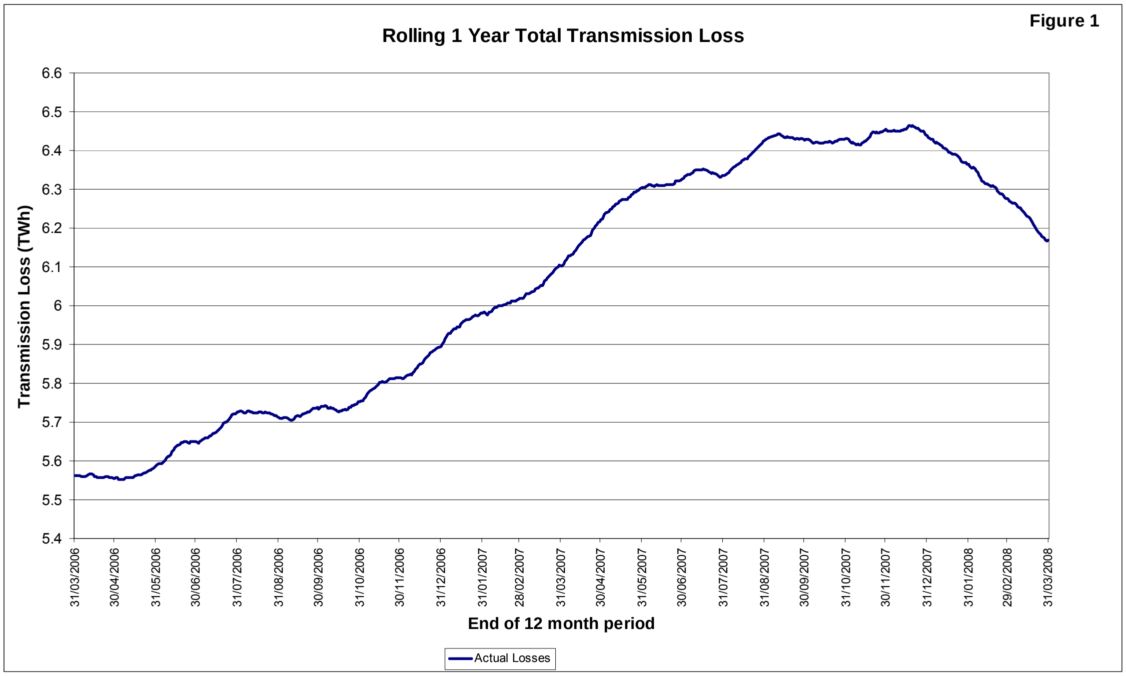

Figure 1 Rolling 365 Day Total Transmission Loss

Note that this graph is effectively an integral of the daily values. As such, a step change in losses would appear as a linear rise for a year – see Figure 2.

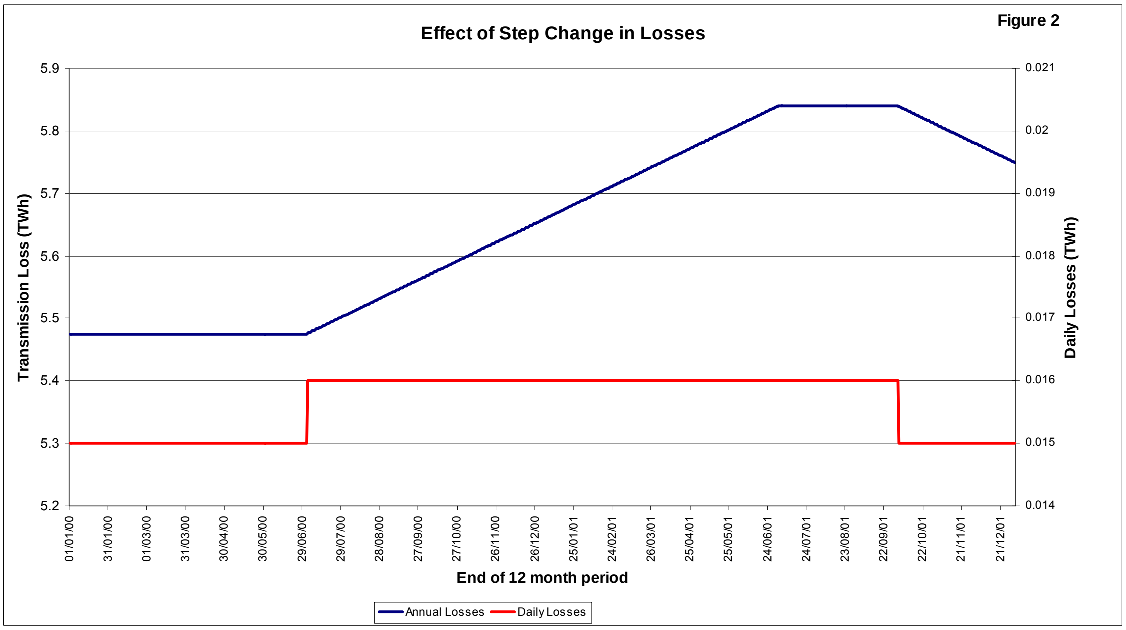

Figure 2 Effect of Step Change in Losses

2 DATA VALIDATION

An extensive data validation exercise was undertaken to identify any metering or calculational error that may have explained the increase in reported transmission losses.

National Grid's operational metering was compared with the Elexon Settlement data which is used to calculate transmission losses. Both generation and demand data was split into their individual components (BMUs, interconnectors, pumping, industrial loads, station demands etc.) in order to try to identify any component showing a change in value that would lead to higher losses. Both weekly aggregated data and detailed snapshots of individual half hour periods were considered.

A few minor issues were identified, but nothing that would explain the observed increase in transmission losses.

Two and a half years worth of weekly aggregated data was analysed. Operational and Settlement generation figures were almost exactly in agreement. Settlement and operational demand figures are comparable for the final year data, and the difference is lower than the previous year.

Extensive discussions/ liaison meetings took place with ELEXON with a view to reconcile the data and get to a common understanding of the calculation methodology adopted. No discrepancies were identified.

The conclusion of this analysis is that there is no evidence of any data anomalies or calculational errors that would explain the increase in transmission losses.

As a result of this exercise, a regular monitoring and comparison process has been set up between National Grid and Elexon in order to provide ongoing assurance that there are no significant anomalies in the loss calculation and associated data that might distort the calculation.

3 MODELLING AND FORECASTING OF TRANSMISSION LOSSES

Historically, National Grid has used a linear model to forecast losses. Generation and demand are divided into a series of zones, and generation scenarios are used to calculate zonal transfers and thus transmission losses. This method has been robust for many years and accurately forecast transmission losses. However, this model has failed to forecast the variation in transmission losses seen in the last two years.

In view of the failure of the existing model to accurately predict the current trends, an alternative method was used to determine transmission losses, and within year revisions to the forecast transmission losses for 2008/09 were based on extrapolation of the settlement data.

In September the forecast BSIS out-turn for transmission losses equated to an out-turn loss of 6.85 TWh. This was obtained from extrapolation of the available data at the time of the forecast, as shown in Figure 3.

