RESPONSE TO NGC'S FINAL CONSULTATION ON GB TRANSMISSION CHARGING

A Report for ScottishPower UK Division

Prepared by NERA

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1. INTRODUCTION

1.1. Background

On 8 April 2004, the National Grid Company (NGC) published an initial consultation paper on the GB transmission charging methodology (the "April TCM").[1] Shepherd and Wedderburn, on behalf of ScottishPower UK Division (SP), asked NERA to write a report commenting on the analysis in that paper.[2]

On 20 August 2004, NGC published its final consultation paper on GB transmission charging (the "August Consultation").[3] In this paper, NGC responds to some**,** but not all, of the conclusions contained in our earlier report. On behalf of ScottishPower UK Division (SP), Shepherd and Wedderburn have now asked NERA to review the terms of the Consultation and to confirm whether:

1. the views expressed in the Consultation (by NGC or other respondents) caused us to alter the conclusions reached by us in our report. If so to set out how those conclusions have altered and the reasons why;
2. we believe any of the criticisms of the Report expressed by NGC are flawed and if so why; and
3. NGC have addressed all of the points raised in the Report. If they have not to specify those areas where NGC have not expressed a view on any issue raised by NERA.

1.2. Outline of Report

We begin this report by responding to NGC's detailed criticisms of our analysis of the expansion constant (Section 2).

We then discuss NGC's latest statements on the treatment of spare capacity (Section 3).

Finally, we highlight the points we made in our earlier report which NGC has not addressed in its final consultation paper (Section 4).

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1 NGC (2004a), ***GB Transmission Charging: Initial Methodologies Consultation***, NGC, 8 April 2004.

2 NERA (2004), ***Review of GB-Wide Transmission Pricing***, NERA, 26 July 2004.

3 NGC (2004b), ***GB Transmission Charging: Final Methodologies Consultation***, NGC, 20 August 2004.

2. EXPANSION CONSTANT

2.1.1. NGC's General Conclusion

In our report on NGC's April TCM, we concluded that the expansion constant used by NGC overstated the true cost of expanding the system, because it took no account of:

1. NGC's ability to increase capacity by using techniques other than the construction of new transmission lines; nor
2. the need to discount the costs of constructing new transmission lines to reflect the long delays, of 10 years or more, associated with this kind of project.

We proposed an alternative expansion constant that was 35-40% less than that used by NGC based on an analysis of the effect of taking into account the above two factors. That analysis was based on a number of assumptions, informed by data contained in a US study from 1995 as well as information provided by (and attributed in our report to) SP.[4]

Although NGC have made a number of criticisms of the assumptions on which we based our alternative expansion constant (discussed in detail below), NGC appears to accept our conclusion that the expansion constant would be lower if it took account of cheaper options to upgrade existing transmission lines. For example, concerning the mix of investments used to expand the transmission system, NGC states:

> *"**we do agree that additional capacity is not always provided by the construction of new circuits. As stated above we believe it would be created by a number of techniques including new build, re-conductoring, voltage up-rating and re-profiling.**"* (August Consultation, Page 35, Para 2)

Concerning the relative cost of techniques other than new build, NGC states:

> *"**the majority of this additional capacity**"* [i.e. past increases] ***has been provided by reconductoring and re-profiling as these tend to be the most economic method of creating additional capacity, and avoid the issues and risks associated with the construction of brand new transmission circuits."*** (August Consultation, Page 34, Para 4.)

We note that NGC makes contradictory statements on the relative cost of new build and other techniques. At Page 34, para 7 of the August Consultation, NGC also says ***"we believe that in general the cost of reconductoring on a £/MWkm basis is more expensive than the cost of new build".*** NGC may be implying that new build is cheaper, but subject to delays ("issues and

[4] Fuldner A.H. (1995), ***Upgrading Transmission Capacity for Wholesale Electric Power Trade***, Arthur H. Fuldner, 1995. At the time this paper was published, Mr Fuldner was an (operations research analyst with the Coal and Electric Analysis Branch of the Energy Information Administration, an agency of the US Department of Energy.

risks"), but that raises the question as to why NGC bases its incremental costs on investment that cannot take place immediately, and may not go ahead at all, and yet does not allow for any discounting of the cost.