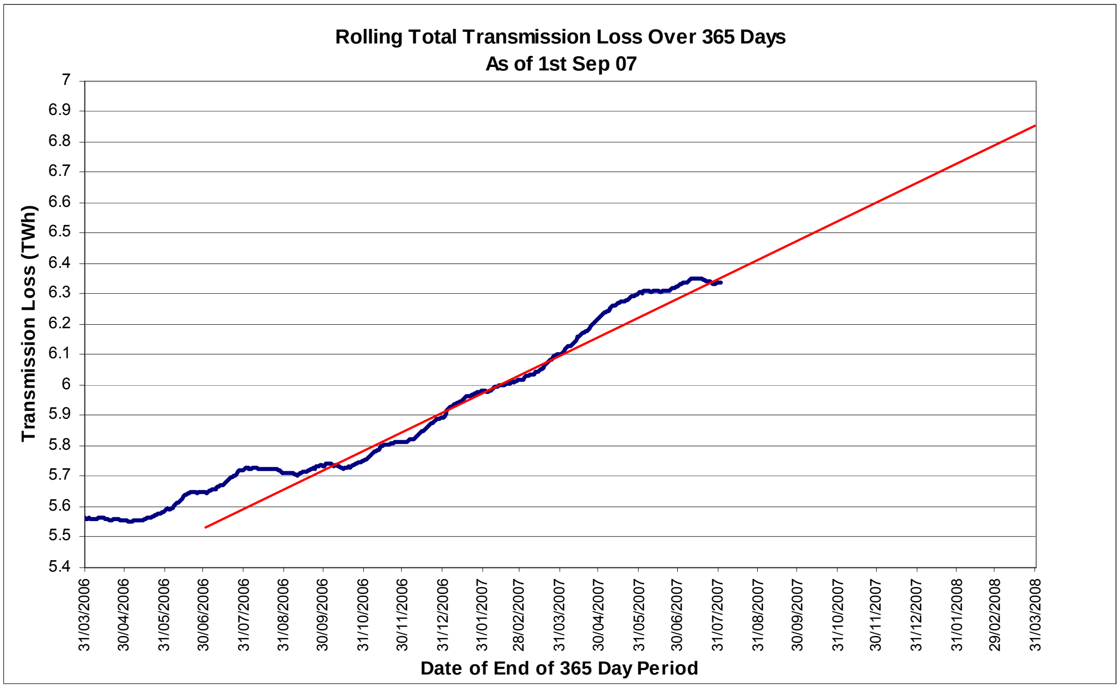

Figure 3 Rolling Total Transmission Loss Over 365 Days as of 1st September 2007

In January 2008, a revised forecast of 6.75 TWh was made based on the latest data. This is presented in Figure 4.

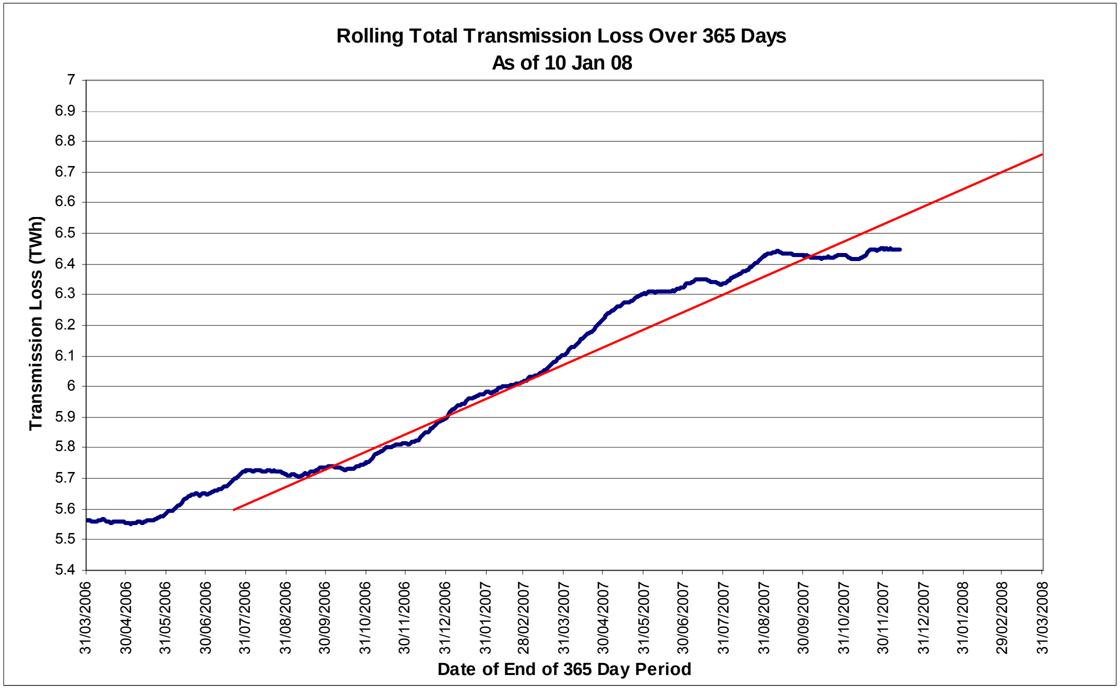

Figure 4 Rolling Total Transmission Loss Over 365 Days as of 10th January 2008

By the end of January, evidence of a plateau in the data meant that a linear extrapolation of the data was no longer considered appropriate, and so a quadratic representation was used. This gave a forecast out-turn of 6.5 TWh, as illustrated in Figure 5.

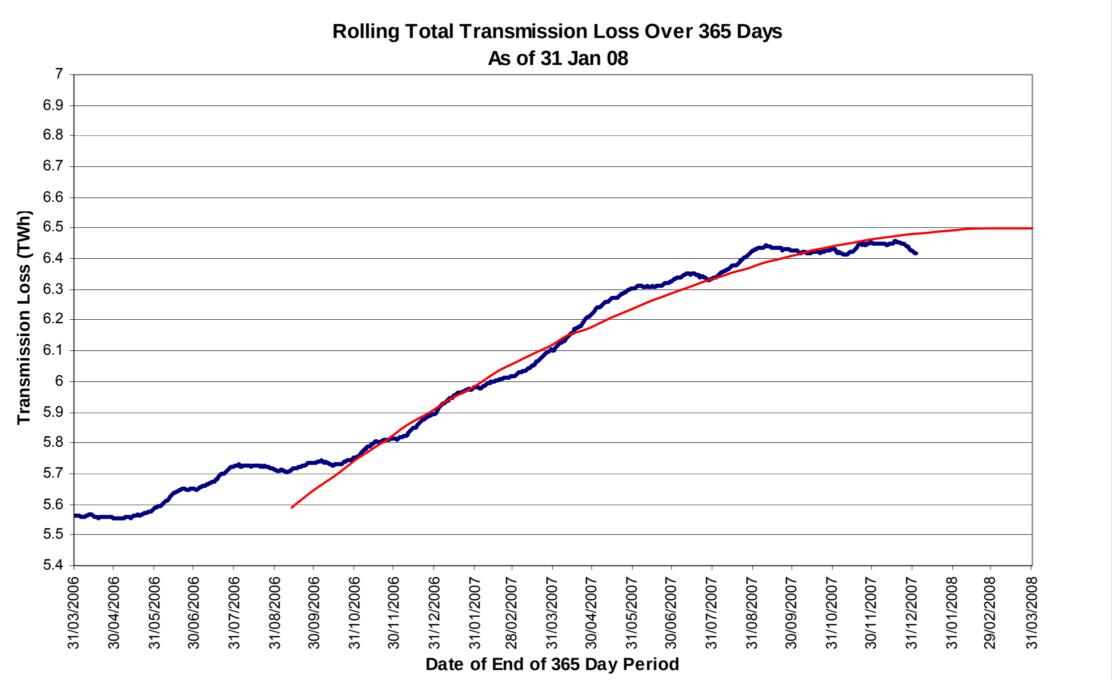

Figure 5 Rolling Total Transmission Loss Over 365 Days as of 31st January 2008

The final outturn for the year, as shown in Figure 1, was 6.18 TWh.