Our conclusion that upgrading existing lines is generally cheaper than new build is supported by international literature on transmission investment costs:

> "***The option to increase transmission capacity by upgrading existing lines is of interest because it can be done at considerably less cost than constructing a new transmission line and with a shorter lead time.***" [5]

> "***By making use of various uprating techniques, the utility can increase the power flow down selected lines. …This can be done effectively in many cases at a fraction of the cost of the new line.***"[6]

> "***Thermal rating of lines is a function of weather conditions, actual templating temperature of the constructed line and safety to the public. …The practical example describes how it was possible to increase the thermal rating by 30% for a cost of 5% that of alternate supply options [possible investment in new line].***"[7]

Despite NGC's apparent recognition that it has overstated the expansion constant by ignoring cheap alternatives to construction of new lines, NGC has decided not to recalculate the expansion constant because:

> "***such a change would add a significant level of complexity and would not necessarily improve transparency and objectivity, which a number of respondents have requested. Furthermore, it is unlikely that we would be able to publish many of the numbers used to calculate such expansion constants, as this information is commercially sensitive.***" (August Consultation, Page 35, Para 3.)

NGC refers to the additional "complexity" of alternative methods as the reason for not carrying out these further calculations, but we do not accept that the level of complexity can be used to justify the use of an incorrect figure. Nor do we accept that the "complexity" to which NGC refers diminishes transparency, and hence the predictability of tariffs for network users. The only information NGC provides to network users at present is its in-house estimate of the expansion constant in £/MWkm, which it does not derive transparently. If NGC published the numbers underlying a revised expansion constant, the data and calculations involved would not be so complex as to defy scrutiny by experienced

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5 Fuldner A.H. (1995), Page 12, Para 2.

6 Stephen R. (2004), Description and Evaluation of Options Relating to Uprating of Overhead Transmission Lines, CIGRE paper B2-201, 2004.

7 Stephen R. (2000), Determination of the Thermal Rating and Uprating Methods for Existing Lines, CIGRE paper 22-305, 2000.

members of the industry. Publishing this derivation would therefore enhance transparency and deflect any suggestion that NGC's proposals are not properly "cost-reflective".

2.2. NGC's Specific Criticisms

Because NGC provides so little information on the costs of expanding the system, we were forced to base our estimate of an alternative expansion constant on assumptions and information from other sources. While NGC has made detailed criticisms of these assumptions in its final consultation paper, it is regrettable NGC still has not published any data on the costs of expanding the system in the UK to allow outsiders to assess the validity of these criticisms.

We discuss below each of NGC's specific criticisms of our assumptions.

2.2.1. Mix of Transmission Investments Used to Expand the System

We made an assumption about the mix of transmission investments that NGC would use to expand the system based on an analysis of (a) the change in capacity of NGC's network between 1992-93 and 2004-05, and (b) the relative costs of different transmission investments. In general, where NGC had not published any information to make these assumptions, we adopted a neutral approach of assuming each option was equally common or equally likely.

NGT criticises our assumptions about the use of "load flow controls" and "reprofiling", but makes no criticism of our assumptions about the share of new capacity that is added through new build, voltage up-rating and re-conductoring.

- Load Flow Controls

NGC states that we were wrong to conclude that about 20% of the increase in network capacity between 1992-93 and 2004-05 was due to load flow controls, since that figure was based on changes in circuit lengths and ratings, which are unaffected by load flow controls.[8] However, we only used this figure as an indication of the relative contribution of this type of investment to the incremental cost of increasing the network capacity actually available to connected system users. NGC has not shown that our estimate of this proportion is wrong, or provided any alternative estimate of the relative proportion.

NGC says that it has spent £300 million on quad boosters – a type of load flow control - since 1992. Given that NGC has spent so much on these controls, it would be useful if NGC could clarify how they affect available network capacity and hence NGC's calculation of network expansion costs. For example, it may be that load flow controls allow higher flows over

8 Para 8, page 33, August Consultation.

existing transmission lines in a "secure dispatch", in which case they affect the cost of adding capacity which is simply not measured by line ratings. NGC could then explain how its TCM recognises the potential contribution of such investments, or instance whether they affect the calculation of the locational security factor (LSF) – for which NGC states that it is using a model of secure despatch - rather than the expansion constant. At present, however, NGC seems to be implying that the expenditure has no benefits in terms of adding network capacity or lowering the cost of expanding the system, which seems unlikely.

- Re-profiling

NGC criticises our decision to exclude re-profiling from the mix of transmission investments:

> "***NERA have dismissed re-profiling (re-tensioning the conductors to allow the circuit to operate at a higher temperature and therefore a higher rating), on the grounds that on a £/MWkm basis it is believed to be more expensive.***" (August Consultation, Page 34, Para 2.)

We excluded re-profiling on the grounds that the data available to us indicated it was more expensive than new construction and hence that NGC, as an efficient operator, would never choose re-profiling. Subsequently, in the August Consultation, NGC stated that re-profiling has been one of the main ways it has added capacity in the past, because it tends to be one of the most economic. In the light of this new information, it appears that our estimate of expansion costs could have included re-profiling as an additional cheap option for upgrading capacity. Including it might even have lowered the expansion constant, but without further information from NGC we cannot be sure.

2.2.2. Relative Costs of Different Types of Transmission Investment

Based on the analysis referred to above, we assumed that NGT would use a combination of the following types of investment to expand its system:

- new build;
- voltage up-rating;
- bundling (i.e., adding new conductors to existing towers) and restringing (i.e., replacing existing conductors with thicker or better quality ones), which NGT seems to have lumped together under the general heading of "reconductoring"; and
- load-flow controls.

We derived estimates of the relative cost of these different types of transmission investment compared to the cost of constructing new 400kV transmission lines, which is the basis of NGC's expansion constant.

- New build

NGC has not commented on our observation that the cost of new construction should be discounted to allow for the delay before a new line can be built. NGC states at several points that its charging methodology is intended to be "cost reflective". However, even if NGC meets demand for new capacity by building new lines, an additional kW of peak network usage does not immediately impose an incremental cost equal to the (annualised) cost of new construction, if the augmentation of capacity will not take place for many years. In these conditions, the effect of additional use is to cause additional investment in several years' time - or even just to advance investment that other growth in usage would require anyway. NGC has made no response to this observation and continues to estimate incremental costs as if additional usage in 2005 would cause additional investment in that year. It remains our view that, such an approach is neither realistic nor reflective of actual incremental costs.

- Voltage up-rating

We estimated the relative cost of voltage up-rating (as a percentage of the cost of new build) based on data provided by SP. We note that NGC have not disputed SP's estimate.

- Reconductoring

We estimated the relative cost of reconductoring based on the relative costs of different 230kV investments reported in a US study from 1995. NGC suggests that we have selected the most expensive form of new build from the US study as the basis of their comparison, but that was not our intention.

The relative cost of the different forms of new build reported in the US study depends on the interpretation of the column in Table FE.2 of that study headed "MW rating". We interpreted it to mean "line rating" (in contrast with the next column, headed "cost per circuit"), in which case the example we took had a cost in the middle of the range. NGC's comment appears to treat the "MW rating" as a "circuit rating". If we accept NGC's interpretation of the "MW rating" to mean "circuit rating", then the typical or average cost of new build in the US is indeed lower.

We have re-examined the US data and discussed its meaning with SP. (We were unable to contact the original author.) On balance, it seems likely that the MW rating refers to circuit ratings. On this basis, the average cost of the six options for building new 230kV lines is about £20/MWkm. NGC sets its expansion constant for 400kV lines at £9.51/MWkm, but multiplies it by an "expansion factor" of 1.74 for 275kV lines. A comparable expansion factor for 230kV lines would be about 2.0, giving an expansion cost of £19/MWkm, which suggests that the average of the six options listed in the US study is broadly comparable with NGC's estimate of the cost of new construction.

This comparison uses a $/£ exchange rate of 1.5, which applied at the time when the information was collected. At today's exchange rate of about $1.8/£, the implied cost of new construction (i.e. NGC's expansion factor) would have to be about 20% lower. We do not know however whether NGC's cost estimates are based on international prices denominated in US dollars or on prices in other currencies. In any case, using a different exchange rate would not affect the relative position of new construction costs versus the costs of other methods.

As noted above, reconductoring includes restringing (with an estimated cost of about £23/MWkm[9]) and bundling (with an estimated cost of about £16/MWkm[10]). Thus, on this basis, transmission companies would typically choose to use bundling, but not restringing, as bundling is 23% cheaper than new construction, whereas restringing is 15% more expensive.