4 NEW MODEL DEVELOPMENT

Work was initiated in January 2008 to develop a new model to explain transmission losses.

Transmission losses were calculated for every half hour since BETTA Go-Live, based on the difference in total settlement metered generation and grid supply point off-take at each node. These losses were correlated against the half hourly output from each individual generator over the same period.

From this analysis, the individual generators having the most impact on transmission losses were identified, being those with the highest correlation coefficients between the generator output and the transmission losses.

The generators having the most impact were found to be in geographic clusters. These clusters were used to define ten zones. These are:

1. North Scotland (SHETL area)
2. Southwest Scotland + Harker
3. Southeast Scotland
4. Northwest England + North Wales
5. Northeast England (Sheffield, Leeds and Newcastle)
6. Humberside
7. Midlands and East Anglia
8. South Wales and Southwest England
9. London and Thames Estuary
10. South and Southeast England

The zones are shown in Figure 6

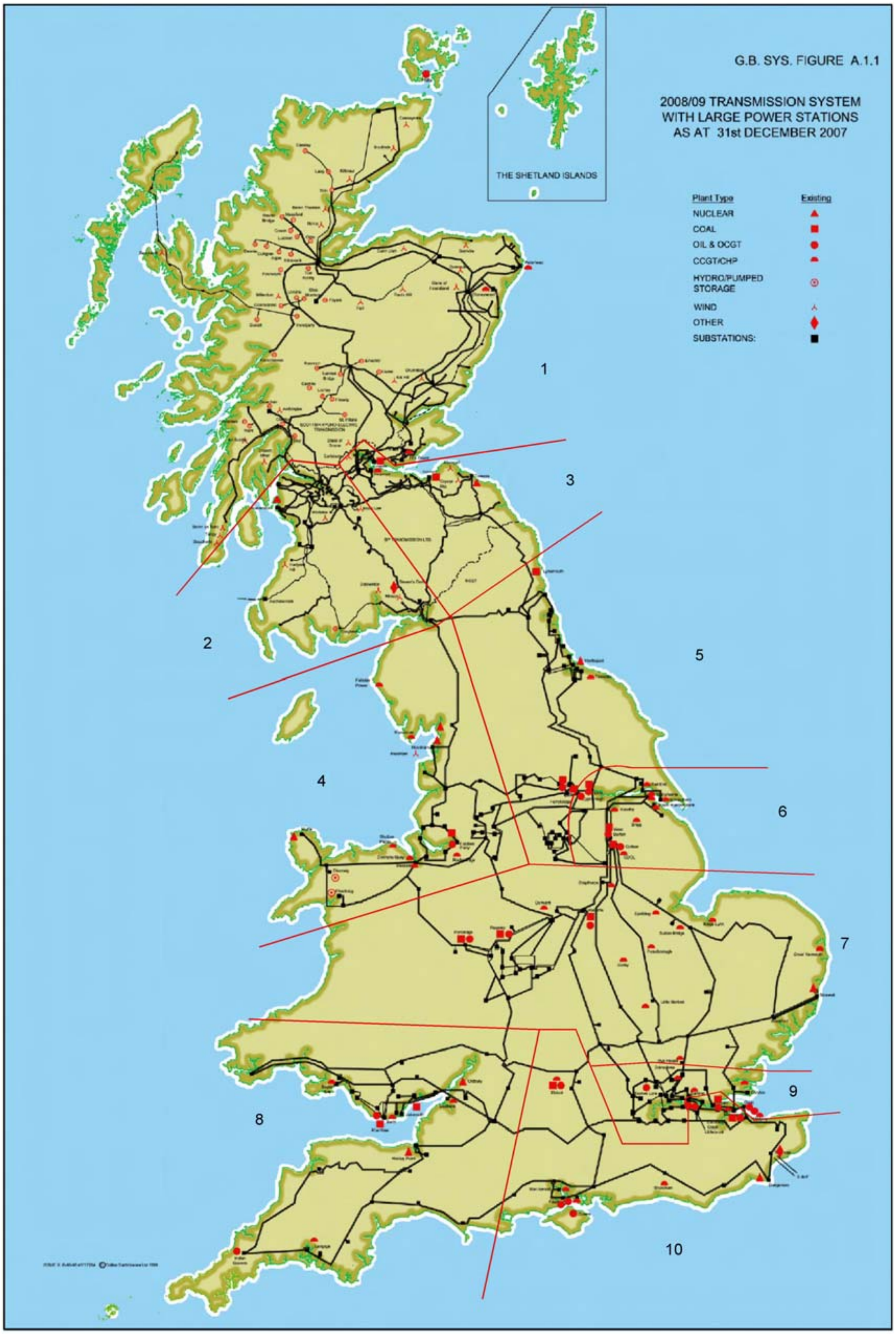

Figure 6 Geographic Zones Used in Analysis

Nodal off-take data was then used to calculate the off-take and generation in each zone in each half hour since Betta Go-Live.

Transmission Losses were then represented as a quadratic function of the difference between total generation and off-take in each zone for each half hour:

$$TL = \sum_{i=1}^{10} \left(a_i T_i^2 + b_i T_i \right) + c$$

where

TL = transmission loss (in MWh) for a particular half hour,
T_i = total generation in zone i – total off-take in zone i

5 DETAILS OF MODEL

Using the 21 coefficient, ten variable model described above, a correlation coefficient of 0.9316 was obtained against the actual data. It was found that zones could be combined with no significant impact on the correlation coefficient for the model. An eleven coefficient, five variable model was developed which gave a correlation coefficient of 0.9180. Linear models were also considered, with an eleven coefficient, ten variable linear model giving a correlation coefficient of 0.8904, and a six coefficient, five variable linear model giving a correlation coefficient of 0.8820.

The eleven coefficient, five variable quadratic model is judged to give the best compromise between model accuracy and number of coefficients.

The model is:

$$\begin{aligned} TL = \; & 195.4 \\ & + 0.0000210120 \; T_{1,3}^2 && + 0.014044 \; T_{1,3} \\ & + 0.000006484457 \; T_{2,4}^2 && + 0.012549 \; T_{2,4} \\ & + 0.000000565834 \; T_{5,7}^2 && + 0.010096 \; T_{5,7} \\ & + 0.00000430689 \; T_6^2 && + 0.002219 \; T_6 \\ & + 0.00000407911 \; T_{8,9,10}^2 && + 0.006105 \; T_{8,9,10} \\ & + \varepsilon \end{aligned}$$

Where

TL = the transmission loss (in MWh) for a particular half-hour.
$T_{1,3}$ = total generation in zone 1 + total generation in zone 3 – total offtake in zone 1 – total offtake in zone 3.
(all values in MWh)
$T_{2,4}$, $T_{5,7}$, T_6 and $T_{8,9,10}$ are defined similarly.
ε = the model error.

This model has a standard error per settlement period of 31 MWh, and a daily standard error of 1.3 GWh, compared with an average daily transmission loss of 16.3 GWh.

This model was obtained by training the data over two years, and using the model to predict the third year's losses. Using this technique provides confidence in the predictive capability of the model. The validity of the model can be qualitatively judged by comparing the losses forecast by the model with the actual losses. This is done in Figure 7.