Table 2.1
Comparison of "Reconductoring" with New Build at 230 kV (US Data)

Technique	Cost per MWkm
Average of 230kV single and double circuit new build costs (6 options)	£20.31
Average of 230kV double circuit new build costs (3 options)	£16.01
Typical Bundling costs for 230kV (1 option)	£15.71
Typical Restringing costs for 230 kV (1 option)	£22.73

NGC also suggests that we should have applied the percentage reductions due to re-conductoring to a new build cost of £25/MWkm (calculated from the US study), rather than NGC's expansion cost of £9.51/MWkm. However, this comparison is misleading. As stated above, NGC's estimated cost for 275kV lines is about £16.55/MWkm (at the expansion factor of 1.74), and would be about £19/MWkm for 230kV lines (at an expansion factor of 2.0).

- Load flow controls

We assumed that the relative cost of load flow controls was at least as low as that of voltage up-rating, on the assumption that NGC would not have invested so heavily in load flow controls unless they were one of the cheapest methods of expansion. NGC criticises our assumption by comparing NGC's £300 million of expenditure on quad boosters (QBs) since 1992 with the increase in MWkms of circuits since 1992, which NGC says is unaffected by investments in QBs. However, if the increase in MWkm is in fact unrelated to investment in QBs, as NGC maintains, such comparisons are misleading.

9 NERA calculation based on Fuldner (1995).

10 NERA calculation based on Fuldner (1995).

2.2.3. Revised Estimate of the Expansion Constant

We have recalculated the cost saving due to bundling using an average of the six new build options listed in the US study, as described above. Using that revised figure, and excluding "restringing" on the basis that it is typically more expensive than new build, we have re-calculated our estimates of the weighted average cost of expansion. Our revised estimates are shown in Table 2.2 and Table 2.3,[11] which are updated versions of Tables 6.4 and 6.5 respectively from our earlier report.[12] As can be seen from these tables, our revised estimates still imply an expansion constant that is about 30-40% lower than that used by NGC in its April TCM.

Table 2.2
Average Cost of Capacity Increases (Estimate 1) -
lower cost reduction due to bundling and no restringing

	Share of new capacity	Relative cost
New 400kV	19%	100%
Uprating 275kV to 400kV	22%	54%
Bundling	29%	77%
Re-stringing	0%	112%
Load flow controls	29%	54%
Weighted average	100%	69%

11 Estimate 1, shown in Table 2.2, is different from Estimate 2, shown in Table 2.3, because: (a) Estimate 1 is based on a new build cost for 400kV lines equal to that used by NGC, whereas Estimate 2 is based on a new build cost that is discounted to reflect the long time delay usually associated with this type of investment (giving a cost relative to that used by NGC of 56%); and (b) Estimate 1 assumes an equal share of new capacity is added by bundling and load flow controls, whereas Estimate 2 uses shares in a ratio that is roughly inverse to their relative costs. The reader is referred to pages 38 and 39 of our earlier report for further detail on the rationale for these assumptions.

12 These tables show separate line items for "bundling" and "re-stringing". In our earlier report, the "restringing" row item was labelled "reconductoring". We have chosen to re-label this item here to avoid any possible confusion with NGC's generic use of the term "reconductoring".

Table 2.3
Average Cost of Capacity Increases (Estimate 2) -
discounted cost of new build, lower cost reduction due to bundling and no restringing

	Share of new capacity	Relative cost
New 400kV	19%	56%
Uprating 275kV to 400kV	22%	54%
Bundling	24%	77%
Re-stringing	0%	112%
Load flow controls	35%	54%
Weighted average	100%	60%

We have also re-calculated our estimates of the weighted average cost of expansion assuming that load flow controls result in no increase in system capacity. These results are shown in Table 2.4 and Table 2.5. As can be seen from these tables, even allowing for no contribution from load flow controls, our revised estimates still imply an expansion constant that is about 25-30% lower than that used by NGC in its April TCM.

Table 2.4
Average Cost of Capacity Increases (Estimate 1) -
no capacity addition from load flow controls

	Share of new capacity	Relative cost
New 400kV	19%	100%
Uprating 275kV to 400kV	22%	54%
Bundling	59%	77%
Re-stringing	0%	112%
Load flow controls	0%	54%
Weighted average	100%	76%

Table 2.5
Average Cost of Capacity Increases (Estimate 2) -
discounted cost of new build, no capacity addition from load flow controls

	Share of new capacity	Relative cost
New 400kV	19%	56%
Uprating 275kV to 400kV	22%	54%
Bundling	59%	77%
Re-stringing	0%	112%
Load flow controls	0%	54%
Weighted average	100%	68%

2.3. Conclusion

NGC has offered no data in defence of its figures or of its method, to permit independent scrutiny of its calculations. Our analysis still suggests that NGC has overstated the cost of expanding capacity by ignoring cheap alternatives to new build. As in our earlier report, therefore, we still conclude that NGC's proposed GB transmission charges are not objective estimates of cost-related prices.