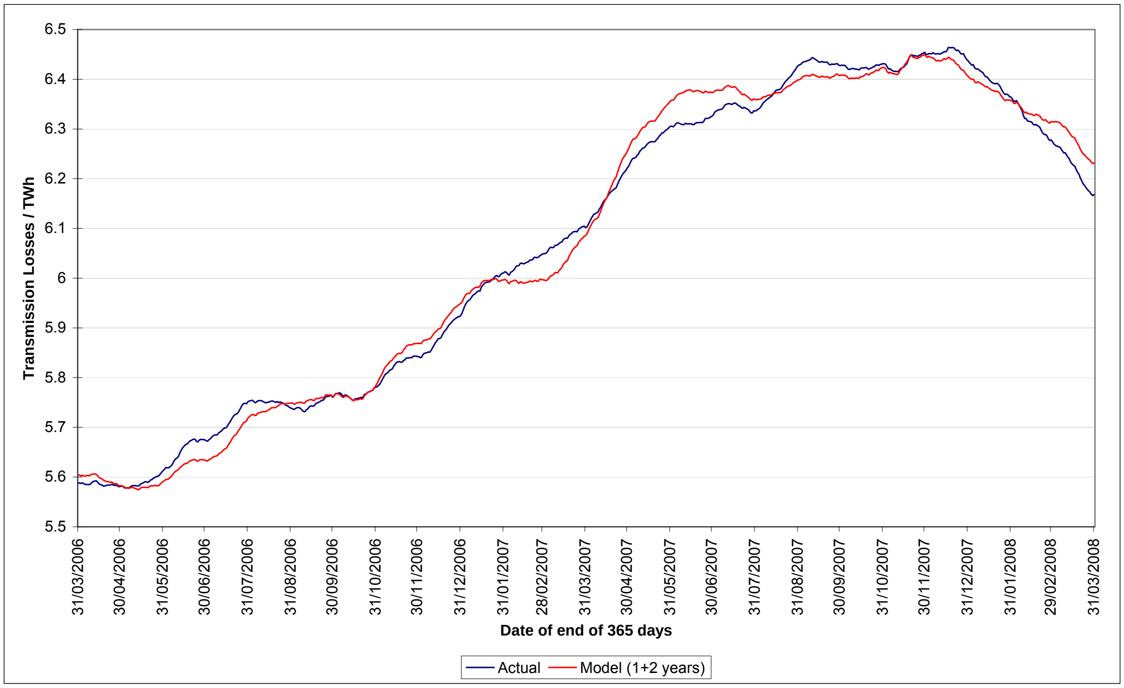

Figure 7 Comparison of Model with Actual Losses

Figure 7 shows the comparison of rolling 365 day totals for actual losses and model forecast, based on three year's of data, from April 2005 to March 2008 to give a rolling 365 day figure for the period April 2006 to March 2008. As can be seen, the model tracks the trend in actual losses closely, with some periods of variation, such as February and June 2007 where the model initially under-forecasts and then over-forecasts losses. Further refinements of coefficients did not remove these variations between actual and modelled losses, which would suggest that these perturbations are caused by effects not represented in the model. These include:

- Intra-zonal generation changes influencing within-zone losses;
- Outages of transmission systems equipment, for example an outage of a transmission line for maintenance will normally increase flows on other circuits, slightly increasing losses.

The stability of the model coefficients with time was tested by training the model over other sub-periods of the data and confirming that the coefficients do not change significantly. This is illustrated in Figure 8 which presents the model obtained by training the data purely on the first year of data.

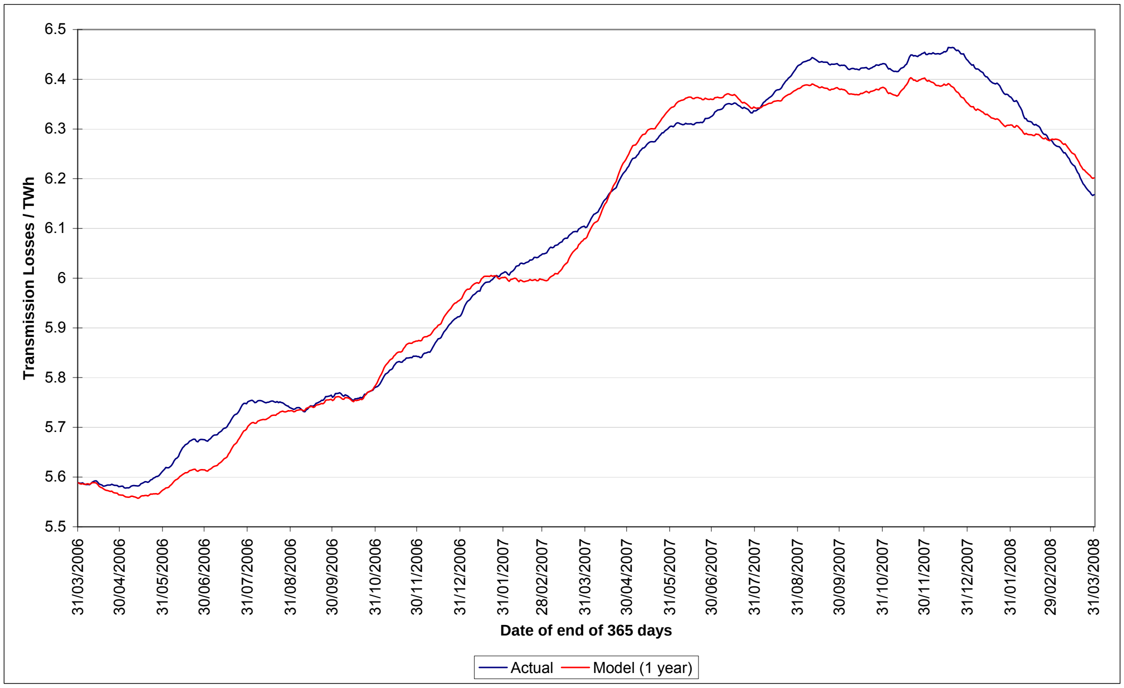

Figure 8 Comparison of Model Derived from Single Year of Data with Actual Losses

6 DISCUSSION

6.1 Effect of Daily Variation

The possibility of using different constants for each period of the day was also considered. Figure 9 shows the variation of total losses in the year by settlement period. As might be expected, this variation follows a typical demand curve.