3. SPARE CAPACITY

3.1. NGC's Latest Statements

On page 46 of its August Consultation, NGC observes that the DCLF model does not increase the expansion constant on lines with spare capacity, to recover the total costs of these lines from their users. NGC states :

> ***"It can therefore be argued that the TNUoS charges paid are only based on the actual usage of each line calculated by the DC load flow model and therefore there is already an allowance for spare capacity in the tariffs."*** (August Consultation, Page 46, Para 7.)

This response confuses several different concepts, many of which are unrelated to NGC's tariff charging methodology.

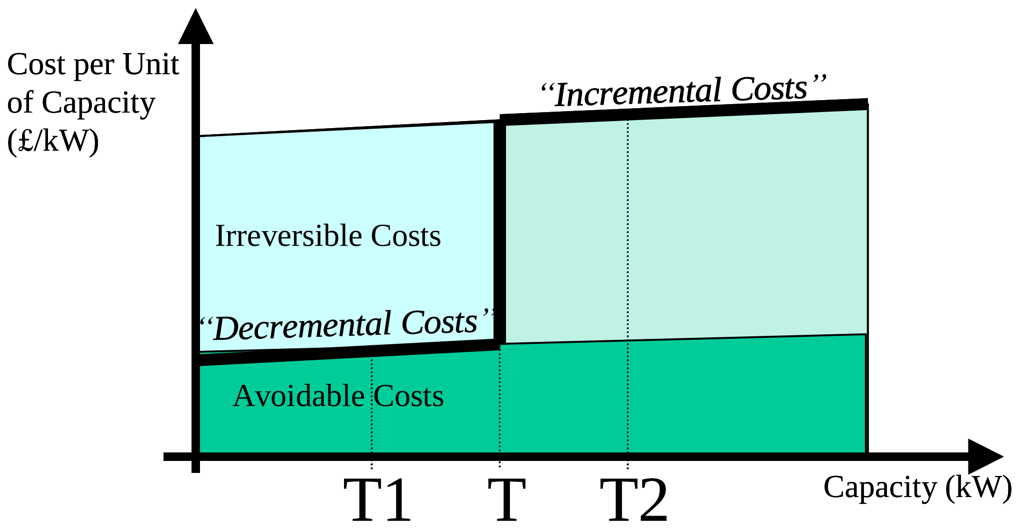
NGC's response implies that the cost of the spare capacity might somehow be allocated to the remaining users, thereby raising the costs allocated to them (in NGC's example, doubling them). This could only happen, however, in a charging methodology that worked on the basis of allocating total costs, rather than by identifying incremental costs. NGC maintains that its charging methodology is intended to reflect incremental costs. In a transmission network, as in any industry, the existence of spare capacity drives incremental costs down (to nearly zero in a transmission network), but NGC makes no such adjustment. The confusion implicit in NGC's response may explain why NGC has failed to take proper account of our discussion in our earlier report of spare capacity and decremental costs.

Taking the example of a 100MW generator using a 200MW line, NGC states that recognising the spare capacity would double the expansion constant, raising it from £9.51/MWkm to £19/MWkm. That might be true if NGC were ***allocating the actual costs of a 200MW line to a 100MW generator***. However, NGC states that it is estimating ***" the incremental (or long-run marginal costs) of future investment or asset replacement".***[13] According to this approach, the cost attributable to the generator is £0/MWkm, because an increase in usage of 0-100 MW would incur no "incremental" cost. Thus, it is misleading for NGC to say that ***"there is an allowance for spare capacity built into tariffs"*** when discussing the spare capacity factor. ***Overall***, tariffs recover the ***total cost*** of the network via the flat-rate element. However, the ***differentials*** between tariffs do not allow for spare capacity to reduce ***incremental costs***. In our view it is therefore incorrect for NGC to state that ***"the proposal to remove the modelling of circuits with spare capacity is more cost reflective, as well as being more transparent."***

[13] NGC has also described the DCLF model and the April-TCM as a method of estimating " the marginal costs of investment in the transmission system required as a result of an increase in demand or generation at each node on the transmission system", ***GB Transmission Charging: Initial Thoughts***, 16 December 2003, page 14.