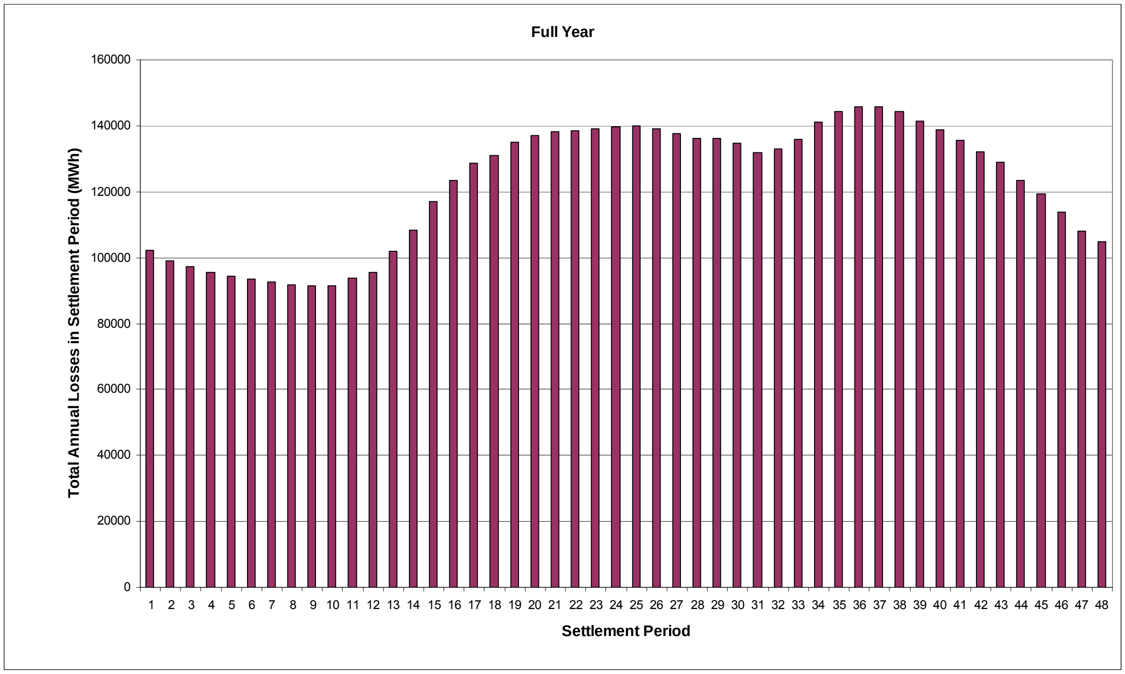

Figure 9 Breakdown of Annual Transmission Losses by Settlement Period

Similarly, further breaking the losses down into total losses month by month by Settlement Period we again see each monthly profile following a typical demand curve for that month, as illustrated in Figure 10.

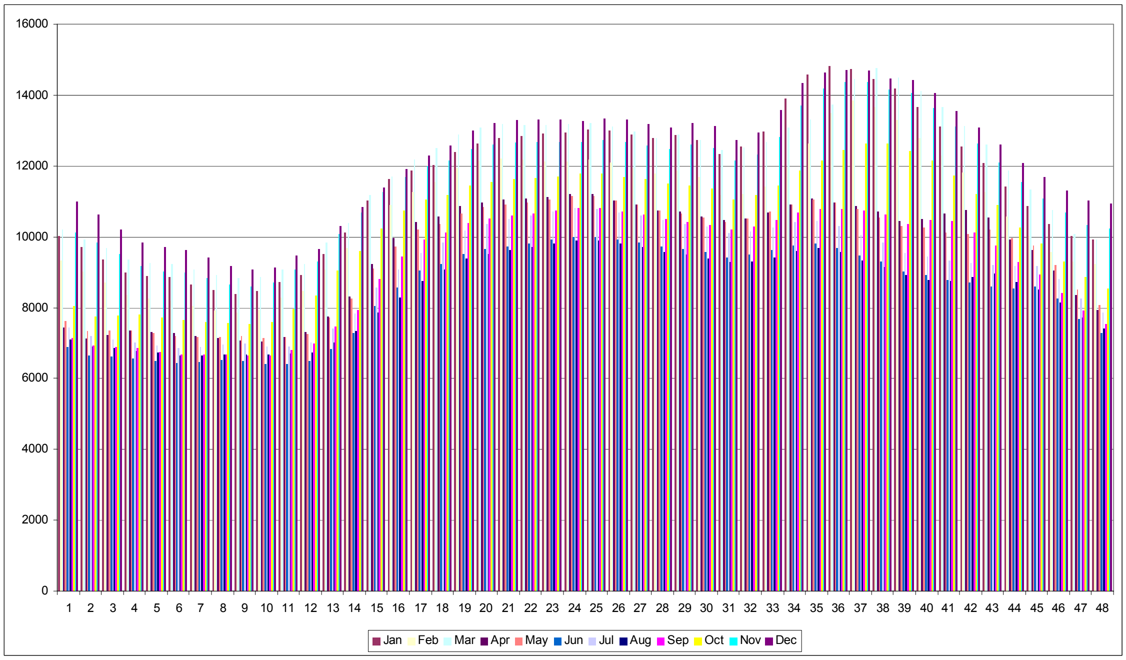

Figure 10 Monthly Total Transmission Losses by Settlement Period

Power dissipated by a resistive load in an electrical circuit may be represented by product of the current and the voltage. To first order, the transmission system voltages are constant, and so the resistive transmission losses will be approximately proportional to the current in the circuit, which itself will be approximately proportional to demand on the system. If these results held perfectly then the ratio of transmission losses to total system generation or demand would be constant.

Looking at the error between model and actual losses, the bias per period was found to be less than 8 MWh per period, compared with a standard error of the model of about 25 MWh per period. Given that the daily variation of transmission losses, as discussed above, exhibits no abnormal behaviour, there seems no value in using different constants per period.

6.2 Dominant Terms in Model

Variations in transmission losses are predominantly driven by variations in the disposition and level of generation and demand, although longer term trends in transmission loss are also influenced by investment and replacement of transmission system equipment. It is possible to explore whether the variation in losses seen between 2006 and 2008 are predominantly caused by changes in generation or demand.

A single year profile for both generation and off-take (i.e. an average of the three years of data) has been calculated. This data is fed into the model to give a line of real generation with average off-take, and a line of average generation with real off-take. This data is presented in Figure 11.

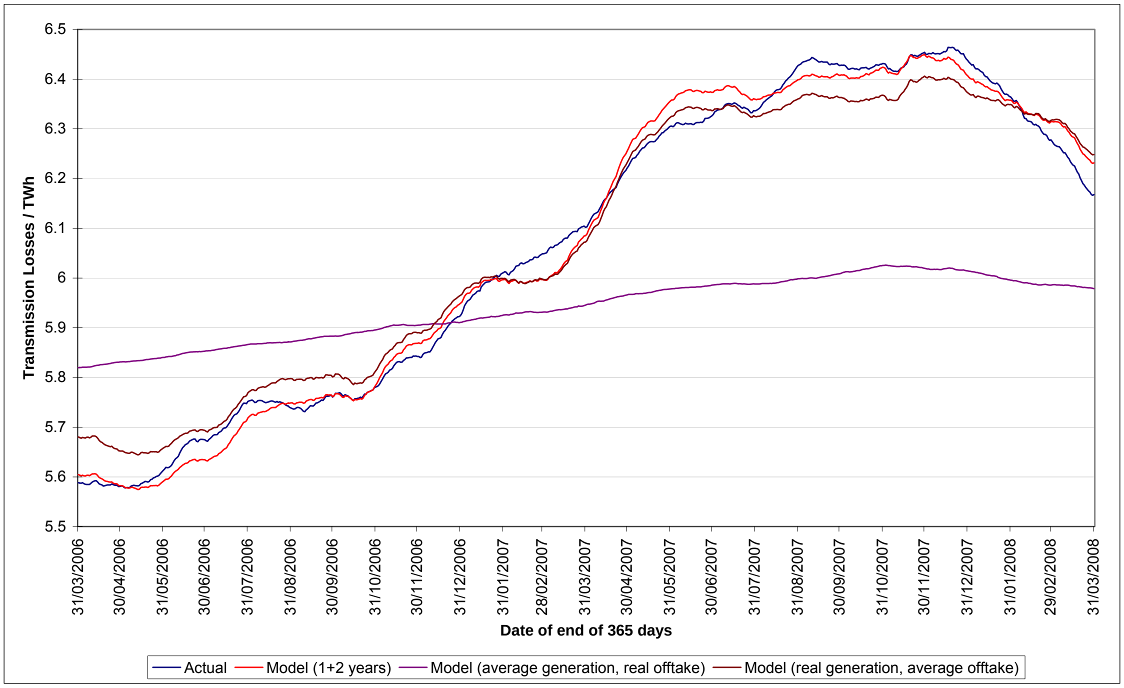

Figure 11 Contribution to Losses of Variations in Generation and Demand

From the graph it is clear that the variation in transmission losses within the two year period has been driven primarily by generation. However, the shallower but generally rising trend in losses caused by changes in the level and disposition of demand is also visible in the rise of the demand-driven losses trend.

6.3 Effect of Individual Zones

Each zone has a range of values of T (Generation – Offtake) that were observed over the three years of half hourly data that was analysed. The range of each zone is presented in Table 1.

	T1,3	T2,4	T5,7	T8,9,10	T6
Minimum	4	-1758	-4038	-5868	1746
Maximum	1977	942	-216	-515	6547

Table 1 Maxima and Minima of Observed T in each zone (MWh per Settlement Period)

In the transmission loss model, the total losses per period are the sum of the losses in each zone, with the zonal losses being represented by a quadratic equation in T. By considering each zone in isolation, and applying the appropriate quadratic for that zone to the range of observed values, one may determine the range of losses contributed by each zone. This data is presented in Figure 12.

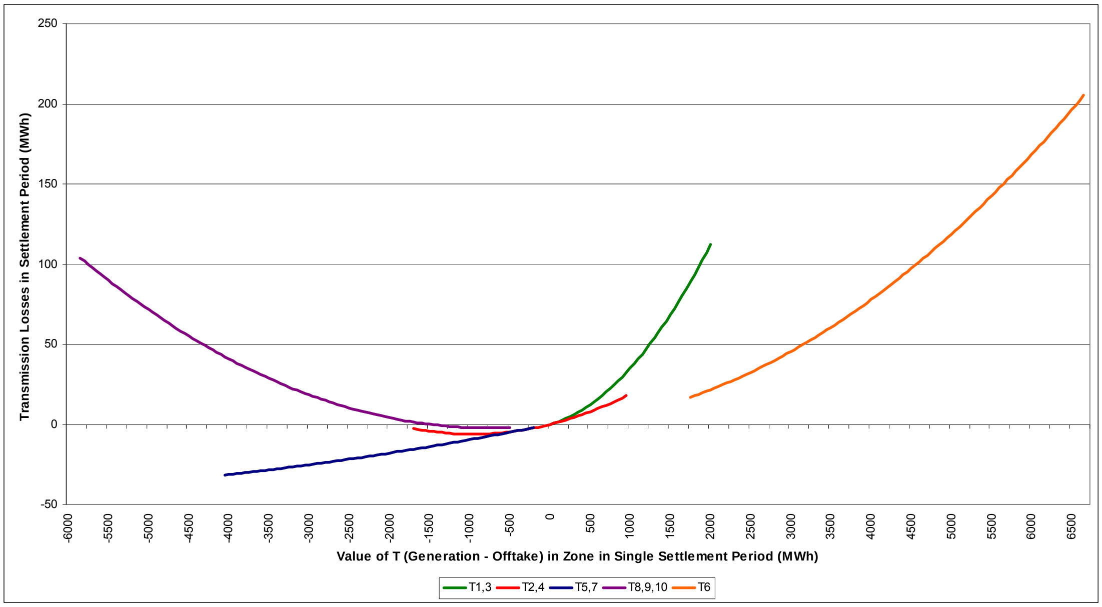

Figure 12 Contributions of Individual Zones to Transmission Losses

From this figure we can determine the effect of each zone, and see the non-linearity of some zones. For example T1,3 has a range of values between 4 and 1977 MWh per period. At 4 MWh per period, zone 1,3 contributes approximately 0 to the losses, while at 1977 MWh per period the zone contributes approximately 110 MWh to the losses in this period.

Figure 12 shows the effect of individual zones in isolation in a single period. By taking an average yearly profile for T in all five zones and then adding or subtracting a constant number of MWh from each half hour over the year for a particular zone one may determine the sensitivity of the zone to variations of the generation / demand balance. This is presented in Table 2. Note that for clarity the perturbations are presented in MW rather than the MWh per settlement period actually used in the model. A positive perturbation implies an increase in generation or a decrease in demand.

Perturbation to Zone 1,3 (MW)	Change in Annual Transmission Losses (TWh)	Perturbation to Zone 5,7 (MW)	Change in Annual Transmission Losses (TWh)	Perturbation to Zone 6 (MW)	Change in Annual Transmission Losses (TWh)
500	0.273	500	0.034	500	0.175
400	0.215	400	0.027	400	0.139
300	0.158	300	0.021	300	0.104
200	0.104	200	0.014	200	0.069
100	0.051	100	0.007	100	0.035
-100	-0.048	-100	-0.006	-100	-0.033
-200	-0.096	-200	-0.013	-200	-0.067
-300	-0.141	-300	-0.019	-300	-0.100
-400	-0.184	-400	-0.026	-400	-0.132
-500	-0.226	-500	-0.032	-500	-0.165

Table 2 Effect of Variation in Zonal Generation on Annual Transmission Losses

6.4 Effect of Moving Generation Between Zones

A similar process may be used to investigate the effect of moving generation from one zone to another. In Table 3, the effect of moving 500 MW of baseload generation between two zones is modelled by adding or subtracting 250 MWh to the three year average values for T for each half hour in the year for the two zones under investigation.

Change in Generation in Zone (MW)					**Change in Annual Transmission Loss (TWh)**
T1,3	**T2,4**	**T5,7**	**T8,9,10**	**T6**	
500	-500	0	0	0	0.242
500	0	-500	0	0	0.240
500	0	0	-500	0	0.369
500	0	0	0	-500	0.107
-500	500	0	0	0	-0.181
-500	0	500	0	0	-0.192
-500	0	0	500	0	-0.314
-500	0	0	0	500	-0.052
0	500	-500	0	0	0.013
0	500	0	-500	0	0.142
0	500	0	0	-500	-0.120
0	-500	500	0	0	0.004
0	-500	0	500	0	-0.118
0	-500	0	0	500	0.144
0	0	500	-500	0	0.131
0	0	500	0	-500	-0.131
0	0	-500	500	0	-0.120
0	0	-500	0	500	0.142
0	0	0	500	-500	-0.253
0	0	0	-500	500	0.272

Table 3 Effect of Moving Base Load Generation Between Zones

A similar sensitivity study may be performed looking at a peak load generation. Table 5 shows the effect of moving 500 MW of generation between 15:00 and 20:00 every day between two zones. The study has been performed for the four zone-pairs giving the highest losses in Table 3.

Change in Generation in Zone (MW)					**Change in Annual Transmission Loss (TWh)**
T1,3	**T2,4**	**T5,7**	**T8,9,10**	**T6**	
500	0	0	-500	0	0.106
-500	0	0	500	0	-0.092
0	0	0	500	-500	-0.075
0	0	0	-500	500	0.080
500	-500	0	0	0	0.066
500	0	-500	0	0	0.068
-500	500	0	0	0	-0.051
-500	0	500	0	0	-0.056

Table 4 Effect of Moving Peak Load Generation Between Zones

Table 4 shows that the effect on transmission losses of moving plant over just the peak five hours of the day is around 25 – 30% of the effect of moving plant for the entire day. This confirms that the model produces higher losses over those peak hours of the day with larger power flows, and thus larger currents.