In our earlier report, we pointed out that decremental costs are a more accurate measure of the costs imposed by users in the presence of spare capacity, or when a decision by an existing user to reduce their usage of the network would create spare capacity. In terms of Figure 3.1 (Figure 6.5 in our earlier report), NGC assumes that required transmission capacity will be T2 so that any reduction in usage (now) saves the incremental cost of expanding capacity to meet the needs of potential new users (in the future). Such assumptions will be unjustified if there is currently spare capacity in the system, or if a network user frees up transmission capacity (e.g. by closing a generator) that will not be used by network users in other locations (e.g. lines emanating from that generator). In these conditions, network usage would sit at the level T1, for which the incremental cost is very low.

Figure 3.1
NGC Defines Incremental Costs Assuming Usage ***Will*** Be T2



NGC has also stated that assuming a decremental cost equivalent to the incremental cost reflects the potential to avoid the full cost of ***replacing*** lines in the future,[14] but we are unaware of NGC ever retiring any transmission lines and find it unlikely that NGC would ever give up the associated way leaves and capacity, in case it was ever needed again in the future. Hence, the available evidence would not seem to support the assumption that continued usage by northern generators imposes incremental costs by preventing NGC from retiring transmission lines that it would not otherwise replace.

[14] NGC (2004a), page 31.

3.2. NGC's Comments on Our Earlier Report

In its discussion of the responses received on the treatment of spare capacity, NGC states:

> "***The aforementioned*** [NERA] ***report on GB Transmission Pricing contains a section on spare capacity. The report agrees with National Grid's conclusions that the removal of the modelling of spare capacity would have a negligible impact on tariffs across GB.***" (August Consultation, Page 46, Para 3.)

This does not accurately summarise what we said in our earlier report. We agreed that changing the spare capacity factor (SCF) from 75% to 100% had a negligible impact, but pointed out that the impact was limited because of the restricted number of circuits NGC designated as having spare capacity. We then went on to show that a relatively small increase in the proportion of circuits designated as having spare capacity had a ***major*** impact on tariffs across GB. In the words of our earlier report:

> "***Thus, although NGC dismissed the need to consider the "Spare Capacity Factor" in isolation, our testing of the April TCM shows that it has a significant effect when considered in conjunction with the rule used to identify lines as having spare capacity.***" (NERA Report, Page 46, Para 2.)

NGC also commented:

> "***NERA state that the process used in England and Wales to identify circuits with spare capacity is not transparent, however they recommend its reintroduction on a GB basis.***" (August Consultation, Page 46, Para 3.)

Obviously, we were not advocating the re-introduction of a non-transparent treatment of spare capacity. Rather, we were advocating that spare capacity should be modelled, because it has a major impact on tariffs, and that modelling should be made transparent by NGC.

4. GAPS IN NGC'S RESPONSE

In their August Consultation NGC noted it had not had sufficient time to respond to all the points in our earlier report, but would continue to consider them:

> "***Given the time for analysis since the receipt of the [NERA] report, we have only been able to respond to the key conclusions related to the charging methodologies and we have not been able to list all the issues in the Industry Responses sections set out below. We will, however, continue to consider the content of the report alongside other comments received, and may include further discussion in our report supporting the final proposals we make to the Authority.***" (August Consultation, Page 17, Para 2.)

We list below those points to which NGC has not yet responded, together with the page and paragraph references from our earlier report:

- ***decremental costs*** (Page 46, Section 6.4) – as mentioned above, we argued in our earlier report that tariffs should be based on decremental costs where there is spare capacity in the system, or where spare capacity would be created by an existing user's decision to reduce their network usage;
- ***scaling of generation capacity*** (Page 48, Section 6.5) – we argued that hydro and wind capacity should be scaled to reflect the higher uncertainty concerning the availability of these plant in peak conditions, compared to conventional thermal generation. NGC's general response on this issue (August Consultation, Page 24, Para 4) just re-iterates its initial approach without considering our argument that this approach lacks objective justification; and
- ***risk of inefficient reduction in generating capacity in Scotland*** (Page 54, Section 7.1) – we argued that NGC's overstatement of the expansion constant and failure to reflect decremental costs in tariffs, combined with the extension of "Plugs" to the whole of GB, would lead to a risk of inefficient plant closures in Scotland.