7 EXPLANATION OF INCREASE IN LOSSES

The analysis described in the sections above shows that the calculation of losses is robust and that the primary driver of variations in losses over the period studied is variations in the disposition of generation output. Movements of the same magnitude in the disposition of demand on the system would lead to similar variations in losses but changes in demand do not occur as readily, or with the same scale during the period studied, as variations in generation.

In particular, section 6.2 demonstrates that the variations in transmission losses during the period April 2005 to March 2008 have been driven primarily by changes in generation pattern. Tables 3 and 4 show that the largest changes in transmission losses are driven by movements of generation or demand between the south / south west and the north. For example, the movement of 500MW of peak load generation from zones 8,9,10, the South/South-West of England and South Wales, to zones 1 and 3 North and South-West Scotland, cause an increase in annual transmission losses of 0.106 TWh.

Examination of generation disposition over the three years studied is complex, however, we have examined these changes in detail to help explain the variation in losses seen. One clear driver of change is the reduction in output at Hinkley Point B Power Station during the relevant period. As a consequence problems at the station, output at Hinkley Point B fell from around 1200 MW to 0 MW between 22-Sep-2006 and 31-May-2007. The output of the station has been reduced by some 300 MW since its return on 1st June 2007.

Hinkley Point B Power Station, with a capacity of approximately 1200MW is one of the few large Power Stations in the South West of England and, in general, its reduction in output would have resulted in increased output from other sources across Great Britain and these, on average, would lead to higher system losses during the period studied.

The total variation in losses seen will be down to a number of such changes. However, the impact of the loss of Hinkley Point B can be assessed by using the actual profiles for half hourly generation and demand since April 2005. By undertaking simple remodelling, assuming that the lost generation at Hinkley Point B is, on average, replaced by increased generation in zone 6 (Humber, including Drax and Eggborough); then reducing the generation in zone 8 (SW England) by 1200 MW from 22-Sep-2006 and 31-May-2007 (and by 300MW on or after 1-Jun-2007), and increasing the generation in Zone 6 (Humber) in the same period.

Based on these assumptions, the level of transmission losses that would have occurred had Hinkley Point B operated at full output over this period is presented in Figure 14.

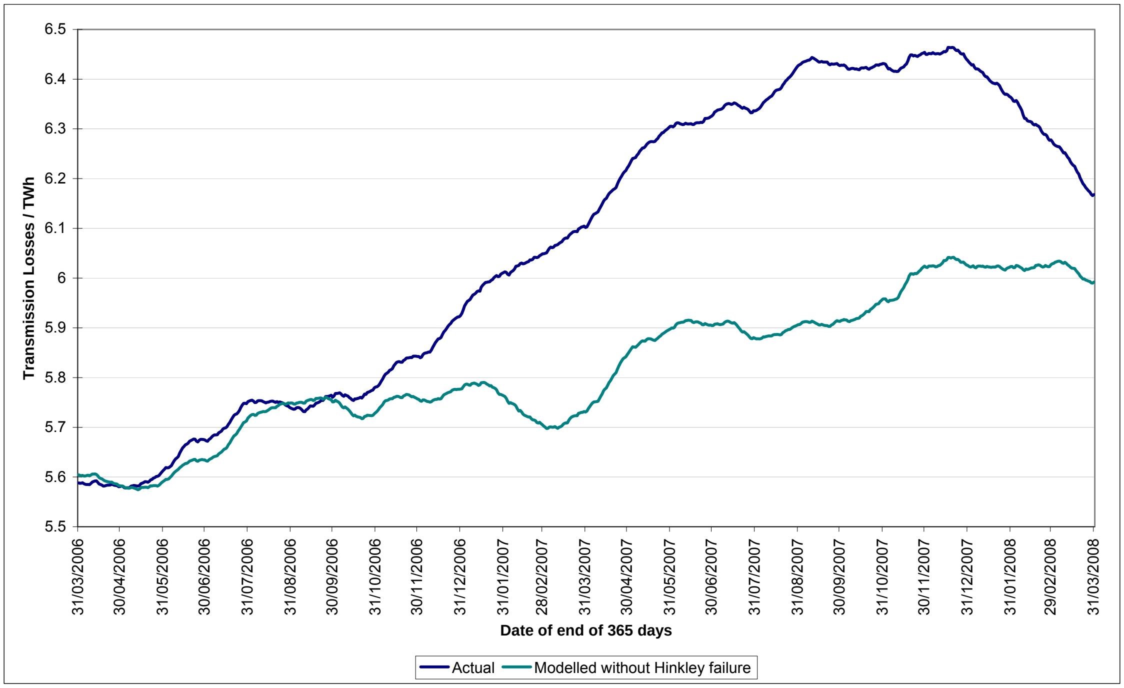

Figure 13 Effect of Reduced Output at Hinkley Point B on Transmission Losses

This figure illustrates the effect that changes in the disposition of generation or demand can have on the level of transmission losses. The changes occur continuously due to generation plant maintenance, breakdown and changes in the economics of plant operation through such factors as changes in primary fuel price. Our analysis shows that it is these changes that have been the primary drivers of changes in transmission losses over the period studied, April 2005 to March 2008.

8 APPLICATION OF MODEL TO FORECASTING TRANSMISSION LOSSES

8.1 Limitations of Modelling Technique

This analysis has developed a numerical model based on obtaining correlations to data. It is not a physical model representing the physics of the processes. As such, the model is reliable for interpolation - predicting the effect of changes within the range of data over which the model has been changed. However, there is no evidence to demonstrate the reliability of the model for extrapolation – forecasting the effect of changes that go outside the range of data over which the model has been trained. In particular, this means that some caution must be applied in using this model to forecast the effect of a significant shift in generation patterns, such as a large increase in wind generation in Scotland or additional CCGTs in the South of England.

A time series based methodology was chosen as it was judged more likely to give greater accuracy over the range of interpolation than a physical model. Any physical model is dependent upon the accuracy of the system parameters such as resistance and inductance used by the model. The load flow models used by National Grid in its transmission studies do not lend themselves to integration over long time periods. The alternative would have been the development of a new representation of the entire GB transmission system to high accuracy over a short period of time. The model would then have to be validated against historic data to confirm the accuracy of its values for transmission loss. In view of the limited time available, the time series approach offers a more ready solution to the request for information.

8.2 Accuracy of Model

The accuracy of the model for each year is presented in Table 6.

Year	Cumulative Error (MWh)	Standard Deviation per settlement period (MWh)	Standard Error per settlement period (MWh)	Standard Error per day (MWh)
2005/06	- 16,437	22.5	22.5	849
2006/07	370,908	34.8	40.7	1780
2007/08	176,035	24.8	26.7	1038
Total	530,505	29.3	29.3	1287

Table 6 Errors in Transmission Loss Model

It can be seen that over the three years for which data is available, the average error between the total annual loss forecast by the model and that observed is some 176,835 MWh. Given such a small sample size in terms of years of data it is not possible to say whether this represents a systematic offset in the data or is a result of random fluctuations.

The size of this error between the model and historic data must be considered in determining the confidence limits of any forecast made by the model.

9 FORECAST TRANSMISSION LOSSES FOR 2008/2009

The latest outturn transmission loss data, based on Settlement Data provided to National Grid 28 days in arrears by Elexon, is presented in Figure 15.

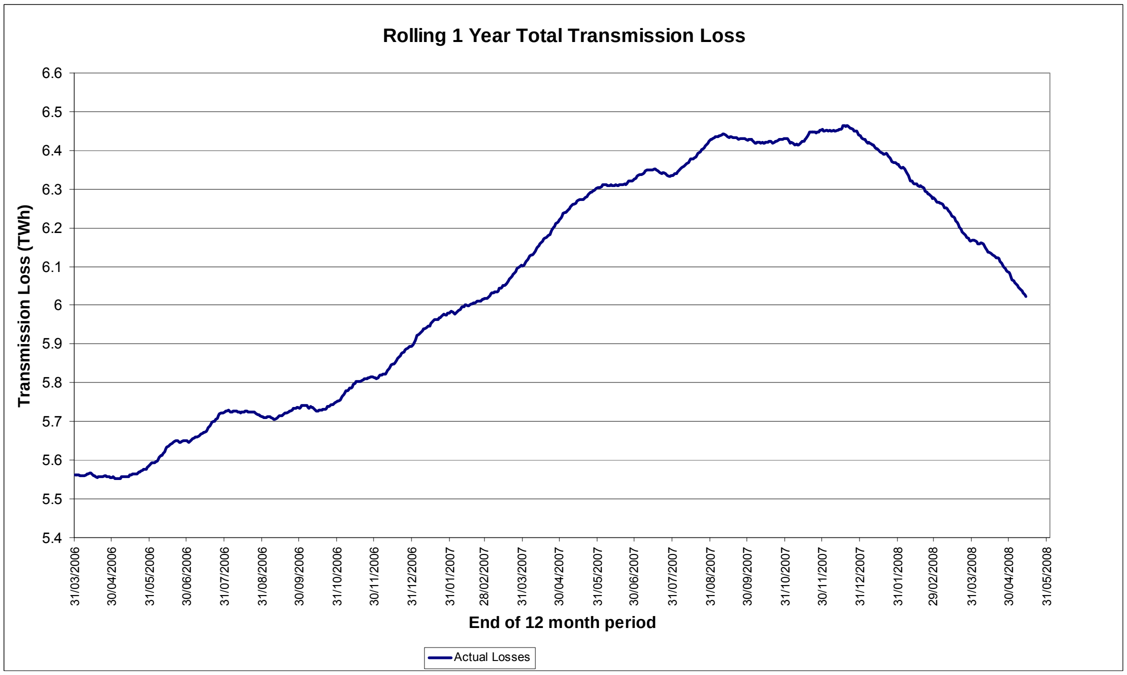

Figure 14 Latest Transmission Loss Data

The transmission loss model described above has been used to forecast transmission losses in 2008/09. Outturn data has been used up to the most recent date available, 14th May. For the remainder of the year, the average yearly profile has been used. This profile has been modified to take account of a number of major outages notified to National Grid under Grid Code OC2 on Wednesday 18th June. This data is commercially confidential and so the outages included in the model can not be explicitly stated in this report.

Using this modified profile, the model predicts the total transmission loss for the year 2008/09 to be 5.886 TWh.

A few credible variations in generation distribution have been tested in Table 7. This data assumes movement of base load generation.

Change in Generation in Zone (MW)					**Annual Transmisson Loss (TWh)**	**Variation from Central Estimate**
T1,3	**T2,4**	**T5,7**	**T8,9,10**	**T6**		
0	0	800	-800	0	6.085	0.199
1000	0	0	-1000	0	6.590	0.704
500	0	0	-500	0	6.214	0.328
500	0	-500	0	0	6.094	0.208
0	500	-500	0	0	5.887	0.001
0	0	-800	800	0	5.710	-0.176
-1000	0	0	1000	0	5.376	-0.510
-500	0	0	500	0	5.607	-0.279
-500	0	500	0	0	5.721	-0.165
0	-500	500	0	0	5.721	-0.165

Table 7 Predicted Transmission Losses in 2008/09 under Various Generation Scenarios

Multiple runs of the model were also performed in order to further investigate the sensitivity of the model to generation distribution.

A random distribution with a mean of 0 and standard deviation of 300 MW was added to each half hour for zones T1,3, T2,4, T8,9,10 and T6. The value of generation in T5,7 was adjusted to give a zero net sum change. This was repeated 1000 times.

The mean of the total annual transmission loss for the randomly perturbed data was 5.903 TWh, with a standard deviation of 0.152 TWh. This equates to a 95% confidence limit of two standard deviations of ± 0.3 TWh.

From this model, the forecast transmission loss for the year 2008/09 is 5.9 TWh with a deadband of ± 0.3 TWh.

10 REVIEW OF OFGEM'S REQUIREMENTS

In their letter of 1st April 2008, Ofgem directed that this report should include:

1) details of the steps that NGET has taken in order to understand the reasons for the continuing increase in the level of transmission losses;
2) details of the major factors, and the magnitude of their individual effect, responsible for all transmission losses;
3) if NGET has failed to fully explain the factors responsible for transmission losses:
    a. the reasons why NGET has failed to fully explain these factors; and
    b. details of the additional steps that NGET proposes to take in order that they can be fully explained;
4) where NGET has ascertained the causes of transmission losses:
    a. the steps NGET proposes to take to reduce the level of transmission losses; and
    b. the steps that NGET considers should be taken by other parties to reduce the level of transmission losses;
5) a revised forecast of transmission losses for 2008/09, drawing on and consistent with, the findings from the investigation;
6) any other information that NGET considers to be appropriate to its investigation.

To address each point in turn as a summary of the report:

1) NGET has undertaken an extensive analysis of the transmission loss data and calculational methodology to seek to identify possible errors in the data. No major errors were identified. NGET has also developed a new quadratic, five variable eleven coefficient model of transmission losses as a function of generation and demand in five geographical zones. This model correlates to the observed data with a correlation coefficient of 0.918. Finally we note that the same drivers that lead to an increase in losses are now causing the current level of losses to decline.
2) Transmission losses are caused by physical energy dissipation effects associated with electricity transmission. In particular resistive heating of circuits carrying electricity and electromagnetic heating within transformers.
   The modelling in this report has demonstrated that the cause of the increase in transmission losses between May 2006 and July 2007, as well as their subsequent decrease, can be accounted for by changes in geographical distribution of generation over this period, in particular the loss of major generation in the South West for much of this time.
3) NGET has explained the factors responsible for transmission losses
4)
   a. NGET seeks to efficiently and economically minimise the level of transmission losses through:
      i. The procurement, operation and maintenance of transmission assets; and
      ii. Through optimal balancing of the system in real time.

      Further to this, NGET is sponsoring a research program investigating techniques for reducing transmission losses by modifying operational procedures.
   b. Our analysis concludes that:
      i. The current calculation of losses is robust and that the change in losses seen during the past three years is predominantly driven by changes in the disposition of generation.
      ii. These changes occur continuously due to generation plant maintenance, breakdown and changes in the economics of plant operation through such factors as change in primary fuel price. Our analysis shows that it is these changes that have been the primary drivers of changes in transmission losses over the period studied, April 2005 to March 2008.
      iii. Changes in the level and disposition of demand would have a similar effect but variations in demand are not so significant during the period studied.
5) A revised forecast for transmission losses has been made, with a forecast for 2008/09 of 5.9 TWh with a deadband of ± 0.3 TWh
6) We consider this report provides a complete overview of our analysis and findings that explain the changes seen in the level of transmission losses during the period April 05 go March 2008.